Socio-economic scenarios for climate change impact assessment

A guide to their use in the UK Climate Impacts Programme

February 2001

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For more information about the UK Climate Impacts Programme contact:

The UKCIP Programme Office
Union House
12-16 St Michael's Street
Oxford
OX1 2DU

Telephone: 01865 432 076
Fax: 01865 432 077
Email: enquiries@ukcip.org.uk

Website: http://www.ukcip.org.uk/ukcip.html

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Executive Summary

Introduction

The first signs of climate change are already emerging, and will continue into a future which will be very different from today. Enormous challenges are faced in devising socio-economic scenarios for the assessment of future impacts and there is very little experience to draw upon. Socio-economic scenarios have not been widely used within impacts studies, but this report will serve to encourage their use more widely within the UK Climate Impacts Programme (UKCIP). The aim has been to develop a scenarios framework through which stakeholders are able to reflect upon possible alternative futures and to make sense of what this means for them in the context of climate change impacts. This report presents a toolkit, so that studies can select and develop socio-economic scenarios and apply them within climate impact assessments. The report contains:

1) An explanation of why socio-economic scenarios are required for climate change impact assessment;

2) A presentation of the national level scenarios commissioned by the Department of the Environment, Transport and the Regions (DETR) and developed for the Programme by a team led by SPRU (Science and Technology Policy Research) at the University of Sussex, and comprising the Centre for Social and Economic Research on the Global Environment (CSERGE), the Climatic Research Unit (CRU) and the Policy Studies Institute (PSI). They are linked to scenarios developed for the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) and the scenarios used in the Department of Trade and Industry's (DTI's) Natural Resources and Environment Panel of the UK Foresight Programme; and

3) Guidance on the use of socio-economic scenarios at a regional level, drawing on the consultation process during the development of the national level scenarios, along with commissioned papers which review initial experience of their use in some first stage regional studies within UKCIP.

Why socio-economic scenarios are required for climate change impact assessment

Whilst the use of climate scenarios as inputs into vulnerability, impact or adaptation assessments is well established, there is far less experience of using socio-economic scenarios. However, studies to assess climate change impacts suffer from serious weakness if by default they merely assume that the projected future climates will take place in a world with a society and economy similar to today.

Difficult though the task is of constructing climate scenarios, it is generally acknowledged that the job of generating socio-economic scenarios is even more complex. This is because while most aspects of climate projection are based on well-understood physical processes, there is less understanding of the interactions of factors operating in socio-economic systems, which change very rapidly. For this reason it is not possible to construct socio-economic scenarios on the same long-term time-scales as climate scenarios.
Scenarios are coherent, internally consistent and plausible descriptions of possible future states of the world, used to inform future trends, potential decisions, or consequences. They can be

considered as a convenient way of visioning a range of possible futures, constructing worlds outside the normal timespans and processes covering the public policy environment.

Different social and economic structures will affect sensitivity to climate change, as they affect the potential for response and adaptation. The impacts of future climates will also be fundamentally determined by future technology and governance structures. Here are some illustrations:

- Land use change and development of the built environment is giving rise to loss of biodiversity irrespective of climate change. In some cases climate change will exacerbate these pressures, in other cases it will cause additional direct threats.
- Flooding events may be worse if there is a larger population living on the flood plain as a result of planning decisions.
- The effect of climate change on crop yields will depend on how many farmers have planted the crops, whether their farm income is dependent on that crop, in turn depending on agricultural subsidies, access to technology and so on.
- Some technological developments, such as improvement of weather forecasting, may enable better precautions to be taken to diminish vulnerability to extreme weather events.

Approach adopted for the UKCIP socio-economic scenarios

Development of the UKCIP socio-economic scenarios (UKCIP SES) has had the benefit of some new work, but use of scenarios has only recently been undertaken significantly within public policy in the UK. Official projections are generally extrapolated trends that, with the exception of demographic data, rarely exceed 15-20 years ahead. The land use planning guidance currently stretches up to 2021. In the private sector, only multi-national enterprises have large strategic and corporate teams with medium- and long-term planning horizons. Many small and medium size enterprises invariably focus on the next year or two ahead. However, with the accelerating pace of change surrounding globalisation and technological development, there has been increased recognition that more strategic, innovative perspectives can provide useful insights. Thus, the UKCIP SES have been able to draw on the work for the DTI's Foresight Programme, which itself was related to new work developed for the IPCC.

In this work, led by SPRU, a predictive approach to the future was avoided in developing the scenarios. Instead the future was approached in an exploratory way, taking into account the perceptions and knowledge of social and economic players involved. The approach adopted was to emphasise that futures scenarios are a tool for visioning the future; they are not a set of prescriptions of how the future will evolve.

Four futures scenarios

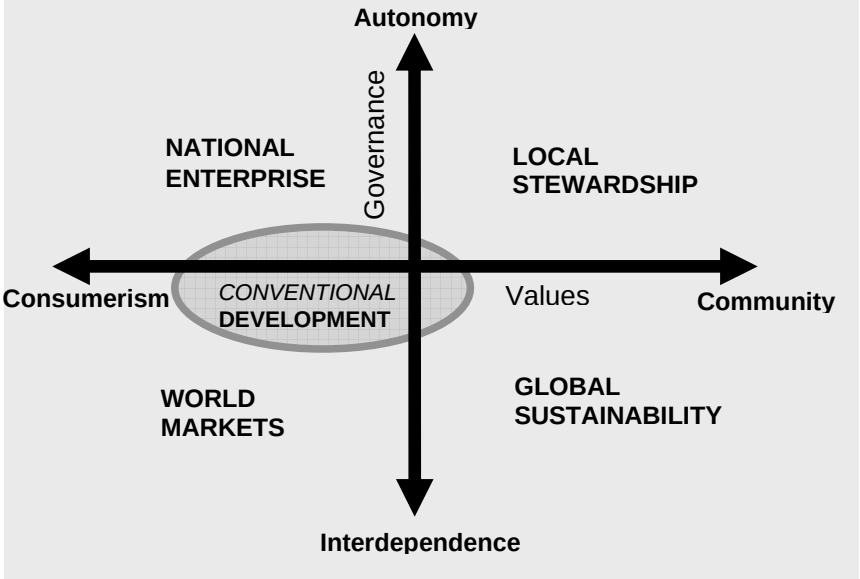
The four socio-economic scenarios which have been developed for the UK by the SPRU team are set in a global context for two time-frames: the 2020s and the 2050s. They are based on a review of the large global futures literature which identified five main dimensions of change highlighted in previous scenario planning exercises:

- the composition and rate of economic growth;
- the rate and direction of technological change;
- the nature of governance; and
- social and political values.

Social and political values, and the nature of governance have been taken to be fundamental and independent determinants of future change. In particular, it was assumed that economic growth, demographic changes and technological changes are primarily an outcome of the relationship between socio-political values and the interests of organisations, although they clearly have an influence on the development of values and the nature of governance. In addition, economic, demographic and technological changes are more easily quantified and amenable to modelling, whereas values and governance cannot be quantified in any useful way.

The scenario framework segments the future 'possibility space' into four quadrants following other work on scenario development. Here they are defined by a 'values' and a 'governance' axis.

Four socio-economic scenarios for the UK



The horizontal **values** dimension captures alternative developments in core social and economic values as they might be represented in choices by consumers and policymakers. At one end of the spectrum ('CONSUMERISM'), values are dominated by the drive to private consumption and personal freedom. The rights of the individual and the present are privileged over those of the collective and the future. Resources are distributed through free and competitive markets, with the function of governance limited to guaranteeing trade and capitalist accumulation. At the other end ('COMMUNITY'), values are shaped by concern for the common good. The individual is seen as part of a collective, with rights and responsibilities determined by social goals. There is greater concern about the future, equity and participation. Civil society is strong and highly valued, and resources are allocated through more deeply managed markets.

The vertical **governance** dimension aims to show alternative structures of political and economic power and decision-making. The future of governance at the UK and regional levels will be influenced to a great extent by developments in the European Union, and at the global level. At one end of the spectrum ('INTERDEPENDENCE'), the power to govern is distributed upwards, downwards and outwards away from the national state level. International economic, political and cultural relationships strengthen, and regional and national boundaries become more permeable. There may be a role for regional decision-making and for regional particularities, but this will be in the context of globalised economic and political systems. At the other end of the spectrum ('AUTONOMY'), economic and political power is retained at national (National Enterprise) and regional (Local Stewardship) levels. Sovereignty is retained over key areas of policy, and the process of economic globalisation is weakened. Governments have greater autonomy in decision-making, and economic, political and cultural boundaries are maintained or strengthened. National and regional development is based on local capabilities and resources.

These two dimensions generate a set of associations which can be applied to understanding of changes at a national, sectoral and regional level. The implications of the dimensions for each of the four scenarios are elaborated in this report. Storylines are presented for each scenario, covering: values and policy; economic development; and settlement and planning. To facilitate their use in climate impacts assessments, the storylines have also been developed for key impacts domains, including: agriculture; water; ecosystems; coastal zones; tourism; and the built environment. Quantitative indicators are provided for demography, economic growth and development, land use change and settlement patterns.

Initial operationalisation within UKCIP

The UKCIP SES have already provided a useful toolkit for several studies. The scenarios have been shown to be capable of flexible application for varying purposes, for example:

- awareness raising on socio-economic dimensions of climate change impact studies (South East scoping study, Wales scoping study);
- providing inputs to the development of broad regional strategies and policies as undertaken by organisations such as the Regional Development Agencies and Regional Planning Bodies (North West UKCIP SES operationalisation study); and,
- as the basis for development of quantified regional socio-economic scenarios for use in integrated work (Regional Climate Change Impact and Response Studies in East Anglia and North west England - RegIS).

The framework scenarios provide a set of standard, unifying assumptions about the basic social and economic dimensions of change. Qualitative assumptions about social values and approaches to governance, as well as quantitative assumptions about economic growth and population change, can be applied across a range of studies. They also provide an opportunity to take a systematic approach to exploring linkages between local, regional and global scales.

Knowledge has accumulated on what are realistic expectations for the application of the UKCIP SES, along with both their strengths and constraints. New reference frameworks have also become established below the UK level. More specifically, in addition to the establishment of the devolved administrations in Scotland and Wales, developments at a regional level in England have proceeded apace in the past two years, particularly with the emergence of Regional Planning Guidance which virtually covers the first time period of the scenarios (2020s). These changes suggest the need for a link between the scenarios and developments in strategic planning at a regional level.

To complement the scenarios, guidance is given on their use, drawing on experience during phase one of UKCIP for the benefit of next stage studies. The scenarios are not intended to act as a ‘blueprint’. The research team carrying out a sectoral or regional study, by virtue of its expertise, will be best placed to develop detailed scenarios. Teams will need to consider carefully how to use the scenarios for maximum effectiveness in their studies. The last section of the report provides some guidance on this covering the following issues: selection and modification of the scenarios to the regional scale; their use with stakeholders; quantification of the scenarios at a regional scale; and their integration with climate scenarios.

Glossary

CAP	Common Agricultural Policy
CRU	Climate Research Unit, University of East Anglia
CSERGE	School of Environmental Sciences, University of East Anglia
DETR	Department of the Environment, Transport and the Regions
DoE	Department of the Environment
DTI	Department of Trade and Industry
EFMA	European Fertilizer Manufacturers Association
ESA	Environmentally Sensitive Area
GCM	Global Climate Model (also known as General Circulation Model)
GDP	Gross Domestic Product
ICT	Information and Communications Technologies
IPCC	Intergovernmental Panel on Climate Change
MAFF	Ministry of Agriculture, Fisheries and Food
MINK	US Missouri-Iowa-Nebraska-Kansas study
NGO	Non-Governmental Organisation
NT	National Trust
NVZ	Nitrate Vulnerable Zone
NSA	Nitrate Sensitive Area
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
PPG	Planning Policy Guidance
PSI	Policy Studies Institute
RAMSAR	Designated wetland of international importance, established under the Ramsar Convention on Wetlands 1971
RDA	Regional Development Agency
RegIS	Regional Climate Change Impact and Response Studies (East Anglia and the North West of England)
RPG	Regional Planning Guidance
RSDF	Regional Sustainable Development Framework
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SES	Socio-economic scenarios
SNW	Sustainability North West
SPA	Special Protected Area
SPRU	Science and Technology Policy Research, University of Sussex
SRES	IPCC Special Report on Emissions Scenarios
SSSI	Site of Special Scientific Interest
UKCIP	UK Climate Impacts Programme
UNEP	United Nations Environment Programme
USNA	US National Assessment

Chapter 1

Why socio-economic scenarios are required for climate change impact assessment

Compiled by UKCIP Programme Office

1.0 Why socio-economic scenarios are required for climate change impact assessment

"There is a feeling that the very foundations of society are shaking. Everywhere you look, it is new! Technology and 'globalisation' are transforming the workplace. Devolution has changed the way in which Britain is governed. We are only beginning to understand the genetics revolution. The Internet, still in its infancy, will radically impact people's lives. It seems that we are leaving an old, familiar world behind, yet we do not know what the new world will be like ... Never in our lifetime has the future felt more important and yet seemed so difficult to imagine."[1]

1.1 Introduction

Climate change will take place in a very different world from today. Studies to assess climate change impacts suffer from serious weakness if by default they assume they are imposed on today's society. Whilst the use of climate scenarios as inputs into vulnerability, impact or adaptation assessments is well established, there is far less experience of using socio-economic scenarios. Great effort is focused on improving the Global Climate Models (GCMs) from which climate scenarios are commonly constructed. However, if studies merely assume that the projected future climates will take place in a world with a society and economy similar to today,[2] such efforts are undermined.

Difficult though the task is of constructing climate scenarios, it is generally acknowledged that the job of generating socio-economic scenarios is even more complex.

"While most aspects of climate projection are based on well understood physical processes, our understanding of the basic structure and causal factors operating in socio-economic systems and their evolution is vastly more limited." [3]

To provide guidance and support for studies within the UK Climate Impacts Programme (UKCIP) on how to handle these difficult social and economic dimensions, a first stage was the commissioning by the Department of the Environment, Transport and the Regions (DETR) of socio-economic scenarios at a national level. These scenarios were developed by a team led by the SPRU (Science and Technology Policy Research) at the University of Sussex, and comprising the Centre for Social and Economic Research on the Global Environment (CSERGE), the Climatic Research Unit (CRU) and the Policy Studies Institute (PSI). During the process of preparation of these scenarios it was evident that more work would be needed on their regionalisation and also their quantification. This report presents the UKCIP socio-economic scenarios (UKCIP SES) to a wider audience for the first time and by reflecting on the initial experience of their use in some first stage studies within UKCIP, provides guidance for their future application.

1.2 The importance of socio-economic change for climate change impact assessment

Scenarios are coherent, internally consistent and plausible descriptions of possible future states of the world, used to inform future trends, potential decisions, or consequences.[4] Socio-economic scenarios "comprise everything that shapes a society."[5] Climate change impacts will depend on the nature of the system that is exposed to climate change.

The SPRU led team has identified that:

"Scenarios are also planning and communication tools that are used to explore uncertain and sometimes disputed futures. They do not aim to predict, but are designed to give representations of possible futures. A scenario will generally have a qualitative 'storyline' element associated with quantitative indicators. Future developments are shaped by deep-seated drivers of economic and social change, by new trends and innovations, and by larger-scale and unexpected 'sideswipes' with a major impact."[6]

Possible scenarios of future climate were prepared by the Hadley Centre and CRU (at the University of East Anglia) for studies within UKCIP at an early stage. These UKCIP98 scenarios cover the time periods 2020s, 2050s 2080s, and suggest very different climate futures, which have not been experienced in recent historical times. In contrast, social, economic and technological change is something familiar, yet how this will unfold over the next 100 years is of course unknown. Some change in these areas, such as population growth in some countries, will be faster than climate change.[7] There is only the need to look at changes in the UK in the past 100 years to realise that the next century could provide some unexpected surprises.

Taking the past 100 years as a whole, stark contrasts emerge.[8] In basic demographic terms alone, major structural changes have occurred. During the twentieth century, the population of the UK increased by over 50% from 38.2 million in 1901 to approximately 58 million at the end of the century. The housing stock trebled in the same period, associated with a reduction in household size. Owner occupation has increased from 10% of homes to 68%. Life expectancy has increased from 45 to 75 years for men and from 49 to 80 years for women. Causes of death have changed: infectious and parasitic diseases and tuberculosis have declined in significance. On the economic side, since 1900, Gross Domestic Product (GDP) per capita has risen at constant prices by an estimated 298%.[9] Living conditions have also changed - Box 1 gives a flavour of changes in rural areas.

Futurologists and science fiction writers have been trying for years to predict the future and sometimes get things right (see Box 2). Whilst it is not possible to predict with any certainty, it is possible to structure how it can be considered and provide guidance for visioning exercises. That is why scenarios are useful and have been used in impact assessment. Uncertainty, however, has to be acknowledged and for this reason a range of scenarios is needed capturing possible, plausible futures.

A snapshot of rural life at the beginning of the 20th century — Box 1

By the beginning of the century, a switch from country to town was underway: rural population was decreasing with younger people migrating to work in the burgeoning manufacturing centres in the towns. This was prompted by the increasing mechanisation of agriculture and the importation of food, resulting in a decline in the number of rural jobs. Furthermore, farm labourers were poor, water supply and sewage arrangements were primitive, and child mortality rates were high. Others left, lured by promises of a brighter future in Canada, Australia, New Zealand and South America; even in 1909 local newspapers carried advertisements for the good life in the 'new world'.

In the decade preceding 1900, the population in some villages had fallen by 40% and half the cottages were unoccupied. In the towns, gas was an available energy source for the new manufacturing industries and electricity was just becoming available. In 1900 there were 3,236 deep mines with a peak of employment in mining in 1920 with 1,250,000 miners. The railways were an important form of transport at the beginning of the century, also attracting workers from the rural population. There were very few cars on the roads; the first Morris car was built in Oxford in 1902. High petrol prices acted as a deterrent: between 1906-1921 the price of petrol was significantly higher in real terms than in 1999. Furthermore, the transport system was not well established: although the number of licenced vehicles in the UK has increased dramatically since this time, the ratio of fatalities has in fact fallen from 2.9 per thousand vehicles in 1926 to 0.1 in 1997.

Source: Chance (2000)

Photograph: "Accident in Marshalls Lane, near Church Enstone, c.1900". Oxfordshire County Council Photographic Archive.

Problems then fade into insignificance today:

"It is quite time that motor machines should be compelled to obey the law with regard to the speed they run through our streets. It is not an uncommon thing to see these machines running at something over 20 miles an hour… some serious accident is sure to occur sooner or later"

Source: Witney Gazette, (26 April 1900)

Predicting life in the next twenty years? Box 2

Science *by* Tim Radford

"With futurology: you can get the big things right, and yet get the details hopelessly wrong … [recall] the lesson of HG Wells, who in 1902 had daringly predicted "that by 1950 there would be heavier-than-air flying machines capable of practical use in war", even though he knew his prophecy would excite ridicule. That is the second lesson of futurology: some apparently simple predictions never come true while others happen with such speed as to make those who prophesied them appear foolish. It was an aircraft designer, the novelist Neville Shute Norway, who in 1929 prophesied that aircraft would advance so dramatically that by 1980 speeds would get to 100-130 mph.

Some things are foreseen and happen, some are foreseen but never happen. Some things happen without being foreseen: among them is x-rays, nuclear energy, radio and television, photography, sound recording, lasers, masers, relativity and transistors. Arthur C Clarke, the man who foresaw the communications satellite and the exploration of space but not the speed at which it would happen, once pointed out the real problem. "The future" he said, "is not logically foreseeable."

But that hasn't stopped anyone having a go, and sometimes getting the trends broadly right ... Biologists believe as firmly as ever that life can be extended, senility can be postponed and incurable diseases contained. They have begun to take the dreams of science fiction and turn them into modern hospital dramas. Tissue engineers have learned to grow sheets of human skin. The next step is to use cloning technology and research into embryo stem cells to "clone" new tissue from a patient's own cells, to repair damage from atherosclerosis or neurodegenerative disease."

Source: Radford, (2000) in "2020 Vision: Life in Twenty Years", Science Museum and the Guardian, pages 2-3

Work *by* Kevin Warwick

"Often the effect of new technology is the opposite of that expected. In the industrial revolution Luddites fought to keep machinery from the workplace due to the obvious loss of jobs; yet it brought about the biggest increase in jobs the world has ever seen. The advent of computers, we were told, would herald a paperless society; but the plethora of new information available has seen a dramatic increase in bureaucracy with multiple paper copies required: in 1999 paper production around the world reached a record high.

Meanwhile new technology, we were told, would reduce working hours and produce more leisure time for us all. The result is that while some people are out of work, others are working record numbers of hours under incredible stress.

Well before 2020 our websites and mail boxes will have a mind of their own. Our mail box will sort our messages, answer some for us and request input from us only on specifically selected items. Our website will be our main interface with the outside world; it will know what our wishes and interests are. There will be e-salesmen – the e-middlemen – catering for the needs of our websites. E-salesmen will travel from site to site, plying them with potential goodies, that may or may not be automatically purchased with our e-money. Present-day cash and even plastic will have gone by 2020 …

We will not be communicating with computers by means of keyboards, nor through speech. Human speech is serial, error prone and unbelievably slow with outmoded coding procedures called languages that severely restrict human intelligence. In 2020, for those that are connected, messages will be passed by thought signals alone: both thought-to-thought communication between humans, and through signals to operate technology. The injection of a simple transceiver device directly on to your brain will be sufficient to allow this to occur. An extensive education programme will be required to teach people how to think to each other, and to research into new ways of thinking."

Source: Warwick, (2000) in "2020 Vision: Life in Twenty Years", Science Museum and the Guardian, pages 10-12

1.3 The current use of scenarios in climate change impact assessment [10]

In 1994, a set of technical guidelines for the assessment of climate change impacts were developed by the Intergovernmental Panel on Climate Change (IPCC).[11] These guidelines recommended that whilst socio-economic trends should be projected when conducting impact studies, this should not be synonymous with the extrapolation of historical trends, owing to the fundamental technological, demographic and other qualitative changes that occur in the long-term. Whilst the development of socio-economic scenarios is essential for meeting the 1994 IPCC guidelines, in practice achievement of this has been limited.

Most studies assume current conditions rather than forming a coherent view of what type of world climate change might impact in the coming decades.[12] Assumptions about future socio-economic conditions often concern only simple adjustments, such as the introduction of new crops or changes in irrigation.

A small number of studies have taken socio-economic trends systematically into account. An example is the US MINK (Missouri-Iowa-Nebraska-Kansas) study that projected the economic impacts of imposing a dry climate analogous to that of the 1930s on both the current and a projected future economy of the region.[13]

To deal with uncertainties, sectoral studies often introduce specific scenarios altering a limited number of variables relevant to the sector under consideration. The variables can address policy options (e.g. trade liberalisation in agriculture) or 'autonomous' socio-economic trends (e.g. high and low land claims for urbanisation and agriculture). Scenarios in the sense of coherent, systematic, and internally-consistent descriptions of possible futures are very rarely used in climate impact research.

Climate change impact assessment, at a national or regional level, has been based on the interpretation of many different studies. Inevitably, these have been based on different socio-economic, and often climate, assumptions.

1.4 The scope of socio-economic scenarios for climate change impact assessment

According to the IPCC, regional and global climate changes are expected to have wide-ranging and potentially adverse effects on physical and ecological systems, human health and socio-economic sectors and different segments of society can expect to confront a variety of changes and the need to adapt to them.[14]

It follows, therefore, that studies within a Programme on a national scale, like UKCIP, would need to provide substantial support on future social and economic dimensions. A key part of the purpose and functioning of UKCIP is that it provides an integrating framework of varied scale and depth, led and funded by stakeholder organisations. From inception it was recognised that the use of common data-sets and scenarios would provide a crucial mechanism for the integration of studies so that a UK-wide assessment could be constructed. Socio-economic scenarios for the Programme need to be all-embracing, as potential studies within the Programme cover all aspects of life: people's health, lifestyles, livelihoods, jobs, recreation, food, travel, homes and where they live. Furthermore, the impacts of future climates will be fundamentally determined by future technology and governance structures which exist, locally, regionally and internationally.

The SPRU team summarised the required scope of the scenarios as follows:

"Vulnerability to climate change and the capacity to adapt will be determined by many social and economic factors including: the growth and composition of economic activity; changes in population and settlement patterns, the rate and direction of technological change; the capacity of policy-making institutions to formulate and implement adaptation strategies; and the willingness of society to address environmental concerns."[15]

Such requirements have been acknowledged in first stage studies within the Programme. For instance, the consultants ECOTEC reported from experience of undertaking the Wales scoping study:

"There are a number of features about the socio-economic future that have a bearing on our response to climate change. They affect:
- *Availability of resources to cope with climate change*
- *The administrative quality of future governments*
- *Ability of special interest groups to influence the public agenda*

The second type of interactions between society/economy and climate impacts and adaptation is that socio-economic developments can make the world more or less vulnerable to the impacts of climate change." [16]

Similarly, the RegIS team recognises:

"The RegIS project requires socio-economic scenarios as well as climate change scenarios because future socio-economic change has a major effect upon the vulnerability of the systems under investigation (water, agriculture, biodiversity and coastal zone) to climate change. The vulnerability of the coastal zone to climate change depends upon the standard of protection provided and the extent of coastal development – decisions which are socio-economic and political in character. The vulnerability of biodiversity to climate change is influenced by the scale and management of sites and habitats for biodiversity. Finally, the vulnerability of water resources to climate change depends on supply and demand side issues such as: leakage reduction, demand-side management, new supplies, new water charging schemes, conjunctive systems for water transfer, and so on. How much resources and attention we devote to biodiversity, or to ensuring a decent 'headroom' between water supply and demand, are socio-economic and political decisions."[17]

Different social and economic structures will affect sensitivity to climate change, as they affect the potential for response and adaptation. The impacts of future climates will also be fundamentally determined by future technology and governance structures. Here are some illustrations:

- Land use change and development of the built environment is giving rise to loss of biodiversity irrespective of climate change. In some cases climate change will exacerbate these pressures, in other cases cause additional direct threats.
- Flooding events may be worse if there is a larger population living on the flood plain as a result of planning decisions.
- The effect of climate change on crop yields will depend on how many farmers have planted the crops, whether their farm income is dependent on that crop, in turn depending on agricultural subsidies, access to technology and so on.

Conversely, some technological developments, such as improvement of weather forecasting may enable better precautions to be taken and diminish vulnerability to extreme weather events.

1.5 Constraints in developing socio-economic scenarios

Enormous challenges are faced in devising socio-economic scenarios for the assessment of impacts. The broad picture needs to be plausible and coherent. Most impact assessment work is undertaken on a sectoral basis or sub-national level requiring disaggregation of socio-economic factors, thus comprising a substantial, and potentially unmanageable agenda. For this reason the challenge has rarely been addressed and there is very little experience to draw upon. For the US National Assessment (USNA), the working group charged with developing these scenarios judged it unfeasible to attempt to develop fully detailed socio-economic scenarios centrally and *"try to predict a century of American history"*. It considered it was too difficult because of the complexity and diversity of the socio-economic characteristics that might be important contributors to impacts and vulnerability, and because of the highly decentralised nature of the National Assessment process.[18] Furthermore, it was recognised that the determinants of impacts are likely to vary between regions, the identification of which would require detailed local and regional expertise.

Guidance provided by the United Nations Environment Programme (UNEP) also suggests it is *"impossible to make a scenario of everything"*, particularly within the framework of a country study.[19]

"… scenarios are good for broad pictures. The details of the scenarios are not very reliable, and sometimes the details can have important consequences."[20]

How can the need for qualitative and quantitative socio-economic scenarios be reconciled with the fact that it is very difficult to combine broad overviews with an eye for details and insight about historical trends and international comparisons?[21]

Two routes through have been advocated: selection of key elements which are crucial to the climate change impacts being assessed in the USNA and use of existing scenarios within a country for the UNEP handbook. This will be outlined and the approach adopted for UKCIP explained.

1.5.1 Approach in US National Assessment[22]

The USNA team approach adopted a two track approach:

- The scenarios comprised a selection of a few key socio-economic variables, such as population, economic output and employment, which influence many domains of impacts. Three scenarios spanned a wide range of high and low-growth features. Projections of population, income and employment were provided in substantial detail until 2050 - by county and by thirteen economic sectors - and at the national level until 2100.
- The decentralised track was to be used when a particular analysis required future values of more specific or local socio-economic characteristics to be quantified. In this case the relevant assessment team was asked to develop and document the required assumptions themselves. A common template was provided to guide teams in developing scenarios, which involved identifying two or three key characteristics judged to have the most direct effects on the impacts of interest, and varying them jointly through their ranges. In choosing their key issues and key socio-economic factors, each team was requested to use whatever combination of preliminary analysis, expert judgement and stakeholder consultation they judged most appropriate. Ranges chosen for key socio-economic factors were intended to reflect all sources of socio-economic uncertainty except, importantly, climate change itself and US policy responses to climate change. Since the purpose of the assessment was to examine climate change explicitly, and not implicitly, climate change and responses to it did not need to be embedded in variation of socio-economic input assumptions. In contrast, the ranges were to include climate-related uncertainty outside the US, if the team judged such uncertainty to matter for US impacts.

In fact, the region and sector teams apparently made very limited use of the socio-economic scenarios and the template adopted. The Mid-Atlantic Region Assessment tried the approach and identified sectors likely to be sensitive to climate change and then prioritised risks within those sectors.[23]

1.5.2 UNEP handbook on methods for climate change impact assessment and adaptation strategies[24]

The UNEP approach can be summarised as follows:

- Scenarios do not have to be developed from scratch, but can be borrowed or adapted from the literature. It is strongly advised to rely on existing scenarios to save time and to be comparable to and consistent with related studies. New scenarios should only be developed if it is necessary, for instance, for variables that are not projected in existing scenarios.
- Many countries have developed country-specific scenarios to assist national policy-makers in developing long-term strategies. However these seldom reach the second half of the 21st century.
- Scenarios used for impact and adaptation assessment should be consistent with the scenarios used for greenhouse gas emission studies.
- Scenarios should be consistent across sectoral studies, and therefore scenarios that apply to most of the sectors in the study should be developed.

1.6 Approach to socio-economic scenario development adopted for UKCIP

Visioning for the future has not until recently been a significant part of the panoply of tools used within public policy in the UK. Official statistics are generally trend extrapolations that, with the exception of demographic data, rarely exceed 15-20 years ahead. The land use planning guidance currently stretches up to 2021. In the private sector, only multi-national enterprises have large strategic and corporate teams with medium- and long-term planning horizons. Many small and medium size enterprises invariably focus on the next year or two. Thus, DETR recognised at an early stage of its management of UKCIP that special provision would be needed to provide a crucial plank for the Programme's framework in the form of socio-economic scenarios. Initial moves were underway when two other processes were started. First, the IPCC established a team to prepare new emission scenarios, with a key part of their early work being a major exercise to construct qualitative storylines drawing on expertise in the business and academic worlds. Secondly, the Department of Trade and Industry's (DTI's) Foresight Panel on Natural Resources and Environment saw the need to identify and develop a number of appropriate contextual scenarios to engage businesses and a wider audience in environmental futures.[25]

UKCIP was deliberately established to break new ground so that possible problems and constraints were not regarded as insuperable obstacles. A team was commissioned to:

1) Review other work on future scenarios with a view to developing a robust futures framework for impact analysis for UKCIP;

2) Survey the impacts researchers and stakeholder community in order to define their practical non-climate information requirements that could be accommodated in a range of possible future scenarios;

3) Develop a range of possible scenarios of socio-economic change and development, along with a suitable framework for their use in UKCIP. The scenarios should draw upon existing work,

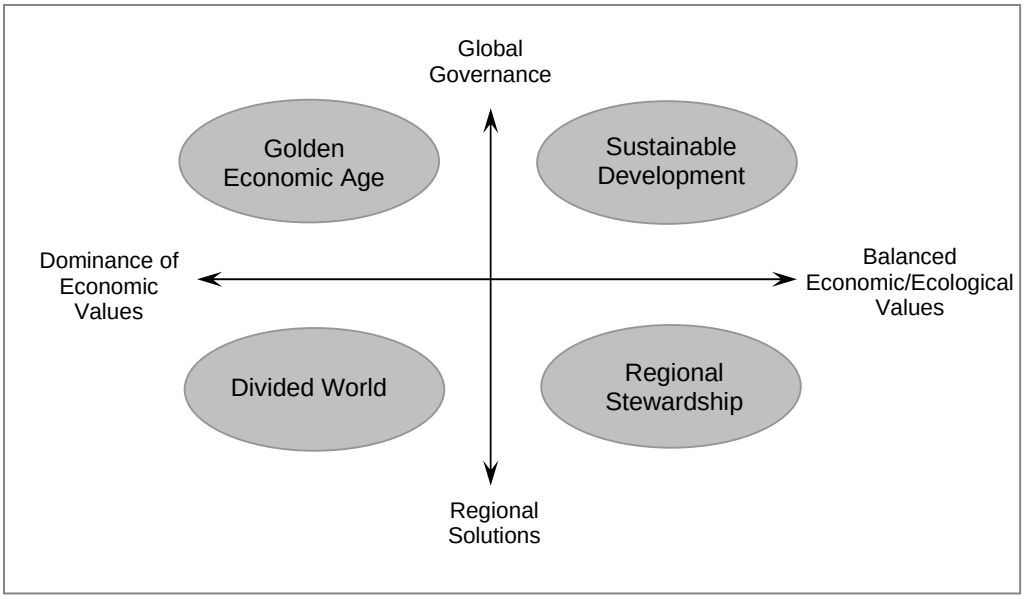
3) Develop a range of possible scenarios of socio-economic change and development, along with a suitable framework for their use in UKCIP. The scenarios should draw upon existing work, provide a detailed analysis of possible futures at 2020 and 2050 and give consideration to governance structures and social values;

4) Provide a range of quantified indicators to accompany the scenarios that meets the demands of the impacts and stakeholder community, including demography, economic growth and development, land use change and settlement patterns; and

5) Provide regional characterisation to these national scenarios.

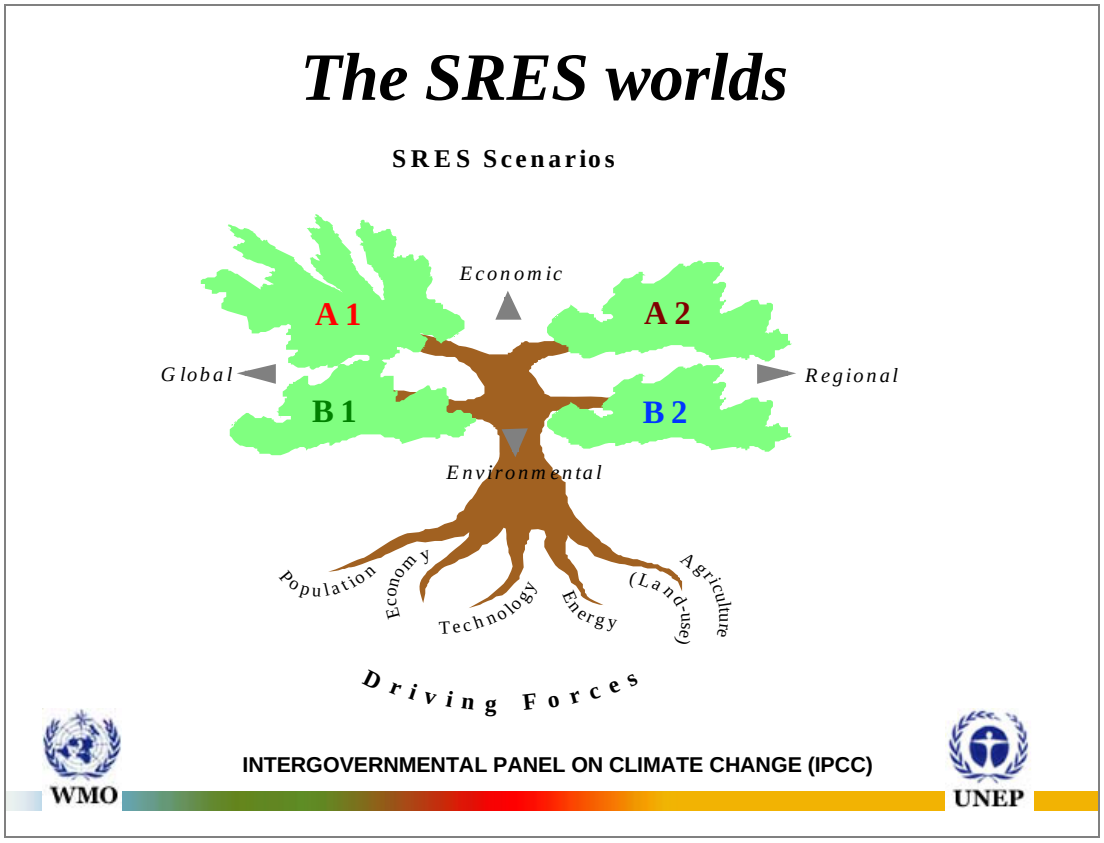
The aim was to provide a framework for the studies within UKCIP and provide a tool for exploring coherent and different pictures of the future. Advantage was taken of surrounding developments. Some members of the SPRU team were also developing the Foresight scenarios at the same time; a process which they indicated was influenced strongly by the on-going IPCC IS99 exercise (see Figure 1.1).

Figure 1.1: IS99 scenarios[26]



Further work for what became the IPCC Special Report on Emissions Scenarios (SRES)[27], developed the scenarios and departed from storyline titles to A1, A2, B1, and B2 (see Figure 1.2). However, there is still a basic linkage between the UKCIP scenarios and the IPCC SRES scenarios, which has been used by the RegIS team and can be further developed when the next climate scenarios are prepared for UKCIP (see Section 3.9). The use of similar storylines for emissions and impacts scenarios consistent with international initiatives (UNEP handbook and work by UN Development Programme).

Figure 1.2: Schematic illustration of SRES scenarios[28]



1.6.1 Differences between the SRES, Foresight and UKCIP SES

For UKCIP, the SPRU team developed systematic, narrative, qualitative scenarios around these dimensions for use within climate impact assessment. Additionally, in response to stakeholder requests, considerable effort was focused on substantiating the quantitative side with the development of indicators for key impact domains (for example, agriculture). Thus, in both respects, the scenarios represent a significant step forward from the Foresight scenarios.

The UKCIP SES assume different policy responses to climate change, and propensities for adaptation within the various storylines, in contrast to the SRES which are "no policy" scenarios. Also the SRES assume that there may be different technology paths followed within each scenario family rather than one single distinctive path in the UKCIP SES. There are also some differences which arise because of adjustments to the dimensions. Nevertheless, the close connection to the SRES axes is helpful because it facilitates linkages between the climate scenarios, which can be enhanced in next stage work on both climate and socio-economic scenarios in the Programme. For example, the new climate scenarios for UKCIP being developed by the Hadley Centre and CRU (the UKCIP2002 scenarios) are modelling climate change for the A2 and B2 emissions and scaling for A1 and B1 emissions.

The next part of the report explains the UKCIP socio-economic scenarios.

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Chapter 2

Presentation of the UKCIP socio-economic scenarios for climate change impact assessment

SPRU: Dr Frans Berkhout (Co-ordinator) and Julia Hertin
CSERGE: Irene Lorenzoni, Dr Andrew Jordan, Prof Kerry Turner,
Prof Timothy O'Riordan, Dr Dick Cobb, Dr Laure Ledoux, Dr Rob Tinch
CRU: Dr Jean Palutikof, Dr Mike Hulme
PSI: Prof Jim Skea

2.0 Presentation of the UKCIP socio-economic scenarios for climate change impact assessment

This chapter covers the key parts of the final report to DETR by the SPRU team on "Socio-Economic Futures Scenarios for Climate Impact Assessment", October 1999. Available from the authors or the UKCIP Programme Office.

2.1 Development of the UKCIP SES

A review was undertaken of existing scenario work and this suggested four criteria for the development of the socio-economic scenarios in this study:

- **relevant (applicable to public and private sector decision-making).** The scenarios should be of *relevance* to impact researchers and constructed in a way that allows them to be broken down on a regional and/or sectoral scale. The scenario framework must be flexible enough to integrate sector-specific options or sub-scenarios. Relevance to stakeholders involves identifying the main variables influencing vulnerability to climate change.
- **consistent (based on coherent assumptions).** Scenarios for impact assessment have to be integrative and comprehensive. They need to embody a consistent storyline and set of illustrative quantified indicators.
- **credible (not over-estimating the rate of change).** The scenarios should describe a set of credible outcomes that, nevertheless, challenge present-day assumptions. Being prospective in nature, the scenarios should cover a range of alternative outcomes which is sufficient: to make people think about the future; to present options; to examine the robustness of long-term strategies; and to indicate the boundaries of risks and chances.
- **transparent (clear exposition of assumptions).** The scenarios need to be transparent in order to be acceptable to stakeholders and impact researchers. A clear methodology is needed to enable different impact studies to be comparable.

General principles of scenario construction were applied with the following aims:

- **The basic scenario dimensions**. It was decided to make the more qualitative dimensions of socio-economic change the basis of scenario construction. The two dimensions relate to: a) governance and the capacity of institutions at different levels to manage change; and b) the orientation of social and political values. This choice was made on analytical grounds, on the basis of the scenarios literature, and follows a similar set of dimensions chosen in the IPCC SRES socio-economic scenarios.[29] The choice has been justified by stakeholder engagement throughout the project but could of course be different.
- **Other scenario dimensions**. Other dimensions of future developments are associated to a greater or lesser extent with governance and values. Some dimensions such as population develop in a predictable, semi-autonomous way, while others such as technology are more dependent on social values and regulation. The task of elaborating storylines in the context of these qualitative dimensions has a strong subjective and judgmental flavour where stakeholder contributions have been valuable.

- **Relevance at national and regional levels.** The scenarios refer to the UK, but are applicable at a regional/country level. National indicators have had to be supplemented by expert guidance about differences between regions within the UK. At the same time, the UK operates in a wider European and global context. Therefore, scenarios for developments in the UK implicitly assume characteristics about the development of Europe and the world at large.
- **Consistency of indicators**. The need of the climate impacts research community for a variety of quantified indicators meant that a considerable amount of attention has been paid to consistency within scenarios. No formal modelling has been undertaken within this project, but a set of consistency checks has been applied to ensure that different indicators (e.g. household formation and economic growth), although determined through expert judgement, are telling the same story. Where possible, sector specialists were consulted in choosing relevant indicators and defining indicator values.
- **Symmetry in treatment of scenarios.** A balance has had to be struck between scenarios which appear plausible because they extrapolate current trends, and those which represent a break with the past and are deliberately more challenging to the conventional wisdom. A deliberate decision was made to develop a set of four scenarios which were clearly separate and distinctive, but which did not break all bounds of plausibility. Equivalent effort has been devoted in this study to elaborating each scenario - a practice recommended to users of the scenario framework. This does mean however, that in terms of for example economic growth, the scenarios are more extreme than typical Treasury forecasts.
- **Drivers and impact domains.** In order to facilitate use by the climate impacts research community, the exposition of each of the scenarios is based around drivers and impact domains. The drivers are: values and policy; economic development; and settlement and planning. The impact domains are: agriculture; water; ecosystems; coastal zones; tourism; and the built environment.

2.2 Overview of the UKCIP SES

Four scenarios have been developed for the UK, spanning two time-frames: the 2020s and the 2050s. The aim is to describe framework conditions for social and economic development that can be used to assess vulnerability and policy responses to climate impacts at the UK regional level. Each scenario is further elaborated in the remainder of this report with the broad time-horizon set at 2020. Developments to 2050 are suggested by a selected list of key quantitative indicators.

The review of the large global futures literature identified five main dimensions of change highlighted in previous scenario planning exercises:

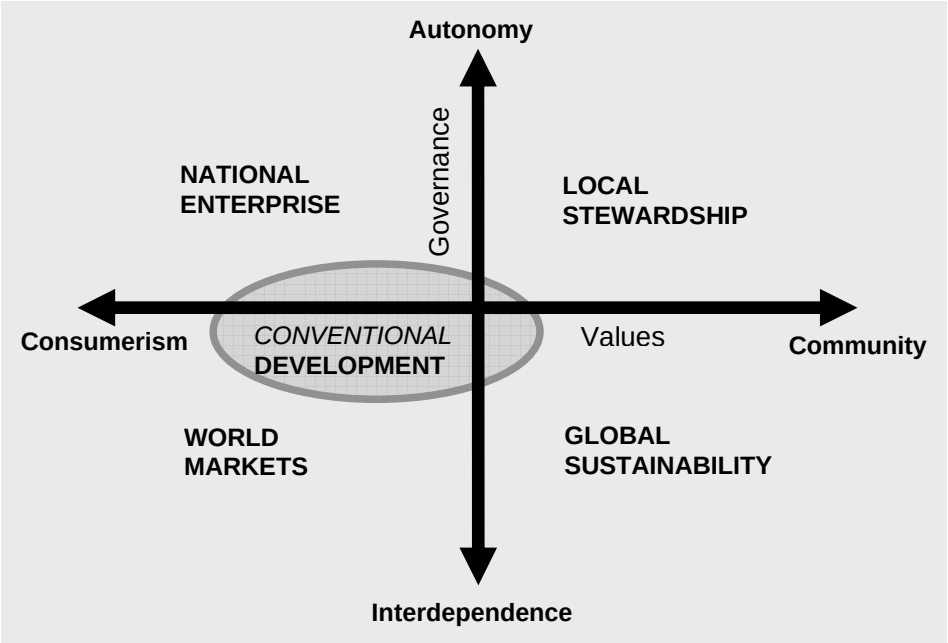
- demography and settlement patterns;
- the composition and rate of economic growth;
- the rate and direction of technological change;
- the nature of governance;[30] and
- social and political values.

Social and political values, and the nature of governance are considered to be foundational and independent determinants of future change. In the study of societies, whether from an economic, political or sociological perspective, many of the key debates are over the relationship between ideas and values on the one hand, and interests of organisations and institutional structures (broadly, governance) on the other.[31] The balance between these socio-political values and the interests of organisations is resolved differently during different periods of history, and is seen as reflecting and shaping many other changes that are taking place. In particular, it is assumed that economic

shaping many other changes that are taking place. In particular, it is assumed that economic growth, demographic changes and technological advances are primarily an outcome of the relationship between values and interests, although they clearly have some reciprocal influence on the development of values and the nature of governance. Economic growth, for instance, will be determined by the way in which a society chooses to allocate resources, and the nature and regulation of markets. It can therefore be seen as an *outcome* of a values/governance configuration, rather than generative of it. Similarly, the rate and direction of technical change will be determined by the generation and adoption of innovations emerging in specific markets. Lastly, economic, demographic and technological changes are more easily quantified and amenable to modelling, whereas values and governance cannot easily be quantified. These dimensions are intrinsically more difficult to handle in scenario-building, and therefore it has been decided to place them in centre stage.

The scenario framework segments the future 'possibility space' into four quadrants that are defined by a 'values' and a 'governance' axis (see Figure 2.1). The horizontal **values** dimension captures alternative developments in core social and economic values as they might be represented in choices by consumers and policymakers. At one end of the spectrum ('CONSUMERISM'), values are dominated by the drive to private consumption and personal freedom. The rights of the individual and the present are privileged over those of the collective and the future. Resources are distributed through free and competitive markets, with the function of governance limited to guaranteeing trade and capitalist accumulation. At the other end ('COMMUNITY'), values are shaped by concern for the common good. The individual is seen as part of a collective, with rights and responsibilities determined by broadly-defined social goals. There is greater concern about the future, equity and participation. Civil society is strong and highly valued, and resources are allocated through increasingly managed markets.

Figure 2.1: Four socio-economic scenarios for the UK



The vertical **governance** dimension aims to show alternative structures of political and economic power and decision-making. The future of governance at the UK and regional levels will be influenced to a great extent by developments within the European Union, and at the global level. At

downwards and outwards away from the national state level. International economic, political and cultural relationships strengthen, whilst boundaries fade. There may be a role for regional decision-making and for regional particularities, but this will be in the context of globalised economic and political systems. At the other end of the spectrum ('AUTONOMY'), economic and political power is retained at 'national'[32] (National Enterprise) and regional (Local Stewardship) levels. Sovereignty is retained over key areas of policy, and the process of economic globalisation is weakened. Governments have greater autonomy in decision-making, and economic, political and cultural boundaries are maintained or strengthened. National and regional development is based on local capabilities and resources.

These two dimensions generate a set of associations which can be applied to the understanding of changes at a national, sub-national and sectoral level. Implications across a range of climate impacts-relevant sectors and domains are elaborated for each of the four scenarios in this chapter. Storylines and quantitative indicators for each scenario are presented under a standard set of headings for both the drivers of change and the climate impact domains. A fuller set of indicators for drivers and impact domains can be found in Appendix A and the sources used to derive them are presented in Appendix B.

DIVIDING PAGE

2.3 Scenario: National Enterprise

2.3.1 Summary of climate vulnerability

Under this scenario, biodiversity is under pressure from habitat fragmentation, industrial/housing development and weak environmental controls. Ecosystems are therefore vulnerable to climate impacts. The policy drive to combat biodiversity loss is also unambitious. The capacity to adapt to climate change in the agricultural sector is constrained by poor economic conditions in the sector and low levels of investment. Water systems are stressed, especially in the South East, because of a failure to curb demand and constraints on the financial resources available for investment in water supply. Water quality is poor. The economic and organisational capacity to protect coastal zones, where there is continued investment, is also weak. In the latter part of this scenario, in the 2050s, the climate signal is also strong because of a failure to curb greenhouse gas emissions.

2.3.2 Values and policy

Social/political values	Prevailing social and political values are such that people concentrate on meeting their own needs through private consumption. There is little concern about social equity or protection of the environment, other than where it meets people's recreational needs.
Role of the state	The state broadly allows markets to determine social and economic outcomes, but intervenes to protect prevailing interests at the national and regional level. The transfer of sovereignty to global and European institutions is resisted and government at the UK level continues to play an important role. The pace of devolution within the UK is slow, but assemblies at the Scottish, Welsh and regional levels in England act to protect economic activity at the local level.
Policy style	Economic and political power is consolidated in traditionally strong interest groups - the law, the City, the professions. The 'top-down' policy-style leaves little room for local democracy and more open policy processes.
Welfare and health	State provision of healthcare and education declines and access becomes uneven. Social service provision also declines with relatively low concern about social inequities. Income disparities grow.
Education	Those who can afford it increasingly make use of private education as the quality of state education declines. The focus is very much on teaching basic skills that will fit people for an economically-oriented society. The education system does little to impart concern about social inequities or the environment. Those at the lower end of the social scale generally have low educational attainment.
Environmental policy	Environmental policy measures which are seen to impede economic development or restrict personal freedom do not succeed. There is little concern about global environmental issues. People support measures which enhance their immediate local environment, especially those relating to clean air, the built environment and the provision of recreational opportunities. Policies which benefit affluent groups and those with access to political power are more often successful.

2.3.3 Economic development

Economic policy

Economic development

Growth is a political priority under this scenario but falls below the long-run UK average as a result of protectionist policies at the national and regional level. Export-oriented sectors grow relatively slowly, while businesses focused on meeting domestic consumer demand fare better. In general there is little state intervention in the economy, except in relation to key industries (utilities, banks, defence) where national industries are supported against foreign competition. The UK remains outside European Monetary Union (EMU), but continues to trade extensively with the EU.

Regional trends

There are considerable variations in economic development at the regional level. London and South East England experience the highest growth rates. Scotland, Wales and the rest of England suffer from relative underdevelopment through the continued drift of economic activities towards the South East. The peripheral regions continue to rely on traditional activities, especially manufacturing, and there is a lack of investment in new industries. Regions heavily dependent on international airports and shipping ports face lower growth prospects due to the relatively slower growth of international trade. Generally, regional policies are determined by decisions at the UK level. Economic, political and cultural development continue to vary from one region to another.

Manufacturing

The relative decline in overall manufacturing activity ceases and there is more intensive exploitation of agricultural resources, with greater diversification of output to meet local demands. Sectors operating in global markets (banking and finance, chemicals, pharmaceuticals, metals, automobiles, electronics) face slower growth rates. The rate of innovation is generally low due to low investment in research and technological development and restricted international competition.

Services

In the service sector, demand for private education and healthcare rises. On the other hand, concentrated sectors operating in global markets (specialised services, banking and finance) grow more slowly.

Construction

The construction sector struggles because of lack of investment in new housing and infrastructure. Construction and refurbishment activity within existing urban areas is an important market. Maintenance and conversion of existing buildings and infrastructures is the primary activity. Traditional UK construction techniques continue to play a major role. Much of the sector remains labour intensive with low skill micro-enterprises predominating.

Energy

The energy sector is based on plentiful supplies of fossil fuels. There is a strong tendency to preserve existing sources of energy including indigenous coal and nuclear power by extending the lives of existing stations. Prices for final consumers of energy are relatively high because some higher cost forms of generation are maintained. The pursuit of energy efficiency is limited in this

scenario despite higher prices, due to a lack of available capital and the low priority attached to environmental investments. Renewables do not develop under this scenario, although there is some further development of combined heat and power plants.

Key Economic Indicators	**Mid-1990s**	**2020s (linear)**	**National Enterprise**
GDP (average growth 1995-2025)	+2 % p.a.	+2 % p.a.	+ 1.75 % p.a.
GDP/capita (at factor cost, current prices)	£ 10,500	£ 18,500	£ 17,000
Government final consumption expenditure (% GDP)	21.5 %	22 %	19 %
Value added in sectors (% of GDP)			
Services	71 %	87.25 %	74.5 %
Industry	27 %	12 %	23.25 %
Agriculture	2%	0.75 %	1.25 %

2.3.4 Settlement and planning

Population

Population numbers increase slowly as there is little inward migration and birth-rates are relatively low. Average household size is stable due to medium economic growth and low social provision.

Planning

Planning controls at the local level are weakened in an effort to encourage economic development. There is a presumption in favour of new housing, industrial and infrastructure developments. Regional-level decision making is heavily steered by national guidance.

Housing development

New housing development generally takes the form of additions to existing towns and villages. As fewer planning barriers exist for high-income housing, new developments are established in green belts and in the countryside, including in areas which are environmentally sensitive.

Transport

There is a continuing reliance on private transport with little additional provision for public transport. Moderate GDP growth limits the spread of car ownership and use, and the car fleet grows rather slowly. Due to a lack of investment, many roads operate at full capacity and congestion and accidents increase. New technologies, such as informatics, are introduced at the very top end of the car market.

With a relatively slow growth in international trade, air traffic increases no more quickly than other transport modes. Without new developments in the rail system, freight continues to be moved mainly by road.

Key Planning Indicators	**Mid-1990s**	**2020s (linear)**	**National Enterprise**
Household numbers	24.5 million	28 million	25.5 million
Land use (%)			

Agricultural	75 %	72.5 %	73 %
Forest, woodland and other	10 %	11 %	10 %
Urban and not specified	15 %	16.5 %	17 %
Land changing to urban use (England only) (per year, average 1995-2025)	13,000 ha/p.a.	*no stable trend*	16,000 ha/p.a.
of which re-used land	6,500 ha/p.a.	*increasing*	5,000 ha/p.a.
of which formerly undeveloped land	6,500 ha/p.a.	*decreasing*	11,000 ha/p.a.

2.3.5 Agriculture

Agricultural policy

Support measures

Agricultural policy aims to protect the British agricultural and food industry and to ensure the availability of high-quality food at modest prices. There is little concern about the rural environment. Public support for agricultural production continues through a modified Common Agricultural Policy (CAP) and national subsidies. As a result, consumer prices remain relatively low. There is almost no link between public support and environmental objectives.

Agricultural trade

Consumer demand

Self-sufficiency in food supply increases slightly because of trade barriers and subsidies. Diets do not change radically, meat consumption remains high. Trade in food commodities continues but there is less development of global markets for seasonal and high-quality food inputs. Retailers have a strong influence over farmers, but this is manifested in requirements for uniform, high quality products rather than for sustainable farming practices.

Farming practices

Current agricultural practices intensify with high inputs of pesticides and fertilisers. The uptake of genetically modified organisms is patchy, drawing on the UK science and industrial supply base. There is a moderate trend towards large farms.

Agricultural Production

Agricultural productivity increases within the limits of conventional technologies which leads to a further decrease in the area devoted to UK agriculture. Productivity growth slows gradually.

2.3.6 Water

Water demand	Water demand increases because capital investment in water efficiency is low and demand-side management remains a marginal activity. Leakage levels are high. On the other hand, price mechanisms limit the increase of water demand in both the industrial and household sectors. Metering systems are installed in the majority of private houses and tradable abstraction permits are used in industry.
Water supply	Supply strategies are based on the 'predict and provide' principle. Increased demand is met by extending traditional water sources. There are new and enlarged reservoirs, inter-regional transfers and additional groundwater development. Supply difficulties arise in the South and East of England.
Water quality	The quality of river and groundwater deteriorates as a result of the intensification of agriculture, low investment in sewage treatment and the weak control of industrial pollution.

2.3.7 Biodiversity

Nature conservation policy	There is little public concern about biodiversity. Nature conservation policy is not sufficiently strong to restrict development pressures on the natural environment. The current level of protection for many conservation areas declines.
Agricultural impacts	Although the total area in agricultural use is smaller than today, biodiversity is under very significant pressures from agriculture. Intensified farming practices and the trend towards larger farms leads to biodiversity loss and fragmentation of habitats.
Housing and industrial impacts	Changes in land use resulting from housing and industrial developments also have detrimental effects on biodiversity. Environmental pollution and the depletion of water resources also put stress on animal and plant species.

2.3.8 Coastal zone management

Coastal zone development	Housing development in coastal zones takes place but is limited by the generally low rate of investment in new housing.
Coastal protection	Coastal defence aims to protect all coastal areas, environmental, housing, commercial, industrial and infrastructure assets as well as agricultural areas. Withdrawal from formerly protected areas occurs only in small areas where the costs of protection exceed the derived benefits. Coastal defence investment is significantly higher than today but still within the range of economically justified spending.

2.3.9 Built environment

Housing and transport infrastructure	The quality of public infrastructures is poor because of low public investment. Innovation in the construction sector remains at a low level. Housing and other buildings in poorer areas declines while high quality buildings are developed close to centres of economic activity.

DIVIDING PAGE?

2.4 Scenario: Local Stewardship

2.4.1 Summary of climate vulnerability

Under this scenario, there is both the will and the capacity to protect biodiversity from the impacts of climate change. Economic development is controlled so that fragile ecosystems are protected, although there is some threat from the expansion of agricultural areas. Housing developments on the edges of smaller towns may also have local impacts on the countryside. Extensive agriculture focused on small-scale, diversified and organic production provides an alternative route to high adaptive capacity in the sector. There is less pressure on water resources due to lower demand, but local difficulties continue where there is resistance to the development of new water resources. The vulnerability of coastal zones will be decreased because resources are made available for protection. There is a willingness to contemplate 'managed retreat' where protection is too expensive.

2.4.2 Values and policy

Social/political values	Social values are community-oriented encouraging co-operative self-reliance and regional development. Economic growth is not an absolute political priority. Instead, there is a strong emphasis on equity, social inclusion and democratic values. The conservation of resources and the protection of the natural environment are strong political objectives. Cultural and political variations across the UK regions, and in Europe more generally, lead to a stronger regional flavour in policy making, with diverse socio-economic outcomes. The EU develops as a 'Europe of Regions'.
Role of the state	The promotion of these social values becomes the most important task of public institutions which successfully turn community values into practice through purposeful social and economic planning. Decision-making power is devolved downwards in a more federal system of government. Political systems are transparent, participatory and democratic at the local level. Traditional 'regulation' is replaced by a more diffused structure of governance involving stakeholders throughout society.
Policy style	
Welfare and health	There is a high level of public provision for health and social services which are open to all.
Education	The publicly funded educational system aims to ensure equal and broad access. The educational system affirms a strong degree of citizenship and promotes concern about social equity and environmental protection.
Environmental policy	The conservation of resources and the natural environment are strong political objectives. Environmental policy succeeds as a result of structural and behavioural changes as much as on technological change and innovation.

2.4.3 Economic development

Economic policy	Economic growth is slow relative to the long-term average. Smaller-scale production of goods and services is encouraged.
Economic development	Small and medium-sized enterprises in the manufacturing sector, co-operatives, and locally-based financial and other services prosper. Agricultural production stabilises as a proportion of economic activity. International trade plays a relatively less important role in economic growth. Even more so than in the National Enterprise scenario, sectors heavily dependent on international trade face difficult growth prospects. National champions re-emerge in key industries such as energy and communications.
Regional trends	Economic growth is more evenly spread across the regions, with London and the South East of England ceasing to be the main pole of economic development. Greater importance is placed on regional development and the local economy as a way of achieving sustainable social and environmental benefits. Wales, Scotland, Northern Ireland and the English regions are able to pursue their own economic development more autonomously. Given this level of local economic autonomy, specific outcomes of development are more firmly determined by regional resources and the capabilities of local government, businesses and people.
Manufacturing	Rates of investment and innovation in manufacturing industry are generally low. Major changes occur in industrial structure, since the scale of markets is restricted. Small and medium size enterprises, along with technologies adapted to small-scale sustainable production are favoured. Innovative new applications of information technology and biotechnology enable smaller production units to remain economic. There is a stress on eco-efficiency, quality and durability in consumer goods.
Construction	In construction, a conservationist ethic and low levels of investment leads to the survival of traditional housing, and a relatively slow uptake of new styles and technologies. The industry continues to be dominated by small firms, but the skill base is greatly enhanced, leading to efficiency gains and higher quality.
Energy	The exploitation of local energy resources is a particular feature of this scenario. A wide range of renewable energy technologies is exploited, facilitated by a willingness to invest in technologies with low rates of return. Some local coal resources are also exploited in this scenario, but with high standards of environmental control. Locally based combined heat and power schemes flourish. Green tariffs are taken up by environmentally conscious consumers and reinforce more formal regulatory controls. High energy prices lead to the large-scale adoption of energy efficiency measures.

Key Economic Indicators	**Mid-1990s**	**2020s (linear)**	**Local Stewardship**
GDP (average growth 1995-2025)	+2 % p.a.	+2 % p.a.	+ 1.25 % p.a.
GDP/capita (at factor cost, current prices)	£ 10,500	£ 18,500	£ 15,000
Government final consumption expenditure (% GDP)	21.5 %	22 %	25 %
Value added in sectors (% of GDP) Services Industry Agriculture	 71 % 27 % 2%	 87.25 % 12 % 0.75 %	 73 % 25 % 2 %

2.4.4 Settlement and planning

Population

The UK population is stable and the trend towards smaller households is reversed due to lower growth in household incomes, strong planning controls on new housing development and the revival of more collective social values. Household numbers decline slightly and urbanisation stops.

Planning

Tight planning control over the countryside and the need to preserve land for agricultural production leads to denser urban development. Growth is concentrated within existing towns and smaller cities. Government policy encourages the conversion of urban land to natural vegetation.

Housing development

There is general migration away from the larger cities and a corresponding growth of small and medium-sized towns more suited to a smaller-scale local development path. The distinction between countryside and towns is preserved. Planning favours mixed residential and commercial development and decentralisation. As a result, overall transport volume decreases.

Transport

The transportation sector is affected by a major slowdown in the growth of trade and the demand for mobility. Transport costs rise sharply due to high energy prices and policies which internalise environmental costs. Passenger transport is still dominated by private cars but public road and rail transport structures are extended. Alternatives such as car sharing, cycling and walking increases. Cars based on low emission technology (fuel cells, electricity, hybrids) are commonly used.

Key Planning Indicators	**Mid-1990s**	**2020s (linear)**	**Local Stewardship**
Household numbers	24.5 million	28 million	23 million
Land use (%)			
Agricultural	75 %	72.5 %	76 %
Forest, woodland and other	10 %	11 %	9 %
Urban and not specified	15 %	16.5 %	15 %
Land changing to urban use (England only) (per year, average 1995-2025)	13,000 ha / p.a.	*no stable trend*	3,000 ha / p.a.
of which re-used land	6,500 ha / p.a.	*increasing*	3,000 ha / p.a.
of which formerly undeveloped land	6,500 ha / p.a.	*decreasing*	--

2.4.5 Agriculture

Agricultural policy

The main goal of agricultural policy is to support a broader social desire for local self-sufficiency and what are seen as traditional farming practices. Research and technical support increases the productivity of low-input farming systems. Large scale farming is not encouraged.

Support measures

Agriculture is heavily subsidised to protect food security, local landscapes and to reduce environmental impacts.

Agricultural trade

Retailers and consumers place considerable emphasis on procurement of local supplies while sales of exotic fruits and out-of-season vegetables decline.

Consumer demand

Demand for meat continues to fall, and broader support for animal rights brings an end to the transport of live animals over long distances.

Farming practices

There is a rapid growth in organic and low input farming. Farm size declines and the use of fertilisers and pesticides decreases. Genetically modified crops are banned.

Agricultural production
Agricultural area

The shift to extensive farming practices decreases productivity and the total agricultural area is extended. Production of arable increases slowly, while livestock production decreases.

2.4.6 Water

Water demand	Water demand falls as a result of low growth and effective demand-side management measures. Consumers install water conservation technologies, grey water systems and radically reduce the use of public supply water in gardens.
Water supply	There is an increasing consciousness that water resources have to be protected. Exchange of water resources between regions in the UK becomes more difficult. High water-using activities either innovate in regions with shortages (like the South East) or relocate to other regions. Major investments are made to reduce water leakage. Few new supply-side investments are needed.
Water quality	Water quality improves dramatically as a result of acute concerns about the quality of the local environment, reduced pesticide use and changes in industrial structure. Dry waste systems are increasingly adopted resulting in a decline in demand for waste water treatment.

2.4.7 Biodiversity

Nature conservation policy	There are strenuous efforts to preserve wildlife at the local level, both in rural and urban areas.
Agricultural impacts	Some pressures arise from increased land use associated with agriculture. On the other hand, the shift away from high input and large-scale livestock agriculture to extensive and more diverse agricultural areas has positive effects on biodiversity.
Housing and industrial impacts	Planning controls ensure that land is set aside for nature conservation and that habitats are protected from housing and industrial development. Some tensions arise because demands for public access to conservation areas puts pressure in ecologically vulnerable areas.

2.4.8 Coastal zone management

Coastal zone development	Planning controls are consciously used to limit economic development in coastal zones, especially in environmentally sensitive areas.
Coastal protection	'Managed retreat' becomes an increasingly important policy option, especially where artificial sea defences are costly. Major areas of productive agricultural land and areas already developed tend to be protected by publicly funded sea defences. As public bodies try to keep maintenance investments at a low level, the quality of defence structures is relatively poor. There is a significant increase in risks of economic loss through defence failure.

2.4.9 Built environment

Housing and transport infrastructure	Improving the quality of housing is a political priority for social as well as environmental reasons (energy efficiency). However, efforts are limited by budget constraints. Investments in transport infrastructure are low as the demand for mobility remains stable.

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2.5 Scenario: World Markets

2.5.1 Summary of climate vulnerability

This is a scenario in which biodiversity is vulnerable as a result of fragmented habitats, particularly under pressure from housing development, high-intensity farming and leisure industry uses of the countryside. There is little public concern about biodiversity loss. Conversely, the capacity to adapt in the agriculture sector is high because technology offers the opportunity to introduce new varieties and techniques in response to climatic changes. Pressure on water resources is very high, especially in the South East, but prices provide incentives to use water efficiently and cut leakage. The vulnerability of coastal regions increases because of continued investment in housing and infrastructure. There is a demand to protect these investments from coastal flooding.

2.5.2 Values and policy

Social/political values	People are primarily concerned with personal consumption and their material well-being. The market, as opposed to state institutions, is presumed to best deliver these goals. There is a strong desire for mobility. People are less tied to locality and are more concerned with creating personal objectives and identities in a post-modern culture.
Role of the state	There is a continued reshaping of governance, with the retreat of the nation state. Political responsibilities are more disparate than today. On the one hand, fiscal, trade and defence policy is increasingly transferred to the EU level. On the other, attempts to improve the efficiency of regional and local decision-making lead to further, though limited, devolution.
Policy style	Governments experiment to some extent with more open and deliberative decision-making. Private sector, non-governmental agencies and international organisations have an increasingly strong influence on public policy. Regional governments also have a growing role, but their primary goal is to attract inward investment to secure jobs through investment in transport and other infrastructures.
Welfare and health	There is a declining role for governments in the provision of healthcare, education and other public services. Private sector provision becomes the norm. Privatisation leads to increasing inequalities in access and quality of social services, creating significant new social tensions.
Education	Access to high quality education becomes very uneven, with the wealthier enjoying high standards and the quality of public education declining. The education system emphasises basic skills, information technology and personal fulfilment. It does not promote interest in local culture, social equity or environmental issues.
Environmental Policy	Environmental policy is aligned to meeting competitiveness goals and protecting local amenity and environmental quality. It relies heavily on economic instruments and focuses on problems which immediately affect the population, e.g. noise and air

quality. Areas which are easily accessible to wealthier people with high levels of mobility for recreational purposes tend to enjoy higher levels of protection. Longer-term, global issues such as climate change tend to be neglected.

2.5.3 Economic development

Economic policy

This scenario is characterised by liberalised national and international markets, the dismantling of trade barriers and the retreat of the state, leaving a greater role for the private sector. Income distribution widens in this scenario more than in any other.

Economic development

By historical standards, economic growth is rapid under the World Market scenario. Globalisation proceeds rapidly with growing trade in goods and services, and the further integration and growth of financial markets. The development and pervasive application of World Trade Organisation rules leads to the removal of trade barriers. Much of UK goods and services are produced for an EU market expanded to include new members in eastern and central Europe. Global markets, including China, Latin America and other emerging markets, are important for a growing number of firms. This scenario is compatible with early UK entry into EMU.

Structural change in the economy is rapid. The service sector, including financial services, healthcare and education, leisure, distribution and transportation, dominates overall economic activity. Mining, manufacturing and agriculture all decline.

Regional trends

All regions benefit from rapid economic growth through 'spill-over' effects, although regions heavily dependent on manufacturing face rapid change. Regions and localities offering world-class knowledge-based services will tend to grow fastest, wherever they are. This leads to high levels of local and regional specialisation in sectors where UK industry has a comparative advantage. Those sectors which do not perform at a world-class level do not survive. London grows rapidly as a world financial and service centre, and has a positive economic influence on neighbouring regions. Areas close to airports and ports will benefit from the growing volume of trade.

Manufacturing

Rates of innovation and growth are high in many manufacturing sectors, with information technology and biotechnology being the main technological drivers of change. Traditional manufacturing in primary industries declines as a result of competition from newly industrialising countries in South Asia and the Middle East. However, resource extraction grows in order to meet energy and infrastructure construction needs. Small-scale, agile assembly industries linked to complex, global supply chains continue to grow. There is local and regional specialisation in high value-added industries. Pharmaceuticals benefit from the rapid growth in demand for health care.

Construction

The construction industry experiences high rates of growth and

there is rapid innovation in technologies for the built environment. New towns and communities are constructed on 'greenfield' sites. New technologies, materials and construction processes are adopted and the UK becomes more open to non-traditional building techniques. There are major advances in training and skills within the construction sector. Modular buildings are assembled from units pre-fabricated off-site. There is a greater willingness to scrap the existing building stock and a lower priority is attached to the preservation of existing buildings.

Energy

Energy markets are dominated by fossil fuels, particularly natural gas. Exploitation of alternatives to conventional oil begins. Demand for electricity and transportation fuels continues to grow. Electricity supply investments are generally in modular, distributed power systems. Energy prices remain low, and there is little concern for energy efficiency, although most of the easy energy efficiency opportunities have been realised. High discount rates and the low priority attached to global environmental problems preclude the widespread adoption of renewable energy. Neither is there a revival of nuclear power because of high discount rates and low fossil fuel prices.

Key Economic Indicators	**Mid-1990s**	**2020s (linear)**	**World Markets**
GDP (average growth 1995-2025)	+2 % p.a.	+2 % p.a.	+ 3 % p.a.
GDP/capita (at factor cost, current prices)	£ 10,500	£ 18,500	£ 24,000
Government final consumption expenditure (% GDP)	21.5 %	22 %	17 %
Value added in sectors (% of GDP) services industry agriculture	 71 % 27 % 2%	 87.25 % 12 % 0.75 %	 80 % 19 % 1 %

2.5.4 Settlement and planning

Population — The UK population grows slowly but the labour force becomes increasingly mobile. There is not only a higher rate of immigration from outside Europe but also a significant migration within the UK. Net out-migration continues in regions such as the North East, the North West, Yorkshire and Humberside, while the population of Scotland, Wales and Northern Ireland remains relatively stable. Population grows in London, the South East and East Anglia.

Households — High incomes and individualist values reinforce the existing trend towards smaller households. Rising demand for housing causes urban land use to increase significantly across all regions, especially around larger towns and cities. Renting and buying property will become increasingly expensive in the London area, causing housing demand to be particularly high in the South East.

Planning — The planning system is weak and is not used to counter-act wider social and economic trends.

Housing development — New housing development will take place along the main transport lines leading to London, in the Midlands, the North West and the South of England.

Transport — Housing development creates a need for new investments in infrastructure, especially in transport. New roads are built to meet the increased demand for passenger transport. Traffic is efficiently managed using new control systems. The quality of water, energy and communication infrastructure will improve significantly.

Key Planning Indicators	**Mid-1990s**	**2020s (linear)**	**World Markets**
Household numbers	24.5 million	28 million	31 million
Land use (%)			
agricultural	75 %	72.5 %	71 %
forest, woodland and other	10 %	11 %	11 %
urban and not specified	15 %	16.5 %	18 %
Land changing to urban use (England only) (per year, average 1995-2025)	13,000 ha/p.a.	*no stable trend*	24,500 ha/p.a.
of which re-used land	6,500 ha/p.a.	*increasing*	12,000 ha/p.a.
of which formerly undeveloped land	6,500 ha/p.a.	*decreasing*	12,000 ha/p.a.

2.5.5 Agriculture

Agricultural policy	Agricultural policy becomes much less interventionist and subsidies are reduced to a comparably low level.
Support measures	The CAP plays only a minor role and lower food prices prompt farmers to search for improved productivity.
Agricultural trade	Food markets are increasingly dominated by the large retailers. There is a growing differentiation between staple 'engineered' foods, and higher value unadulterated food produced using traditional methods. More processed food is consumed, and a greater proportion of food is eaten outside the home.
Consumer demand	
Farming practices	Agriculture becomes increasingly concentrated, industrialised and global in scope. Farms increase in size, accelerating the adoption of technological approaches such as 'precision farming'. The use of genetically modified crops becomes pervasive, and has a major impact, raising productivity. Fears about the environmental impact of genetically modified crops on biodiversity are demonstrated, but are primarily of concern to environmentalists who have little influence in this scenario.
Agricultural production	The total agricultural production rises because of higher productivity.
Agricultural area	Substantial tracts of land are converted from agricultural to recreational uses, or are sold for development.

2.5.6 Water

Water demand	Water demand increases significantly due to economic growth, higher living standards, small household sizes, minimal environmental concern and the development of more distributed communities. Metering is universally adopted and water prices are high. This encourages the adoption of low-cost efficiency measures.
Water supply	High water prices encourage a significant reduction in water leakage and the development of new sources of supply. There is little resistance to the development of new reservoirs except where significant recreational opportunities are threatened.
Water quality	Water quality is mixed: agricultural and road run-off are a severe problem; river quality improves in recreational areas; and groundwater quality declines.

2.5.7 Biodiversity

Nature conservation policy	Conservation sites are maintained and slowly expanded but are designed with access in mind, to provide space for tourism and leisure activities rather than in order to protect biodiversity.
Agricultural impacts	Habitats are under high pressure from large-scale farming. The wide use of genetically modified crops creates new problems for biodiversity.
Housing and industrial impacts	Urban sprawl and the demand for 'managed landscapes' (as opposed to habitat preservation) put pressure on biodiversity.

2.5.8 Coastal zone management

Coastal zone development	High housing demand coupled with high income levels and the demand for an attractive living environment enhances pressure for housing development in coastal zones. Areas at high risk from flooding will be developed by high income groups, even if insurance for these areas is refused.
Coastal protection	The state withdraws partly from coastal defence which becomes to a larger extent privately funded. The high value of coastal assets economically justifies the increasingly high investments. Sea defences protect almost all coastal areas making use of advanced technology but they will involve significant costs. Modern early warning systems based on satellite and other remotely sensed data are installed to minimise the risk of human casualty. New construction techniques applied in coastal areas reduce the damage from flooding events.

2.5.9 Built environment

Housing and transport infrastructure	High investment in the built environment drastically improves the quality of the housing and transport infrastructure. The turnover of office and residential buildings increases. There is more rapid adoption of innovative technologies (e.g. information technologies).

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2.6 Scenario: Global Sustainability

2.6.1 Summary of climate vulnerability

In this scenario, natural ecosystems are considerably less vulnerable than in the World Markets scenario but are less well protected than under Local Stewardship. Demand for access to the countryside increases while, on the other hand, pollution levels are lower. Technology allows agriculture to adapt to climate change, but there are tighter controls on the use of genetically modified crops for example than under the World Markets scenario. More efficient end use means that there is less pressure on water resources. Existing coastal infrastructure continues to be vulnerable to sea-level rise but new developments are strictly controlled.

2.6.2 Values and policy

Social/political values	Social values are communitarian and internationalist. There is broad consensus on the need to maintain and enhance social equity and environmental quality. Low discount rates reflect a concern about long-term development issues.
Role of the state	There is a belief that these objectives are best achieved through international co-operation within the EU and in global organisations, such as a strong international climate regime. This leads to the loss of some power over monetary, defence, social and environmental policy at the UK level. Governance becomes more globalised. The main task of regional governments is to implement standards agreed at the EU and global levels. There is less scope for regional autonomy in this scenario, which follows the 'One Europe' model of harmonised standards across international boundaries. Politically strong regions co-operate and integrate horizontally. The accountability and legitimacy of global decisions implemented at the local level is stressed.
Policy style	Consensus about sustainable development is transmitted through participative, open democracies with a growing role for local governments within more federal political systems. The policy-style is characterised by a strong partnership between government, industry and non-governmental organisations (NGOs).
Welfare and health	Policy aims to reconcile social values with economic development and the expenditure of public funds reflects this. The welfare system provides an adequate safety net for disadvantaged groups. There is a shift from care for the sick to high-technology health promotion and preventive care.
Education	There is equal access to high quality public education which reinforces social and environmental values throughout the taught curriculum.
Environmental Policy	Working towards sustainable development is a political priority. Larger ideas such as the maintenance of biodiversity, the protection of the 'global commons' (the atmosphere, the oceans, wilderness areas) and resource efficiency drive environmental policy. Strong concerns are reflected in the development of

external regulation and *internal* environmental management. Environmental policy is based on a mix of market-based and regulatory instruments.

2.6.3 Economic development

Economic policy

Economic growth continues at long-term average rates. Growth is achieved by balancing commercial and social/environmental objectives. Innovation is promoted by high investments in research and technology development, and private-public partnerships. International co-operation and regulation reduces the tensions between social and environmental objectives on the one hand and competitiveness on the other.

Economic development

There is a growth in the role of services in the economy, at the expense of production and agriculture. Resource intensive agriculture and manufacturing tend to decline. The economy is increasingly export-oriented, with mobile, highly skilled labour force. In most markets competitiveness is achieved through encouraging higher quality and emphasis on non-price value-added (branding and functional) differentiation.

Regional trends

Regional development is evenly distributed through planning controls and transfer payments. Development prospects are shaped by the existence of a highly skilled labour force, the 'pleasantness' of towns and cities, and the provision of infrastructure which encourage sustainable economic development. In some more industrialised regions this will necessitate significant structural change. The management of this economic transition is an important task for national and regional policy.

Manufacturing

Manufacturing industry is transformed by a combination of high investment and the drive towards a low input, 'small footprint' economy. Highest growth is experienced in sectors providing eco-efficient goods and services. High levels of investment are associated with the re-structuring and/or phasing out of inefficient and heavily polluting industries. Innovation focuses on radical improvements in eco-efficiency across the board. This has major implications for the market structure of many industries, with returns to scale being replaced by returns to scope and specialisation.

Construction

The built environment is transformed with the rapid replacement of old and inefficient buildings and infrastructures. Due to strict development controls, housing construction is concentrated in existing urban centres and in brown field sites. There is significant innovation in biotechnological and other advanced land reclamation techniques. New, energy efficient buildings are engineered products with relatively short lives. There is heavy investment in new infrastructure in the UK. There is a particular emphasis on training and the acquisition of skills in this scenario, as UK firms seek to learn advanced construction techniques employed in other European countries.

Energy

Natural gas is the dominant energy source up to 2010 in this scenario, but renewable energy sources gain a large market share thereafter. A large global market for solar energy builds up with economies of scale driving down costs, forcing market concentration and making solar the dominant renewable energy form. Encouraged by regulatory incentives, energy suppliers move towards the provision of integrated services, greatly enhancing the take-up of energy efficiency measures. Investment in higher cost energy forms and environmental controls mean that the price of energy for the final consumer is high. With the growing importance of non-fossil energy, hydrogen becomes a significant energy carrier beyond 2020 and there is major infrastructure investment associated with its production, storage and distribution.

Key Economic Indicators	**Mid-1990s**	**2020s (linear)**	**Global Sustainability**
GDP (average growth 1995-2025)	+2 % p.a.	+2 % p.a.	+ 2.25 % p.a.
GDP/capita (at factor cost, current prices)	£ 10,500	£ 18,500	£ 20,000
Government final consumption expenditure (% GDP)	21.5 %	22 %	23 %
Value added in sectors (% of GDP) Services Industry Agriculture	 71 % 27 % 2%	 87.25 % 12 % 0.75 %	 78 % 20.75 % 1.25 %

2.6.4 Settlement and planning

Population

Rising incomes tend to reduce average household size but this factor is balanced by the strengthening of community values. Household size therefore declines slowly and household numbers grow at past rates. More even economic development reduces migration within the UK. London and the South East continue to be attractive due to the proximity to European markets, but regional development elsewhere is supported at a European level. The aesthetic, social, cultural and environmental benefits of living in Scotland, Wales and northern England are valued more.

Planning

Strong planning controls prevent development in the green belt.

Housing development

Most new housing demand is met by dense low-rise development mainly on existing urban land. There is little conversion to urban land on the fringes of smaller towns and villages. Government policy encourages energy efficiency investments in the housing stock. There is a higher turnover of the housing stock, with a general emphasis on modern, high quality housing for socially disadvantaged groups.

Transport

The modernisation and restructuring of freight and passenger transport is started, with the longer-term aim of building an integrated system with an increased proportion of public road and rail transport. Although eco-efficient cars reduce the negative impacts of traffic, a tension between the transport demands of a mobile society and environmental concerns persist. Major new investments are made in telematics as a way of substituting for travel. New roads, rail and airport infrastructures are developed, but with a high priority given to minimising environmental impacts. As a result, the cost of transport rises substantially.

Key Planning Indicators	**Mid-1990s**	**2020s (linear)**	**Global Sustainability**
Household numbers	24.5 million	28 million	27.5 million
Land use (%)			
Agricultural	75 %	72.5 %	71 %
forest, woodland and other	10 %	11 %	13 %
urban and not specified	15 %	16.5 %	16 %
Land changing to urban use (England only) (per year, average 1995-2025)	13,000 ha/p.a.	*no stable trend*	8,000 ha/p.a.
of which re-used land	6,500 ha/p.a.	*increasing*	6,000 ha/p.a.
of which formerly undeveloped land	6,500 ha/p.a.	*decreasing*	2,000 ha/p.a.

2.6.5 Agriculture

Agricultural policy	The aim of agriculture policy is to balance high agricultural yields with low environmental impacts.
Support measures	Support payments for farmers are tied to the sustainable management of rural landscapes. Some existing agricultural land is converted to promote nature conservation.
Agricultural trade	Retailers transmit consumer concerns to farmers through purchasing policies. Common environmental, animal welfare and ethical standards are accepted and implemented through the food supply chain in the UK and EU.
Consumer demand	There is a widespread desire to eat high-quality, nutritious food supplied mainly by major brands and retail chains. More people switch to vegetarianism and meat consumption declines more widely.
Farming practices	Approaches such as integrated crop management are adopted resulting in lower pesticide inputs. There is a gradual uptake of genetically modified crops around which there is considerable controversy. Introduction takes place very slowly, with tight regulatory controls in place to screen for adverse environmental and biodiversity impacts. Large-scale livestock farming declines.
Agricultural production	The increase in agricultural productivity and production slows down and substantial areas of land are taken out of production. This area is used to support nature conservation rather than recreation.

2.6.6 Water

Water demand	Forces tending to increase water demand, such as an improved standard of living, are balanced by demand-side management and the adoption of clean technology.
Water supply	As a result of improved efficiency of water end-use, there is little need to develop new sources of water supply.
Water quality	Water quality improves in this scenario due to reduced pesticide use and the shift to cleaner production in industry.

2.6.7 Biodiversity

Nature conservation	Despite the high priority assigned to the protection of the countryside, landscape and key habitats, this scenario has a mixed impact. Growing demand for access to a clean, quiet rural environment creates pressures which must be consciously managed.
Agricultural impacts	Low input farming and the promotion of sustainable landscape management helps to protect biodiversity. The decline in animal husbandry in marginal upland areas results in radical changes in land use. Rapid changes in agricultural practice across the rest of the UK also result in significant changes in the appearance of the countryside.
Housing and industrial impacts	Tight planning controls prevent the fragmentation and loss of important habitats. The control of industrial pollution improves the quality of air, soil and water.

2.6.8 Coastal zone management

Coastal zone development	The pressure for the development of coastal areas is high but tight planning controls restrict further development, especially in vulnerable areas.
Coastal protection	Coastal zone management follows a twofold strategy leading to diverse regional outcomes. Developed areas and high value assets are protected through artificial engineering structures. These will also be used to experiment with alternative energy technologies such as wave energy. There will be 'managed retreat' in areas where ecological conditions are favourable to the development of biologically diverse habitats. The majority of investments in coastal defence are public. New technological solutions, for example in the construction of houses in areas at risk from flooding, are adopted.

2.6.9 Built environment

Housing and transport infrastructure	High investment is made in public infrastructures and new building stock. Emphasis is given to energy and resource efficient housing and transport projects. The benefits of the better built environment are more fairly distributed.

Notes

[29] More details of the current state of SRES work can be found at http://sres.ciesin.org/. While there are important similarities between these UKCIP scenarios and the SRES scenarios, there are also some differences. The first is that the elaboration of the scenarios in this report is intended for use by climate impacts communities, and not to generate emissions scenarios. The scenarios also differ qualitatively, for instance, in taking technological change as being endogenous to the scenarios, rather than independent of them

[30] *Governance* is distinct from Government, referring to both governmental and non-governmental (private sector, civil society, regional and international organisations) institutions with a role in shaping society and implementing policies

[31] In economics, for instance, this relates first to implicit and explicit rules applied in resource allocation and the use of discount rates on the one hand, and to the structure and regulation of markets on the other. In political philosophy, the relationship between the individual and the collective, and to the establishment and practice of power are seen as seminal problems. In sociology the interplay between ideologies, agency and structure are regarded as central to explanations of social processes

[32] It is recognised that the term 'national' can be interpreted in different ways (e.g. at a UK or UK-country level). Hence, it follows that the National Enterprise scenario can also be interpreted at these different levels.

Appendix A. Indicators of the UKCIP SES

UK IN THE 2020S[i]						
	Mid-1990s	**2020s (linear)**	**National Enterprise**	**Local Stewardship**	**World Markets**	**Global Sustainability**
Economic Development						
GDP (average growth 1995-2025)	+2 % p.a.	+2 % p.a.	+ 1.75 % p.a.	+ 1.25 % p.a.	+ 3 % p.a.	+ 2.25 % p.a.
GDP (at factor cost, current prices)	£ 600 billion	£ 1100 billion	£ 1000 billion	£ 900 billion	£ 1500 billion	£ 1200 billion
GDP/capita (at factor cost, current prices)	£ 10,500	£ 18,500	£ 17,000	£ 15,000	£ 24,000	£ 20,000
Distribution of income (proportion: income of poorest / richest 10%)[ii]	1:4	1:5	1:5	1:3.5	1:5.5	1:4
Poverty (% of people with income below 40% of average income)	9 %	11 %	11 %	3 %	13 %	6 %
Homeless households in temporary accommodation	50,000	*no stable trend*	80.000	20.000	100,000	40.000
Government final consumption expenditure (% GDP)	21.5 %	22 %	19 %	25 %	17 %	23 %
Export in goods Exports (value) Exports (% GDP)h	 £ 154 billion 25 %	 £ 400 billion 36 %	 £ 290 billion 28%	 £ 180 billion 20 %	 £ 520 billion 35 %	 £ 360 billion 30 %
Value added in sectors (% of GDP) Services Industry Agriculture	 71 % 27 % 2%	 87.25 % 12 % 0.75 %	 74.5 % 23.25 % 1.25 %	 73 % 25 % 2 %	 80 % 19 % 1 %	 78 % 20.75 % 1.25 %

[i] All figures give approximate values. The values for the "2020s (linear)" are simple extrapolations from historic data (usually over the last 20 years) and might not be consistent. No projections have been made if the long-term trend shows great variations.

[ii] Refers to real household disposable income.

	Mid-1990s	2020s (linear)	National Enterprise	Local Stewardship	World Markets	Global Sustainability
Planning and Built Environment						
Population	58.5 million	61 million	61 million	60 million	62 million	61 million
Average household size	2.4 persons	2.2 persons	2.4 persons	2.6 persons	2.0 persons	2.2 persons
Household numbers	24.5 million	28 million	25.5 million	23 million	31 million	27.5 million
Housing stock unfit for human habitation[iii]	7.5 %	*no historic data*	7 %	8 %	9 %	6 %
Land use (%)						
Agricultural	75 %	72.5 %	73 %	76 %	71 %	71 %
Forest, woodland and other	10 %	11 %	10 %	9 %	11 %	13 %
Urban and not specified	15 %	16.5 %	17 %	15 %	18 %	16 %
Land changing to urban use[iv] (p.a., 1995-2025)	13,000 ha/p.a.	*no stable trend*	16,000 ha/p.a.	3,000 ha/p.a.	24,500 ha/p.a.	8,000 ha/p.a.
of which re-used land	6,500 ha/p.a.	*increasing*	5,000 ha/p.a.	3,000 ha/p.a.	12,000 ha/p.a.	6,000 ha/p.a.
of which formerly undeveloped land	6,500 ha/p.a.	*decreasing*	11,000 ha/p.a.	--	12,000 ha/p.a.	2,000 ha/p.a.
UK passenger transport (passenger kilometres)	690 billion km p.a.	1100 billion km p.a.	900 billion km p.a.	700 billion km p.a.	1200 billion km p.a.	900 billion km p.a.
UK passenger transport (%)						
air	1 %	1 %	1 %	0.5 %	2 %	1.5 %
Rail	5.5 %	3 %	5 %	10 %	3.5 %	8 %
Road (public)	6.5 %	4 %	5 %	15 %	6 %	12 %
road (individual)	87 %	92 %	89 %	74.5 %	88.5 %	77.5 %

[iii] Compared with the fitness standard defined in the 1989 Local Government and Housing Act. Figures refer to England only.
[iv] Figures refer to England only.

	Mid-1990s	2020s (linear)	National Enterprise	Local Stewardship	World Markets	Global Sustainability
Agriculture						
Total agricultural area of which under agricultural production of which other (set aside, roads etc.)	18,500,000 ha 18,000,000 ha 500,000 ha	17,500,000 ha 17,000,000 500,000 ha	18,000,000 ha 17,500,000 ha 500,000 ha	19,000,000 ha 18,750,000 ha 250,000 ha	16,500,000 ha 16,000,000 ha 500,000 ha	17,500,000 ha 17,000,000 ha 500,000 ha
Value of agricultural goods	£12 billion	£8.2 billion	£12.5 billion	£15.8 billion	£15 billion	£15 billion
Value of agricultural goods per agricultural area	£700/ha	£500/ ha	£700/ha	£800/ha	£950/ha	£850/ha
Pesticide usage	3.8 kg / ha	*no stable trend*	4.0 kg /ha	1.5 kg/ha	3.0 kg/ha	2.0 kg/ha
Synthetic nitrogen fertiliser usage	1.6 Mt N/yr	1.4 Mt N/yr	1.7 Mt N/yr	1.2 Mt N/yr	1.5 Mt N/yr	1.3 Mt N/yr
Agricultural subsidies (CAP and national, part of GDP)	0.49 %	*no stable trend*	0.4 %	0.8 %	0.16 %	0.65 %
Agricultural subsidies (CAP and national, at constant prices) of which related to agri-environment schemes[v]	£ 3,000 million (*large variations)* £ 120 million	*no stable trend* *no stable trend*	£ 4,100 million £ 50 million	£ 7,100 million £ 2,000 million	£ 2,400 million £ 250 million	£ 7,800 million 3,000 million
Organic farming % of area under agricultural production	1 %	*no stable trend*	0 %	40 %	3 %	20 %
Yield of milk per cow	5500 litres/hd/yr	7000 litres/hd/yr	7300 litres/hd/yr	6200 litres/hd/yr	8700 litres/hd/yr	7000 litres/hd/yr
Yield of wheat per ha	7.7 t / ha	9.4 t / ha	9.6 t / ha	7 t / ha	9.8 t / ha	8 t / ha
Production (% output) farm crops livestock	40% 60%	42 % 58 %	43 % 57 %	47 % 53 %	45 % 55 %	47 % 53 %
Water						
Water demand (% change)	+ 0.2 % p.a.	+ 0.5 % p.a.	+ 0.5 % p.a.	- 0.5 % p.a.	+ 1 % p.a.	+/- 0 % p.a.
Public water supply (volume)	20,000 Ml/day	23,000 Ml/day	23,000 Ml/day	17,000 Ml/day	27,000 Ml/day	20,000 Ml/day
River quality (% classified as good) biologically chemically	 93% 63%	 *improving* *improving*	 85 % 50 %	 95 % 65 %	 90 % 60 %	 95 % 75 %

[v] Includes UK and CAP expenditure on schemes such as Environmentally Sensitive Areas, Organic Aid Scheme, Countryside Stewardship Scheme etc.

	Mid-1990s	2020s (linear)	National Enterprise	Local Stewardship	World Markets	Global Sustainability
Biodiversity						
Area of Sites of Special Scientific Interest	2,000,000 ha	3,800,000 ha	1,500,000 ha	4,500,000 ha	2,500,000 ha	5,500,000 ha
Area of lowland heathland	58,000 ha	*decreasing*	52,000 ha	62,000 ha	58,000 ha	64,000 ha
Length of hedgerows	377 thousand km	0 km	370 thousand km	400 thousand km	150 thousand km	200 thousand km
Population number of key species (territories) Linnet (farmland) Spotted Flycatcher (woodland)	 540,000 130,000	 250,000 60,000	 250,000 40,000	 600,000 80,000	 150,000 60,000	 300,000 80,000
Coastal Zone Management[vi]						
Zones protected by coastal defences	240,000 ha		235,000 ha	220,000 ha	240,000 ha	225,000 ha
Formerly protected areas flooded or eroded as a result of 'managed retreat' after the mid 1990s	--		2,500 ha	10,000 ha	0 ha	15,000 ha
Urban land in areas protected by coastal defences	20,000 ha	22,000 ha	25,000 ha	18,000 ha	30,000 ha	20,000 ha
Annual investment in coastal defence	£200 million	£225 million	£230 million	£150 million	£350 million	£200 million

[vi] Figures refer to England and Wales only and exclude tidal defences on rivers and estuaries.

UK IN THE 2050S[vii]						
	Mid-1990s	**2050s (linear)**	**National Enterprise**	**Local Stewardship**	**World Markets**	**Global Sustainability**
Population	58.5 million	61.5 million[viii]	57 million	55 million	59 million	57 million
GDP (average growth)	+2 % p.a.	+2 % p.a.	+ 1.75 % p.a.	+ 1.25 % p.a.	+ 3 % p.a.	+ 2.25 % p.a.
GDP (at factor cost, current prices)	£615	£2000 billion	£1700 billion	£1300 billion	£3600 billion	£2300 billion
GDP/capita (at factor cost)	£10,500	£33,000	£31,000	£24,000	£61,000	£41,000
Land use (%)						
Agricultural	75 %	70 %	70 %	75 %	60 %	70 %
Urban	15 %	12 %	19 %	14 %	22 %	15 %
forest, woodland and other	10 %	18 %	11 %	11 %	18 %	15 %
UK passenger transport (%)						
air	1 %	1 %	1 %	0.5 %	3 %	1.5 %
Rail	5.5 %	0.5 %	7 %	15 %	10 %	15 %
road (public)	6.5 %	1.5 %	7 %	14.5 %	2 %	19.5 %
road (individual)	87 %	97 %	85 %	70 %	85 %	64 %

[vii] Figures represent a rolling forward of the 2020 scenarios, without consideration of limits to growth that might emerge in some areas.

[viii] The figure given refers to a linear projection. However, the Office for National Statistics projects the population to increase to 61.2 million in 2023 and then decrease slowly to about 57 million in the 2050s.

Appendix B. Indicators of the UKCIP SES – sources and consistency checks

INDICATORS	DATA SOURCE	RELEVANCE	CONSISTENCY	SOURCE[ix]
Economic Development				
GDP growth (average growth 1995-2025)	ONS (1998). UK National Accounts. London: The Stationery Office; Northcott, Jim (1999). Britain's Future. Oxford: OPS	characterise scenarios, general driver	various	assumed
Absolute GDP (at factor cost, current prices)	ONS (1997). Key Data. London: The Stationery Office	compare absolute wealth	GDP growth	derived from GDP growth
GDP/capita (at factor cost)	ONS (1999). Social Trends 29. London: The Stationery Office	compare absolute wealth	GDP growth, population	derived from GDP and population
Distribution of income (proportion: income of poorest/richest 10%)[x]	ONS (1999). Social Trends 29. London: The Stationery Office	social vulnerability	public expenditure	assumed
Poverty (% of people with income below 40% of average income)	ONS (1997). Social Trends 27. London: The Stationery Office	social vulnerability	GDP, distribution of income	assumed
Homeless households in temporary accommodation	ONS (1997). Social Trends 27. London: The Stationery Office	social vulnerability	GDP, distribution of income, public expenditure	assumed
Government final consumption expenditure (% GDP)	OECD (1996). Historical Statistics 1960-1994. Paris: OECD	characterise scenarios, institutional adaptive capacity	distribution of income	assumed
Export in goods Exports (value) Exports (% GDP)	ONS (1999). Annual Abstract of Statistics. London: The Stationery Office	characterise scenarios	GDP growth	- assumed - derived from value and GDP
Value added in sectors (% of GDP) Services Industry Agriculture	OECD (1996). Historical Statistics 1960-1994. Paris: OECD	characterise scenarios, driver for environmental change	GDP growth, export	assumed

[ix] Some values are derived from one or more other indicators (e.g. GDP per capita is derived from absolute GDP and the population number). These links between indicators are specified here.
[x] Refers to real household disposable income.

INDICATORS	DATA SOURCE	RELEVANCE	CONSISTENCY	SOURCE[48]
Planning Built Environment				
Population	ONS (1999). Social Trends 29. London: The Stationery Office	various	GDP	assumed
Average household size	ONS (1999). Social Trends 29. London: The Stationery Office; DoE (1995). Projections of Households in England to 2016. London: HMSO	Biodiversity, water scarcity	GDP, income distribution	assumed
Household numbers	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office.	Biodiversity, water scarcity	Household size, population	derived from population and household size
Housing stock unfit for human habitation[xi]	DETR (1999). Key Housing Statistics. http://www.detr.gov.uk	Social vulnerability	GDP, income distribution, public expenditure	assumed
Land use (%) Agricultural (incl. set aside) Urban Forest, woodland and other	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office.	biodiversity, transport, environment	GDP, economic activity, agricultural area	assumed
Land changing to urban use[xii] (p.a., 1995-2025)	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office.	biodiversity, environment	land use, households	assumed
UK passenger transport (passenger kilometres)	ONS (1999). Annual Abstract of Statistics. London: The Stationery Office	characterise scenarios, vulnerability: transport	land use, GDP, population, transport means	assumed
UK pass. transport (%) air rail road (public) road (individual)	ONS (1999). Annual Abstract of Statistics. London: The Stationery Office	characterise scenarios, driver for environmental change, vulnerability: transport	land use, GDP, transport volume	assumed

[xi] Compared with the fitness standard defined in the 1989 Local Government and Housing Act. Figures refer to England only.
[xii] Data for England only.

INDICATORS	DATA SOURCE	RELEVANCE	CONSISTENCY	SOURCE[48]
Agriculture				
Agricultural area	MAFF (1997). UK Food and Farming in Figures. http://www.maff.gov.uk	agriculture, biodiversity	land use, pesticide and nitrogen usage, agricultural GDP	derived from land use
Value of agricultural goods	OECD (1996). Historical Statistics 1960-1994. Paris: OECD	agriculture	agri-environment areas, all agricultural indicators	derived from agricultural GDP
Value of agricultural goods per hectare	OECD (1996). Historical Statistics 1960-1994. Paris: OECD	agriculture	agri-environment areas, all agricultural indicators	derived from agricultural GDP and agricultural area
Pesticide usage	DoE (1996). Indicators of Sustainable Development for the UK, London: HMSO	water quality	agri-environment areas, all agricultural indicators	assumed
Synthetic nitrogen fertiliser usage	EFMA (1998). Forecast of Food, Farming and Fertiliser Use; DoE (1996).	water quality	agri-environment areas, all agricultural indicators	assumed
Agriculture subsidies (CAP and national, part of GDP)	MAFF (1997). Agriculture in the UK. London: The Stationery Office	agriculture	subsidies, all agricultural indicators	derived from subsidies and GDP
Agricultural subsidies (CAP and national)	MAFF (1997). Agriculture in the UK. London: The Stationery Office	agriculture	all agricultural indicators	assumed
Organic farming	Welsh Institute of Rural Studies, University of Wales	agriculture	all agricultural indicators	assumed
Yield of wheat per ha	MAFF (1997). UK Food and Farming in Figures. http://www.maff.gov.uk	agriculture	all agricultural indicators	assumed
Yield of milk per cow	MAFF (1997). UK Food and Farming in Figures. http://www.maff.gov.uk	agriculture	all agricultural indicators	assumed
Production (% output) farm crops livestock	MAFF (1997). UK Food and Farming in Figures. http://www.maff.gov.uk	agriculture	all agricultural indicators	assumed
Water				
Water demand (% change)	DoE (1992). The UK Environment. London: HMSO; DETR (1998). Digest of Environmental Statistics. London: The Stationery Office	water scarcity	population, household size, GDP, economic activity	assumed
Public water supply (volume)	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office.	water scarcity	Change in water demand	derived from water demand
River quality (% classified as good) biologically chemically	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office	vulnerability: water	Economic activity	assumed

INDICATORS	DATA SOURCE	RELEVANCE	CONSISTENCY	SOURCE[48]
Biodiversity				
Area of Sites of Special Scientific Interest	DoE (1996). Indicators of Sustainable Development for the UK. London: HMSO	biodiversity, environment	Agriculture, land use, economic development	assumed
Area of lowland heathland	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office	biodiversity, environment	Agriculture, land use, economic development	assumed
Population number of key species (territories) Linnet (farmland) Spotted Flycatcher (woodland)	DETR (1998). Digest of Environmental Statistics. London: The Stationery Office English Nature, *personal communication*	biodiversity, environment	Agriculture, land use, economic development	assumed
Coastal Zone Management				
Zones protected by coastal defences	MAFF, *personal communication*	sea-level rise, biodiversity	Housing, land use, agriculture	assumed
Formerly protected areas flooded or eroded as a result of 'managed retreat' after the mid 1990s	MAFF, *personal communication*	sea-level rise, biodiversity	Zones protected	derived from zone protected
Urban land in areas protected by coastal defences	MAFF, *personal communication*	sea-level rise	Housing, land use	assumed
Annual investment in coastal defence	MAFF, *personal communication*	sea-level rise	Zones protected, urban land in protected areas	assumed

Chapter 3

Guidance on using the UKCIP SES

Compiled by UKCIP Programme Office

3.0 Guidance on using the UKCIP SES

3.1 Context

Already within UKCIP considerable uses have been found for the scenarios. In addition, knowledge has accumulated on what are realistic expectations for their application, and their strengths and constraints. Along with the establishment of the devolved administrations in Scotland and Wales, developments at a regional level in England have proceeded apace in the past two years, particularly with the emergence of draft Regional Planning Guidance (RPG). RPG provides a coherent 'plan' for much of the first period covered by the scenarios (2020s). These developments suggest the need for a link between the scenarios and strategic planning at a regional level, as studies within the UKCIP framework are increasingly being drawn upon as inputs into the policy process. This section therefore draws together and presents experience during phase one of UKCIP for the benefit of next stage studies by using:

1) Recommendations made by the SPRU team following the process adopted for the generation of the scenarios;

2) The experience of the consulting teams of ECOTEC and WS Atkins, which were the first UKCIP regional study teams to have access to the scenarios during the undertaking of their scoping studies for Wales[33] and South East England[34] respectively;

3) The experience gained by a regional sustainability agency (Sustainability North West) in applying the scenarios as a policy tool;

4) The experience gained by the RegIS study team in using the scenarios;

5) The outcome of a workshop convened by UKCIP in February 2000 in which approximately 20 experts specifically considered the commissioned papers on 1), 2) and 3) above, to determine what operational guidance needs to be provided to potential users of the scenarios.

3.2 General use of the UKCIP SES

Ideally, UKCIP needs consistency amongst studies undertaken so that results can be compared and integration of studies can be achieved. The widespread use of the UKCIP98 climate scenarios, by studies within the broad umbrella of the Programme and by other researchers undertaking more specific activities, is generating a wealth of results which can be integrated to provide a coherent assessment of climate impacts in the UK. The socio-economic scenarios are generally considered not to rest on such a robust methodology and are different in that there is a range of scenarios which has been specifically designed to be exploratory and to facilitate discussion. Indeed, their developers have suggested that:

"The research team carrying out a sectoral or regional study, by virtue of its expertise, will be best placed to develop detailed scenarios … the framework scenarios should not be use as a blueprint, but as a starting point to promote consistency across a range of climate impact studies and provide the basis for synthesising the results."[35]

But this somewhat strong disclaimer has understandably provoked comments from teams trying to use the scenarios, who have asked how consistency can be maintained between teams and indeed whether alternative approaches should be tried.

DETR and UKCIP consider that the UKCIP SES provide a useful toolkit for studies. Stakeholders are looking for leadership and guidance from the Programme on futures analysis. The scenarios have already been shown to be capable of flexible application for varying purposes, for example: awareness raising on socio-economic dimensions of studies (South East scoping study, Wales scoping study); useful for development of broad regional economic and spatial strategies and policies as undertaken by organisations such as the Regional Development Agencies (e.g. North West Operationalisation study – see Chapter 4) and Regional Planning Bodies; and as the basis for development of quantified regional scenarios for use in integrated work (such as in RegIS – see Chapter 5).

UKCIP agrees that:

"*The framework scenarios provide a set of standard, unifying assumptions about the basic social and economic dimensions of change. Qualitative assumptions about social values and approaches to governance, as well as quantitative assumptions about GDP growth and population change, can be applied across a range of studies."*[36]

"The use of the framework scenarios provides an opportunity to take a systematic approach to exploring linkages between local, regional, national and global scales."[37]

Nevertheless, teams will need to consider carefully how to use the scenarios for maximum effectiveness in their studies. That is self-evident and consistent with advice on using other socio-economic scenarios, for example, the USNA approach. The following compilation of experience aims to provide more information for potential users to enable them to determine their approach. It should also be noted that because the scenarios explore worlds where climate change will occur (to identify sensitivity and vulnerability to that change) but do not formally account for autonomous or planned adaptation, they are not self-standing alternative views of the future. Rather they are one step to providing these views (see also Section 3.10).

3.3 Selection of scenarios

The use of the axes adopted for the construction of the scenarios can be questioned and alternatives proposed, but those chosen have received considerable scrutiny in all the consultation exercises which have taken place and a 'comfort' level about their usefulness has developed (see Appendix C for details of the consultation processes). They also have the merit of providing linkage to the IPCC SRES (see Sections 1.6 and 3.9). Teams, however, will need to determine whether all the scenarios can be applied within available resources, particularly in view of the need to also have reference to relevant regional documentation (see below). All studies have expressed concern about the level of resources needed to use the four scenarios in a quantified way, particularly as further development is required before they can be applied.[38] When combined with the four climate scenarios and the two time-frames, 32 potential futures result for the 2020s and 2050s, without including reference/baseline scenarios.

One objective for UKCIP's generation of multiple scenarios for both climate and socio-economic conditions is to give a range of conditions which covers uncertainty in the process of projection. However, if resources are limited both for technical interpretation within the contracting team and for exploration of the scenarios with stakeholders, it will not be possible to work with all four scenarios to a similar level of detail. Obviously if a selection is made, it makes sense to take a diagonal, Local Stewardship/World Markets and National Enterprise/Global Sustainability, which

provides two contrasting scenarios. Alternatively, if a study does not require analysis of a complete socio-economic future, there could be a focus on issues of particular sensitivity.[39] The Wales team found that stakeholders were interested in just one or two climatic variables that *their* industry was vulnerable to.

"It is likely that if we are interested in the interaction between socio-economic futures and climatic futures there might also be a very small number of key socio-economic indicators that are likely to materially interact with climate impacts. In the case of agriculture the trajectory of changes to the CAP, consumers attitudes to GMOs and organic farming are likely to effect their response to climate change much more than economic growth or income distributional issues."[40]

It may also be necessary to step outside the framework completely.

"*Many respondents were concerned with the incrementalism implicit in the scenario framework. Both the storylines and the indicators assume an accumulation of small changes over a long period of time within each of the four scenarios. In the real world not only are changes sometimes more rapid, but there may also be breaks in the trajectory of change due to unexpected, but profound occurrences ("sideswipes"). Sometimes this could result in a fundamental change in the 'rules of the game' so that transitions between scenarios could occur. These 'sideswipes' or crises are usually random and unexpected events. If they had been expected, contingencies would have been made. For this reason, they could not be built into the scenarios used in this document, but need to be added as external forces of change.*"[41]

3.4 Explaining the use of the scenarios to stakeholders

Experience of using the socio-economic scenarios so far has shown that it takes time for teams to become familiar and confident with the scenarios, particularly as most teams undertaking UKCIP studies have rarely had strong support from economists or social development specialists, and indeed applying these tools is an innovation. It follows therefore that using the scenarios with non-specialist stakeholders is even more difficult.

Planning timescales present the first obstacle. Planning for climate change requires a new long-term strategic activity not yet routinely undertaken even in the public sector and less still in the private sector. All the initial UKCIP scoping studies have reported this difficulty, indicated here by a comment from the South East England team:

"It was disappointing that many of the stakeholders in key industries for the region, such as the service sector and even tourism, showed little interest in climate futures and were unable to consider impacts or adaptation beyond a very short time span of 2-5 years."[42]

There is also a 'wait and see approach' evident in the business sector. Clearly it will not be possible to reverse corporate attitudes about the relative significance of climate factors compared to economic factors within a stakeholder consultation exercise on one climate change impact assessment. The message to take on board is that effort does need to be put into explaining the dimensions of climate change, in order to elicit engagement in responses on socio-economic scenarios. One way forward may be to suggest 'major sideswipes', i.e. things that businesses may not have planned for, which can challenge incremental thinking (see above).[43] The tool of analogy has also proved to be a useful means of communicating different climatic conditions. There might be some merit in trying to explain socio-economic futures using analogies: for instance, relating to farmers that pesticide use in the 2020s might return to levels used in the 1970s.[44] Extreme weather events, such as the autumn 2000 floods, could be used to explore how vulnerability would vary with different socio-economic scenarios.

When undertaking stakeholder consultation on climate change it is necessary to target the approach, as understanding of the issue varies considerably as does the way its management is handled within companies. The interviews undertaken in East Anglia by CSERGE for the SPRU team revealed that an organisation's time planning horizon was a critical determinant of response and that few stakeholders had both good information and organisational processes for dealing with change.[45] In UKCIP studies, consistently only the water and power sectors have been found to engage in long-term planning. The South East England study team suggest that, overall, stakeholders can be broadly classified into four groups according to the perceived importance of climate versus socio-economic factors affecting their vulnerability (see Table 3.1 below).

Table 3.1: Interview responses: stakeholders' view of vulnerability to socio-economic and climate impacts[46]

Vulnerability to Socio-economic change			
	HIGH	Services Tourism Manufacturing Health	Paper manufacturing NGOs Local Authorities Brewing Agriculture Insurance
	LOW	Energy Oil Pharmaceuticals Biotechnology	Water Ports
		LOW	HIGH
		Vulnerability to climate change impacts	

Nevertheless, with effort, effective explanation of the socio-economic scenarios does offer routes to new types of dialogue with stakeholders on long-term challenges with benefits to both parties.

3.5 Possible modes of engagement

All experience with the scenarios so far suggests that proper visioning of even a single socio-economic future is a resource-intensive exercise. If resources permit, workshops can be used to develop scenarios with stakeholders. Otherwise, having generated a detailed interpretation for the region within the study team, a workshop can be held with a small number of selected participants and a facilitator, to refine the scenarios and explore possible futures. Summaries of succinct data from the climate scenarios can be presented briefly, by statistical representation or by using analogues in telephone interviews. These have proved an effective way of generating response for the regional scoping studies.[47] But by general agreement, it is simply not possible to represent adequately the complexity of the socio-economic scenarios in such situations:

"Interviewers regarded the idea of attempting to carry out a visioning exercise, or an attempt to introduce scenarios over the phone as unworkable."[48]

Stakeholder interviews provide a broad-brush overview of many sectors and organisations rather than an in-depth interview of a limited number of organisations. Without efforts being put into

making the scenarios accessible, stakeholder consultation can become the exclusive dialogue of the cognoscenti.[49] A possible way forward is suggested here, drawing particularly from material from the South East England team:

- Socio-economic scenarios must be considered before consultation begins and incorporated into inception notes describing how the interviews will handle climate change;
- Considerable downscaling and translation into meaningful examples at a regional level is required. The scenarios must be accessible and meaningful, possibly with reference to specific legislation and possible changes in values and governance, with specific examples to which stakeholders can relate, for the wide range of regional and national stakeholders. (This work can be undertaken by scoping study project study teams but there are implications for study costs);
- In presentation, work also needs to be invested in developing a thorough understanding of regional developments over the past twenty years (see also comments on Regional Planning Guidance 3.11);
- For each variable, opinions from 'experts' should be sought rather than purely interpreting secondary sources;
- A strengthened consideration of the influences of new technology may be needed; and
- Particular features of regions need consideration e.g. house prices in South East England.

3.6 Specific issues with the UKCIP SES

Departing from the comfort zone of the linear projection trend presents challenges, and consequently, acceptability of the scenarios varies. According to the South East England team, only the World Markets scenario is instantly recognisable. Work by CSERGE in East Anglia found Global Sustainability to be the most easily recognisable.[50] Questions have been raised about the plausibility of the National Enterprise scenario for the 2020 period, and particularly when applied to the regional level.[51] In South East England for example, *"over 50 % of the land is protected under international and national legislation: the population have a willingness to pay for environmental improvements; water demand restrictions are politically unacceptable and the most expensive coastal flood defence scheme in recent years was constructed in Bournemouth."*[52] Working in more detail, the RegIS team has also found that the National Enterprise scenario does not work out at a regional level in terms of economic development, and felt the need for a strong regional economic development model, where the regions begin to function as semi-autonomous economic units. Their high consumerism/high autonomy scenario is entitled Regional Enterprise.[53] It was felt this would provide policymakers with a wider choice of futures when considered with the 'green' world of Global Sustainability. Similarly, there was a need to re-interpret the Local Stewardship scenario as a Regional Stewardship scenario.[54]

There is an important issue at stake and a balance needs to be struck between challenging and visioning scenarios (descriptive scenarios) and the need for the work to be relevant to policy-makers and decision-takers who might be more comfortable with normative (prescriptive scenarios). The SPRU team have stated that the scenarios framework is to encourage stakeholders to examine and potentially revise their assumptions about the future. However, plausibility is a necessary criterion of a scenario, otherwise it becomes science fiction. The 2020 time-frame is close to that required for strategic spatial planning purposes, an effort which is backed by over 50 years of legislation and currently supported by a complex, sophisticated plan-making and public review system. For this reason, it is recommended that as part of the application exercise, it is also necessary to have regard to what can be considered as a planning, conventional wisdom scenario, related to the Regional Planning Guidance (see Section 3.11). It should also be noted that the scenarios do not rest on an underlying model of economic activity and this might cause problems with regard to internal consistency, although expert judgement was used for refinement. With the state of current

understanding about economic modelling it would be difficult to construct long-term scenarios using them without considerable resource commitment.

3.7 Quantification

So far, the UKCIP SES have been expounded at a national level in terms of qualitative and quantitative variables and for different time-frames. No differentiation is made between 2020 and 2050 in terms of the qualitative 'storylines'.

Substantial effort was put into the development of a set of quantified indicators by the SPRU team.[55] Quantification is focused on the 2020 timeframe with limited indicators for the 2050s. These indicators were designed both to serve as inputs to climate impact models (input indicators) and as illustrations of the qualitative changes projected in each of the scenarios (outcome indicators). A core set of indicators covering key drivers of socio-economic change, and illustrating changes in the main impact domains (for instance, biodiversity, coastal zone management) was developed with the assistance of sector experts and scientists from across government.[56] Further consultations were held on the question of indicator values. The basic approach was to identify from available official UK sources a present-day value for a given indicator. Values for the 2020s for each of the four scenarios were derived by establishing a 'business as usual' value and varying around this taking account of the values-governance conditions prevalent in a given scenario. In a few cases, values for the 2020s were available in official publications, but in many cases a linear projection forward was carried out by the project team. Derived values for each of the scenarios were subjected to peer review by sector specialists wherever possible, and modified where necessary. These indicators are attached in Appendix A.[57]

Some issues have arisen during the preparation of this basic set of indicators at a national scale and with further use and generation of these indicators in studies. There is a tension between the qualitative and quantitative elements of the scenarios. In some cases, the stakeholders see the indicators as obstacles to engagement with the most important qualitative elements of the scenarios. In addition, because many of the indicators are derived from existing present day statistics they are essentially modifications of the 'business as usual' extrapolation. They do not necessarily produce many significant differences between the scenarios. The RegIS team have revisited this issue and as they needed to construct, for example the prices of agricultural products, consulted different experts and made significant changes.

In a way, the quantification of the selected indicators which have been presented, incorporate a distinct element into the UKCIP SES, which is a manipulation of baseline, business as usual information (see Appendix A). Nevertheless, a valuable start has been made at assembling statistics at a national level and of demonstrating how this type of exercise can work. Sectors with long-term planning horizons have indicated that they find long-term models helpful and would be supportive of Government initiatives to have a more standard methodology.[58]

Particular studies have particular needs for data and input assumptions. In a sectoral or regional study, values may need to be assigned to very specific variables that have not been considered in developing the framework scenarios. Possible developments may be highly specific to the sector or region concerned. The RegIS study has needed to derive indicators for a wide range of spatial and non-spatial variables covering urban areas, population, land use, crop prices, crop yields, chemical usage and machinery size (see Chapter 5).

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From the perspective of UKCIP, ideally one set of indicators should be provided and be available for studies. This approach is clearly impracticable, and therefore it is vital that there is transparency and openness in the derivation of indicator values so that when studies are integrated, the possible causes for variation in results can be seen. Sources need to be identified, and consistency checks

need to be reported.[59] Official data sources are preferable as a basis for indicator derivation because of their pedigree, and the consistent and therefore comparable way in which they are reported. However, official statistics are often not available on sector- or organisation-specific factors. Expert and local knowledge are therefore also very important to indicator development.

3.8 Regionalisation

Regionalisation of both the qualitative and quantitative elements has been widely recognised as vital, but requires wide stakeholder consultation as well as in-depth knowledge of the region and sectors under investigation.

As the UKCIP SES stand, they can be used at a regional level but their limitations are evident. In the exercise to operationalise the scenarios in the North West, "*the UKCIP SES proved extremely useful for generating discussion points on broad, 'macro' scale issues. For example, when examining their interaction with climate change impacts on the chemicals sector, the impact of factors such as 'economic development and policy' or 'social and political values' on 'new and expanded market opportunities' was quite clear. Interactions with more specific climate impacts such as 'less risk of freezing' or 'better storage conditions' were difficult to draw out from the scale of information provided in the socio-economic scenarios. This would suggest that the scenarios are useful in terms of developing broad regional strategies and policies as undertaken by organisations such as Regional Development Agencies, but would need to be refined to be of real use to individual economic sector representatives.*"[60]

The absence of a spatial disaggregation of the indices was regarded as a major constraint on their use in the Wales scoping study, and a problem because GDP growth and demographic change have a strong regional dimension.[61]

Where time and resource constraints have prevailed, for example in the South East England scoping study, the team converted the outputs of national socio-economic scenarios into the sub-regional form using a standard conversion factor based upon the historical economic performance of the sub-region compared to the national economy. Quantification also provided further depth to interviews. Selected indicators were introduced into some stakeholder interviews by the South East England team to generate dialogue. For example the rate of urbanisation under different scenarios was a useful indicator of particular relevance:

"Many key climate impacts such as the fragmentation of habitats, problems of meeting peak summer water demand and decline in general environmental quality (air/landscape/amenity) could not be discussed without reference to future greenfield house building. At the sub-regional scale, other indicators are probably best estimated by experts in the stakeholder community themselves. For example, water resources experts were asked about the sensitivity of various demand indicators (annual average, peak annual, peak day, peak week) to both climate factors, socio-economic factors and other factors."[62]

For the RegIS study both the qualitative and quantitative dimensions of the scenarios have been developed at a regional level (see Chapter 5).[63]

So in summary, the existing UKCIP SES can be used in a strategic way at a regional level but need further work.

3.9 Integration of socio-economic and climate scenarios [64]

Ideally, integrated assessment of climate change needs *consistent* descriptions of both climate and socio-economic futures. Consistency is important because climate and society are co-evolving systems, each influencing the other, at least to some extent. Thus, a future world in which social, political and technological changes lead to a reduction in carbon emissions is not consistent with a climate scenario that assumes accelerating growth in greenhouse gas emissions and therefore a high rate of climate change. Conversely, a climate scenario with a low rate of climate change is not likely to be consistent with a socio-economic scenario of a future world which continues its reliance on carbon-based fuels, pays little attention to energy efficiency concerns, and in which there are no agreements to control greenhouse gas emissions.

Consistency between climate and socio-economic futures is therefore clearly desirable, but has not always been achieved in past impact and adaptation assessments. Full consistency has also not been achieved within UKCIP studies to date. The reasons for this, some suggestions about how to minimise inconsistencies, and what is planned for the next set of UKCIP2002 climate scenarios are summarised below.

The UKCIP98 climate scenarios were commissioned at the beginning of 1998. At that time nearly all the GCM experiments had been performed assuming a future growth in greenhouse gas concentrations of 1 per cent per annum. The Hadley Centre, whose model was to be used for the UKCIP98 scenarios, had in fact also completed an experiment assuming a growth rate of only 0.5 per cent annum. These two Hadley experiments therefore assumed two different worlds - a medium-high emissions growth rate similar to the IPCC IS92a scenario and a low emissions growth rate similar to the IPCC IS92d scenario. The UKCIP98 climate scenarios were designed around these two experiments and these two future worlds - **High** and **Medium-high** assuming IS92a and **Medium-Low** and **Low** assuming IS92d.

The UKCIP socio-economic futures study began after the climate scenarios had been published. By then it was clear that the old IPCC IS92 emission scenarios were being superseded by the new emission scenarios being prepared for the Third IPCC Assessment[65]. The SRES scenarios have the potential for much richer descriptions of alternative future worlds, descriptions that could in principle be interpreted at a national level. They are going to be widely publicised and used by the IPCC and other assessment teams over the years to come. Therefore, the UKCIP socio-economic futures were designed around four SRES emissions scenarios, A1, A2, B1 and B2. This timing of events has meant, however, that it has not been possible in the Programme to make a precise match between the climate and socio-economic futures.

This inconsistency will be rectified when the new UKCIP2002 climate scenarios are produced. There are now global and regional climate model experiments being conducted, by the Hadley Centre and others, assuming emissions generated by the various SRES worlds. The results of these new experiments will form the basis of the new climate scenarios, so a direct and consistent link with the UKCIP socio-economic futures can be made.

As an interim measure, however, how should the existing four UKCIP98 climate scenarios be combined with the four socio-economic futures? At first glance there are 16 possible combinations of scenarios for each time-frame (see Table 3.2).

There are two ways to decide which combinations should be evaluated, assuming that all 16 are too many to handle. First is to approach the problem from a sensitivity analysis perspective. The extreme combinations can be chosen, to examine how sensitive the UK is to different assumptions about future climate and future socio-economic change. Thus the four combinations marked ‘S’ in Table 3.2 might be used. This approach would for example examine the impact of a slow rate of climate change in a world of global regulation, environmental awareness and efficient energy use

(Global Sustainability) versus a 'selfish' world of inefficient technologies, little environmental concern and parochial markets (National Enterprise).

An alternative approach to combining scenarios is to judge which combinations *a priori* are sensible. In this approach the underlying global emissions for each future are considered and related to the rate of global warming in each climate scenario. Thus a Global Sustainability world is likely to generate the lowest emissions growth and therefore could be considered with the **Low** climate scenario. For the World Markets future, heavy fossil use is envisaged. In this case, two scenarios might be considered. Possible consistent combinations are marked by 'C' in Table 3.2.

There is clearly no single 'right' answer to the question of combining the UKCIP climate and socio-economic scenarios. As with most scenario analysis, what is important is an explanation of the choices made and a careful interpretation of results.

Table 3.2: An approach towards combining the UKCIP climate and socio-economic scenarios, developed in consultation with the RegIS study.
'S' may be combinations used in sensitivity analysis; 'C' may be combinations used if consistency between scenarios is considered.

	Global Sustainability	**Local Stewardship**	**World Markets**	**National Enterprise**
Low	S C			
Medium-low		C		
Medium-high		C	C	
High	S		C	S C

3.10 Adaptation

The objective of the scenarios is to explore sensitivity and vulnerability to climate change in a variety of socio-economic futures. In order to identify what the impacts of climate change might be, it is not appropriate to take account of response to climate change within the socio-economic scenarios. This follows usual practice:

"In most usage, scenarios are exogenous to the analysis; they describe aspects of the world that must be specified for the analysis, but are assumed rather than calculated within the analysis."[66]

In practice however, some provision is made for action, for example, the level of environmental protection operating varies within the different scenarios; policies which support a resilient network of protected sites for biodiversity will provide a better basis for dealing with climate change. Similarly, coastal protection policy is envisioned as varying between the scenarios. However, the scenarios basically provide a reference point for conclusions to be drawn about relative sensitivity to climate change. There are further dimensions of this tricky issue, as have been identified and are explained here from the RegIS study:

"The approach advocated by the project's sponsors and funders is problematic in that it does not permit interaction between climate change and socio-economic changes. If vulnerable systems such as water resources are seriously affected by climatic factors, including change (inter alia) then this will influence the social and political response to the protection of those systems not just in the 2050s or 2080s, but much sooner. These particular responses will clearly have a major impact upon the subsequent vulnerability of these systems to climate change in 50 to 80 years time. Indeed, coastal protection policy is already strongly driven by the direct effects of climate change, with the height of new sea-wall defences being raised by 4mm per year in direct response. The development of non-climate [socio-economic] *change scenarios demands an approach which attempts to*

embrace complex societal and economic change and use this as indicators of plausible future states. Thus they do not emerge directly from current practises per se, rather they abstract particular forces for change, differentiating and extrapolating them."[67]

However, the merits of this approach are also clear:

"Non-climate change [socio-economic] *scenarios are useful in conducting sensitivity analyses. By definition, non-climate change scenarios provide the extreme case of a society that does not respond to the threat of climate change over the next 50 to 80 years. Hence, when the socio-economic scenario which increases stress upon biodiversity, water, coastlines and agricultural systems, is combined with a high level of climate change, we are likely to have something approaching the 'worst-case' scenario. Using non-climate change socio-economic scenarios also has the benefit that it permits a clearer distinction between the effects of physical climate change, and autonomous socio-economic changes (and hence identifies more clearly the role of response in the 2050s and 2080s). Once feedbacks are included between climate change and socio-economic change, then the relative impact of physical climate change, socio-economic change and socio-economic/political responses becomes more difficult to untangle (especially when relatively few model runs can be performed as in RegIS*)."[68]

Commissioners of studies will need to decide at the outset whether they want recommendations from studies to indicate coherent futures, in which case a more deliberate effort should be made to build in adaptation responses into the scenarios.

3.11 Regional planning developments

In view of the increasing use being made of studies within the UKCIP framework as inputs to policy documents, it is necessary to reflect on recent developments regarding regional planning guidance (RPG) and the regional sustainable development frameworks (RSDFs). The relationship between RPG, RSDFs and the UKCIP SES can be summarised as follows:

- Confusion could occur during stakeholder consultation exercises on the UKCIP SES, if there is no effort to clearly explain how and why they are different from the formal planning processes;
- The RPG documents are intended to set out a framework for the next 15-20 years, thus overlapping the 2020s period of the UKCIP SES for the current RPG reviews;
- The Government makes it clear that stakeholder consultation is vital to the preparation of both RPG and RSDFs documents so that there is wide ownership. There are direct links into local and regional democratic processes with the preparation of both documents. In addition, the RPG undergoes a formal Public Examination of issues on which an independent panel reports to the Secretary of State who then finalises the RPG;
- An authoritative process is attached to preparation of the statistical underpinning of both these frameworks and clearly conflicting and alternative quantification from the UKCIP SES will need to be explained. One advantage is that the new developments have already given momentum to the preparation of regional databases on a range of environmental and economic issues; and
- So far there is only tentative consideration of climate change issues within the RPG and RSDFs.[69] If climate change were to assume greater significance, then there would be a need to give this issue further consideration.

For these reasons, it is recommended that the RPG be used as the basis for a 'conventional wisdom' scenario for the 2020s and through discussions at regional level, insights are provided as to how this might figure at 2050.

3.11.1 RPG and RSDFs

New regional planning arrangements were first outlined in a consultation paper published in January 1998 by DETR which replaced the advice on Regional Planning Guidance (RPG) contained in Planning Policy Guidance (PPG) Note 12 in 1992. They were developed in draft PPG 11 on regional planning issued for consultation in February 1999[70] and published in final form in October 2000.[71] The draft PPG has been the basis for action and provides the framework for the preparation and public examination of draft RPG covering all of England outside of London, with the exception of the West Midlands where work on a revised RPG under new arrangements has recently started. The new approach set out to achieve a number of aims, including to:

- Place greater responsibility on regional planning bodies, working with the Government Offices and regional stakeholders, to resolve planning issues at the regional level through the production of draft RPG. This will promote greater local ownership of regional policies and increased commitment to their implementation through the statutory planning process;
- Strengthen the role and effectiveness of RPG by advising on the need for greater regional focus concentrating on strategic issues;
- Facilitate the adoption of a spatial strategy which extends beyond land use issues; and
- Introduce a requirement for a sustainable development appraisal of the environmental, economic and social impacts of development options to inform and accompany the draft RPG.

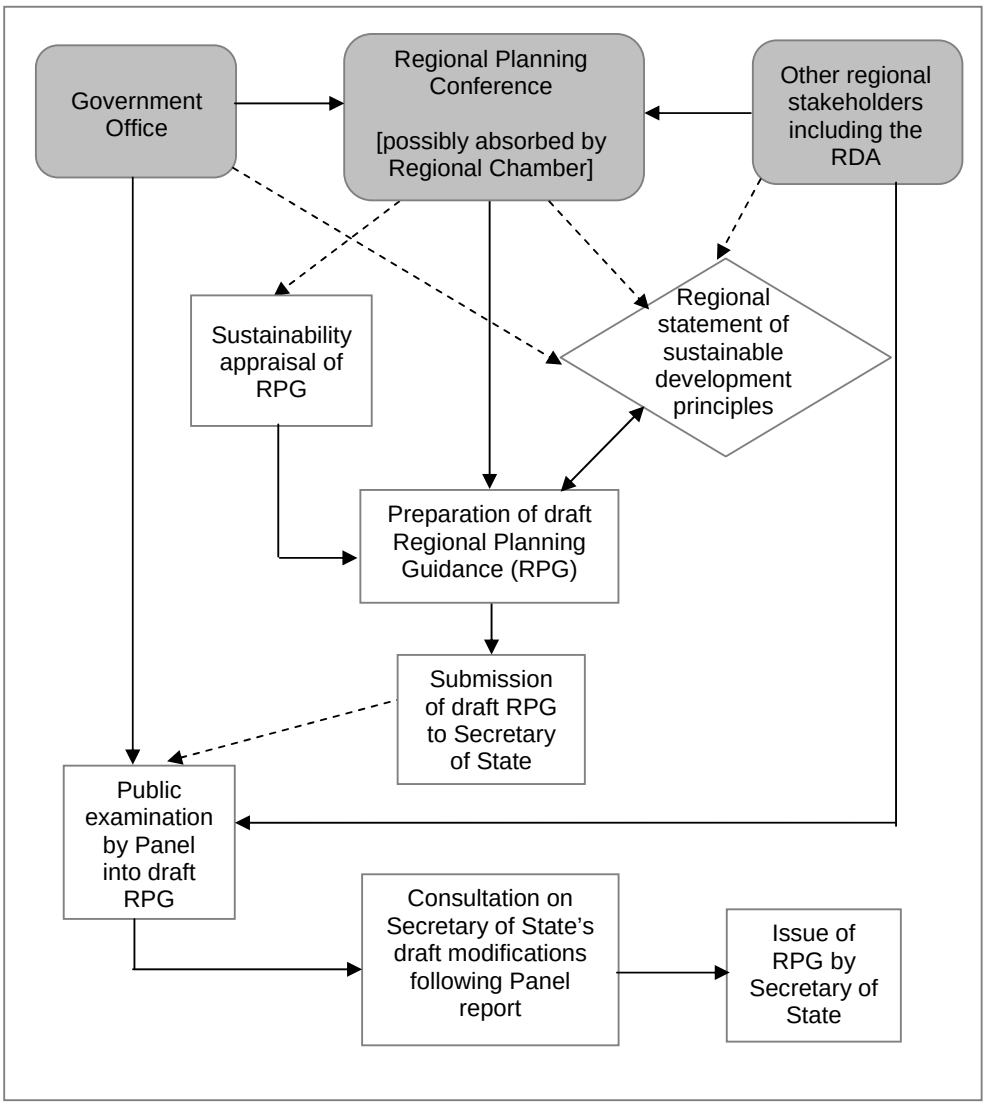
The main purpose of the RPG is to set out a broad development framework for the region over a fifteen to twenty year period and to identify the scale and distribution of provision for new housing and priorities for the environment, transport and infrastructure, economic development, agriculture, minerals and waste treatment and disposal. By virtue of it being a spatial strategy it also informs other strategies and programmes.

In February 2000, a Guidance note was also issued on Preparing Regional Sustainable Development Frameworks (RSDFs). Since then several have been published. The frameworks are intended to be both complementary to, and provide a framework within which, the RPGs and strategies of the Regional Development Agencies can be viewed. This development is also of relevance to the use of the UKCIP SES because the Government is encouraging the frameworks to:

- Define a high-level vision with wide-ranging support, for moving towards sustainable development in the region, considering the key social, economic, environmental and resource issues and the inter-relationships between them; and
- Define sustainable development objectives for the region, and set priorities with the help of regional indicators and targets.

The revised arrangements for producing RPG can be seen in schematic format below:

Figure 3.1: The new arrangements for producing RPG[72]



References *(see Bibliography for full references)*

[33] The Wales Scoping study findings are presented in the report by Farrar *et al*, (2000)
[34] The South East England scoping study findings are presented in the report by Wade *et al*, (1999)
[35] Berkhout *et al*, (October 1999, page 33)
[36] Berkhout *et al*, (October 1999, page 33)
[37] Berkhout *et al*, (October 1999, page 37)
[38] Vaze, (2000), Wade *et al*, (2000), Shackley and Wood, (2000), Shearlock, (2000)
[39] See also discussion on USNA in Section 1
[40] Vaze, (2000)
[41] Berkhout *et al*, (October 1999, page 45)
[42] Wade *et al*,(2000, page 4)
[43] Vaze, (2000)
[44] Vaze, (2000)
[45] Berkhout *et al*, (October 1999, page 42)
[46] Wade *et al*, (2000)
[47] Vaze, (2000)
[48] Vaze, (2000)
[49] Wade *et al*, (2000)
[50] Berkhout *et al*, (October 1999, page 61)
[51] The National Enterprise scenario, *inter alia*, envisages that biodiversity is under pressure with poor policy support, water systems are stressed, water quality is poor and coastal protection is weak, (see Section 2.3)
[52] Wade *et al*, (2000)
[53] Shackley and Wood, (2000)
[54] see Shackley and Wood, (2000)
[55] Berkhout *et al*,(October 1999, page 64)
[56] In defining the indicator set, intensive consultations were held with members of the study Advisory Committee, and with DETR, the Ministry of Agriculture, Fisheries and Food (MAFF), the Environment Agency, English Nature, and other bodies
[57] Additional sources of regional level indicators can be found in DETR (February 2000: Annex 2 pages 20-30)
[58] Vaze, (2000)
[59] Berkhout *et al*, (October 1999, page 46)
[60] Shearlock, (2000)
[61] Vaze, (2000)
[62] Wade *et al*, (2000)
[63] Whilst the SPRU team had developed a Global Sustainability scenario for East Anglia, this did not cover all the ground needed for the RegIS study and that team has developed another Global Sustainability scenario alongside the other scenarios. It is of interest that there are some differences between the RegIS and SPRU East Anglia Global Sustainability scenarios - presumably these have arisen because all four scenarios being used in the RegIS study have been developed by the RegIS team
[64] This section was written by Mike Hulme for UKCIP's first three year report: McKenzie Hedger, *et al*, (eds.) (2000)
[65] Nakićenović and Swart (eds.), (2000)
[66] Parson and Granger Morgan, (2000, page 8)
[67] Shackley and Wood (2000, page 1)
[68] Shackley and Wood (2000, page 2)
[69] Although the RSDFs are expected to provide a regional vehicle for meeting national targets on renewable energy
[70] DETR (11th February 1999)
[71] DETR (17th October 2000)
[72] Derived from Figure 1 *in* DETR, (11th February 1999, page 14)

Appendix C. The consultation process

At an early stage, a survey of the needs and interests of climate impact researchers and government/business stakeholders at the national level was carried out. Twelve interviews were conducted with researchers and stakeholders to help underpin the relevance of futures scenarios and to identify stakeholder views about vulnerability to climate change. An emerging conclusion was that adaptive responses to environmental change that might be taken in the future should not be built into the scenarios, as this would pre-empt subsequent detailed work undertaken under UKCIP. However, vulnerability and the capacity to adapt are key concepts linking socio-economic futures and climate impacts and adaptation. The SPRU team therefore sought to describe those aspects of sensitive sectors and impact domains most relevant to understanding their vulnerability and adaptive capacity.

Once constructed, the scenarios were tested in East Anglia by presenting them to a wide range of stakeholders operating in sectors such as tourism, coastal defence, health, water, energy supply and environmental regulation. In 20 semi-structured interviews, stakeholders were invited to draw out the implications of the scenarios for their organisations in terms of vulnerability and capacity to adapt.

A national workshop was held, to assess the scenario framework, evaluate its relevance to the climate impacts community and develop recommendations for the use of the scenarios in climate impacts assessment. The workshop was attended by 27 people from a variety of organisations, and provided clear guidance concerning the finalisation of the scenarios and the need for practical guidance on applying them in subsequent impacts studies. In the final phase of the project, a draft report was exposed to independent academic review and to comments.

Chapter 4

Operationalising the UKCIP SES in the North West of England

Chris Shearlock [73]

4.0 Operationalising the UKCIP SES in the North West of England

4.1 Introduction

Sustainability North West (SNW) was commissioned by UKCIP to undertake a study to operationalise the emerging UKCIP SES for the North West of England and develop North West regional scenarios for climate change impacts work. Work outlined here [74] has attempted to inter-link four national/global level socio-economic scenarios with the regional level climate impacts revealed in work undertaken by the North West Climate Group (see Appendix D).[75] A main aim of the project has been the identification of threats and opportunities presented through the combination of climate change impacts and future socio-economic trends. Initial attempts have been made to examine and, where possible, quantify the extent of these threats and opportunities upon baseline social, economic and environmental indicators for the region. Use was made of current regional strategy documents such as the North West's Regional Economic Strategy[76], and these are assessed in terms of their ability to address the issues identified. Regional level social, economic and environmental information is notoriously difficult to obtain. It is even more difficult to obtain long-term projections, predictions and forecasts for regional level indicators which would greatly facilitate scenarios work. Moves towards regional devolution and the creation of Regional Development Agencies and Regional Chambers has resulted in much improved data collection and collation at the regional level.

Within each of the UKCIP SES a number of key economic and planning indicators are suggested for the UK. It has been attempted to adapt these to the North West. It must be emphasised that these projections, whilst having been adapted and extrapolated from recognised sources, represent an informed guess and are thus highly speculative. Attempts have been made to quantify changes to key economic and planning indicators that would be likely to occur from the combination of climate change and the four different socio-economic scenarios, which are shown below within the summary of results. Again, these quantifications are highly speculative in nature, but do at least help to illustrate the varying impacts of climate change and socio-economic trends upon the region.

A more detailed set of baseline indicators for the North West is provided in Appendix E. These indicators were chosen on the basis that they are readily available across all UK regions and could thus be easily transferred. In order to exploit the richness of the narratives that have been developed from combining the climate change impacts with the socio-economic scenarios, it would be useful to attempt to quantify changes to these indicators.

Climate change impacts for four landscape domains (Urban Core and Fringe, Coast, Rural Lowlands and Rural Uplands) and three economic sectors (Chemicals, Manufacturing and Tourism) were compared against the socio-economic conditions detailed in the four UKCIP SES (National Enterprise, Local Stewardship, World Markets and Global Sustainability). The three economic sectors were selected due to their particular relevance to the North West's economy, and in conjunction with the landscape domains were felt to offer an adequate basis from which to assess the combined impacts of climate change and socio-economic conditions within the region.

Climate change impacts and socio-economic scenarios were combined using a matrix-based approach similar to that involved in Environmental Impact Assessment and Sustainability Appraisal as shown in the table below:

Identification matrix for climate change impacts and socio-economic scenarios

Manufacturing – Beneficial Effects **World Markets** – Values and Policy						
	Social and political values	Role of the state	Policy style	Welfare and health	Education	Environmental policy
Lower running costs						
Expanded and new markets						

The matrix-based approach was used to highlight potential interactions between the climate change impacts and the socio-economic scenarios. Different interactions were characterised in terms of being:

- synergies (i.e. positive/positive and supporting/virtuous in nature);
- double whammies (i.e. negative/negative and undermining/vicious in nature);
- simultaneously positive and negative;
- mitigating (e.g. where detrimental climate change impacts are partially offset by socio-economic conditions and vice-versa); and
- lost opportunities (e.g. where an opportunity resulting from climate change is reduced due to socio-economic conditions and vice-versa).

This characterisation was then enhanced with simple narratives discussing the scale, nature and probability of the interaction.

In many cases there was no foreseeable or obvious interaction between the climate change impacts and the socio-economic scenarios. In these cases, matrix cells were left blank.

4.2 Summary of results

4.2.1 National Enterprise

In conjunction with climate change impacts, this scenario represents a very poor outcome for the North West. Detrimental effects of climate change are greatly exacerbated by poor protection of the environment and many lost opportunities arise as a result of a lagging regional economy, limited technological innovation, stagnation of traditional industries and inequitable welfare provision. Very few synergies occur under this scenario as potentially positive outcomes are at least partially negated due to these factors.

Example: National Enterprise and Urban Core and Fringe

Dominated by double whammies such as:

- stresses on trees, parks and gardens exacerbated by low environmental priority and social/political values;
- increased air conditioning costs, aggravated by high energy costs;
- structural damage and urban heat island effect compounded by under investment in the built environment and minimal innovation in construction techniques;

and missed opportunities such as:

- poor transport infrastructure reduces the ability of the region to capitalise upon tourism and leisure opportunities;
- inequitable access to health care reduces the positive benefits of increased outdoor activities and healthier lifestyles.

Example: National Enterprise and Chemicals Sector

- Potential synergy of new and expanded markets (due to climate change) and strong economic priority and low environmental protection (envisaged in the socio-economic scenario) is reduced greatly by a lagging regional economy, high energy prices, and limited export opportunities. In the long-term, declining state education and growing income disparities (problems which are already apparent in the North West) could seriously reduce the region's ability to capitalise upon new 'high tech' markets; and
- Detrimental climate change effects such as the increasing costs associated with greater cooling requirements, flooding and storm risk, along with the loss of certain markets (e.g. for anti-freeze agents) could be severely compounded by the socio-economic conditions found in National Enterprise.

Key economic indicators	Late 1990s	2020s (linear)	National Enterprise
GDP	£72.2 bn	£115 bn	£105
GDP/capita	£10,400	£16,900	£15,900
Value added in sectors (% of GDP)			
Services	65%	75 – 80%	58.5%
Industry	34%	20 – 25%	40%
Agriculture	<1%	<0.5%	1.5%

Key planning indicators	Late 1990s	2020s (linear)	National Enterprise
Population	6.9 m	6.8 m	6.6m
Household numbers	2.8 m	3.1 m	2.9 m
Land use (%)			
Agricultural	80%	78%	79%
Forestry	6%	7%	6%
Urban	14%	15%	15%

Under a combination of forecasted climate impacts and socio-economic trends envisaged by the National Enterprise scenario, it is likely that the North West would under-perform in terms of economic growth relative to the linear projection for the 2020s. It is also likely that when coupled with strong growth in the South of the country, growing income disparities and social inequities (problems that the North West is already suffering from), the region will depopulate at a faster rate than predicted due to economic migration. Whilst the National Enterprise scenario would suggest that the region's industrial base would grow relative to its linear forecast (i.e. due to peripheral

regions relying on traditional industries such as manufacturing), the combination of climate change impacts makes this much less certain. It can be seen from the example above that the North West chemicals sector faces a number of missed opportunities and double whammies due to the combination of climate impacts (such as flooding or the loss of certain markets) and unfavourable socio-economic conditions (such as declining education, high energy costs and reduced export opportunities). It would suggest, therefore, that whilst the North West may have a significant industrial base under a National Enterprise type future, this could be uncompetitive and highly vulnerable due to the impacts of climate change.

Whilst it is outside the scope of this study to attempt a realistic quantification of the additional baseline information for the North West it is logical to suggest some indicative trends. Energy consumption and waste creation would be likely to increase; the area of dereliction may remain fairly stable rather than being reduced, whilst the area of land receiving Site of Special Scientific Interest (SSSI) status may be reduced; improvements to inland waterways and bathing waters could possibly be compromised due to growth in industrial output and minimal associated investment in effluent abatement and environmental management; the number of air pollution days may increase due to traffic congestion and minimal investment in public transport. Examining the region's social baseline, it is likely that educational attainment and health figures would worsen considerably due to the increasingly inequitable provision of health care and education opportunities. In combination with these trends and adverse climate impacts, it is likely that unemployment would rise and, combined with economic out-migration, would exacerbate a 'brain drain' effect leading to further social problems such as higher crime levels. In terms of economic baseline indicators, National Enterprise would certainly see a decline in the number of employees within 'high tech' and 'fast growing' sectors due to reduced levels of innovation, the emphasis on traditional industries within the peripheral regions, and the decline in educational attainment levels (i.e. manifesting itself in the form of a shortage of skilled workers in the long-term). In combination with adverse climate impacts and the resultant costs imposed upon companies operating therein, it is likely that the region would become a less attractive place to locate, reducing business formation rates and potentially affecting business survival rates.

4.2.2 Local Stewardship

Under this scenario many detrimental climate impacts are at least partially mitigated. This is largely due to the high level of environmental protection integral to Local Stewardship. A small number of detrimental climate impacts may actually be aggravated under Local Stewardship. However, the degree to which these 'double whammies' would present problems would be reduced due to dominant social and political values. An example of this is that of coastal erosion and loss of land. This would increase under Local Stewardship as a result of limited investment and innovation in coastal defences, but would be accepted due to the widespread support for 'managed retreat'. Many of the economic opportunities resulting from climate change would be lost or reduced under this scenario. This is due to the low priority given to economic growth and international trade, along with the limited degree to which technological innovation is pursued. However, as a counter to this, economic prosperity would be better distributed throughout the regions than under National Enterprise, and the pursuit of domestic self-sufficiency, increased spending on health and education, and protection of the environment would present new market opportunities.

Example: Local Stewardship and Rural Lowlands

- Farming opportunities such as new crops are partially enhanced due to the priority given to reducing pesticides use and attaining local self-sufficiency but are simultaneously reduced due to the use of less intensive, small-scale production methods;
- Recreational opportunities are high due to the quality of the natural environment; however, protection of the natural environment through planning and access controls could in turn reduce these opportunities;

- Detrimental climate change effects, such as stresses on plant and animal communities (with species migration being limited by development), would be greatly reduced due to the high priority given to environmental protection;
- Farm water supply and waste-water treatment problems could be offset by the pursuit of water conservation and efficiency; and
- Animal husbandry problems should be reduced in scale due to support for animal rights and reductions in livestock farming.

Example: Local Stewardship and Tourism and Leisure

- Opportunities for new and expanded markets enhanced through high quality natural environment and the conservation and enhancement of the natural environment. Conversely, low economic growth, planning controls, environmental protection and high transport costs could reduce these tourism and leisure opportunities;
- Detrimental climate change impacts such as variability of weather, flood and storm risk, along with increased running costs, could be compounded by factors such as high transport costs and limited investment in new infrastructure; and
- Loss of amenity value from sea defences would be reduced under this scenario due to the policy of 'managed retreat' and minimal investment in coastal defences.

Key economic Indicators	Late 1990s	2020s (linear)	Local Stewardship
GDP	£72.2 bn	£115 bn	£100 bn
GDP/capita	£10,400	£16,900	£14,500
Value added in sectors (% of GDP)			
Services	65%	75 – 80%	68%
Industry	34%	20 – 25%	30%
Agriculture	<1%	<0.5%	2%

Key planning indicators	Late 1990s	2020s (linear)	Local Stewardship
Population	6.9 m	6.8 m	6.9 m
Household numbers	2.8 m	3.1 m	2.8 m
Land use (%)			
Agricultural	80%	78%	79%
Forestry	6%	7%	7%
Urban	14%	15%	14%

It is extremely difficult to predict the scale of change to the key economic indicators that will occur under the combination of climate change impacts and socio-economic trends depicted in the Local Stewardship scenario. Whilst it is likely that economic growth would be reduced relative to the linear projection, there are a number of factors that would counter this. These include increased spending on health and education, increased domestic self-sufficiency and, perhaps most importantly, an improved distribution of economic growth throughout the regions. Advocates of a Local Stewardship type approach to future development would no doubt state that quality of life gains, to be accrued from a more inclusive society and a better protected environment, would far outweigh reductions in GDP.

In terms of the mix of sectors found within the region, it is likely that Local Stewardship would see a massive increase in the value of the agricultural sector (relative to current trends) due to moves towards local self-sufficiency. It is also likely that the industrial sector would remain fairly static for similar reasons and that service sector expansion would not occur to the same degree as currently projected due to a reduced focus on international trade.

It is likely that environmental baseline indicators such as energy generated from renewables, waste recycling rates, area of dereliction, and both air and water quality would all improve due to the desire to promote eco-efficiency seen under Local Stewardship. Social baseline indicators such as life expectancy and educational attainment levels would also improve dramatically on the current position and projected trends. The impact of Local Stewardship on the region's economic baseline is much less clear. Whilst a better distribution of wealth to the regions could well improve GDP per head, the reduced focus on innovation and economic growth *per se* could see a dramatic reduction in numbers employed in 'high tech' or 'fast growing' sectors. Again, adverse climate impacts such as risk of flooding (which might actually be exacerbated under Local Stewardship) could have a detrimental effect on business formation and survival rates. The focus on improved local self-sufficiency could result in a greater percentage of the workforce who are self employed and the desire to reduce social inequities could lead to an increasing percentage of businesses with a formal human resource development plan.

4.2.3 World Markets

The economic opportunities resulting from climate change are fully grasped. A few climate impacts are partially mitigated (e.g. increased cooling costs are offset by reductions in energy costs). Many of the detrimental climate change impacts are exacerbated. This is particularly the case for adverse impacts on the natural environment. In the long-term, these exacerbated climate impacts could threaten the viability of some of the climate change opportunities. For example, new leisure and tourism opportunities would eventually be constrained by widespread environmental degradation.

The extent to which the North West can capitalise upon the climate opportunities for manufacturing and chemicals sectors is highly dependent upon the degree to which it can be globally competitive and distinct. This is clearly a significant variable and thus difficult to incorporate fully into this study. Global competitiveness of the North West could be adversely affected by many of the negative climate impacts (e.g. working conditions, flood and storm risk, etc.) which are potentially exacerbated under this scenario.

Example: World Markets and Manufacturing Sector

- Expanded and new market opportunities are fully exploited due to high levels of personal consumption, thriving economies and strong international trade;
- High levels of regional autonomy allow the North West to determine its own economic development and thus capture the opportunities that climate change offers;
- High levels of economic growth and technological innovation potentially help to mitigate some of the threats that the manufacturing sector faces, such as poor summer working conditions and increasing energy demands for cooling. Innovation and investment in the built environment and the construction sector has the potential to reduce the scale of flood and storm damage. Despite this, adverse climate impacts could threaten the viability of the sector in an increasingly competitive and open global market place; and
- Higher water prices and costs associated with coastal zone management and defence compound detrimental climate impacts.

Example: World Markets and Rural Uplands

- Loss of niche habitats and erosion associated with climate change are increased due to low priority attached to conservation of the natural environment;
- Low water levels and water deficit problems are potentially compounded due to the need to meet growing water demands through new reservoirs and abstraction;

- Recreational pressures increase in accessible areas due to increasing personal recreation demands and people being less 'tied' to location (representing both a threat and an opportunity to the region); and
- New opportunities for farmers and landowners are enhanced through innovative farming techniques, increased recreational demands and limited planning constraints.

Key economic indicators	Late 1990s	2020s (linear)	World Markets
GDP	£72.2 bn	£115 bn	£140 bn
GDP/capita	£10,400	£16,900	£21,000
Value added in sectors (% of GDP)			
Services	65%	75 – 80%	75%
Industry	34%	20 – 25%	25%
Agriculture	<1%	<0.5%	<0.5%

Key planning indicators	Late 1990s	2020s (linear)	World Markets
Population	6.9 m	6.8 m	6.7 m
Household numbers	2.8 m	3.1 m	3.4 m
Land use (%)			
Agricultural	80%	78%	77%
Forestry	6%	7%	7%
Urban	14%	15%	16%

Due to strong economic growth, high levels of international trade and innovation in combination with the beneficial impacts associated with climate change such as new market or leisure and tourism opportunities, it is possible that the region's GDP could greatly exceed its linear projection. However, there are a number of factors that suggest this may be overly optimistic. Firstly, the South East will continue to be a national power house for economic growth resulting in continued out migration from the regions (although not at the level seen under National Enterprise). Secondly, some adverse climate impacts may be greatly exacerbated in the longer term, reducing regional competitiveness. The degree to which the North West can be internationally competitive (a pre-condition to gaining a share of this global wealth) is also a significant variable – it is quite apparent when looking at its baseline indicators relative to regions such as the South East that the North West is not globally competitive at present.

In examining the impact of the World Markets on the region's environmental and social baseline it is likely that this scenario would result in a mixed picture of both positive and negative changes. For example, energy consumption and waste production would be likely to increase; however, it is possible that air quality could be improved and greater protection afforded to areas of recreation value due to their immediate impact upon an increasingly demanding and mobile population. Disparities in health and education may increase; however, an 'average' figure for the region may remain similar, or actually improve due to high innovation levels and considerable improvements for those who can afford these services. It is unlikely that social and environmental problems would manifest themselves to the same degree as seen under National Enterprise due to the opportunities that high economic growth would offer and the way in which the World Markets scenario would seize the opportunities that climate change offers.

The region's economic baseline would most probably be greatly improved under World Markets. High levels of innovation, and strong international trade combined with the opportunities that climate change offers suggest that there would be substantial increases in the number of employees in 'high tech' and 'fast growing sectors'. Whilst it is likely that there would also be associated

increases in business formation and survival rates, it is possible that these could be compromised by some of the adverse climate change impacts that may actually be exacerbated under a World Markets type approach.

4.2.4 Global Sustainability

Opportunities arising from climate change are not actually negated as under Local Stewardship, but similarly are not exploited to the same extent as under World Markets. Many detrimental climate impacts are mitigated due to the relatively high level of environmental protection. The 'attractiveness' of the North West (i.e. the degree to which it is 'a nice place to live') is an extremely important factor in determining its competitiveness on a global stage. As many of the negative climate impacts have been mitigated and a number of synergies occur, the North West could benefit considerably from climate change under a Global Sustainability scenario.

Example: Global Sustainability and Manufacturing Sector

- New and expanded market opportunities are supported by stable economic growth and investment in research and technology;
- New construction techniques may help to overcome increased summer cooling costs and adverse working conditions and offer a 'win-win' situation in conjunction with lower winter heating bills;
- Availability of health care for all and moves towards new and preventative health care could offer strong synergy with new and expanded market opportunities;
- Strong environmental priority creates both threats (e.g. energy taxes compounding increased cooling costs) and opportunities (e.g. new markets for environmental protection);
- Transport policy creates a mixed picture offering high quality infrastructure but at a high cost. This would simultaneously support and reduce new and expanded market opportunities; and
- Balanced approach to coastal zone management may offset flood risk.

Example: Global Sustainability and Coasts

- Opportunities for coastal regeneration and tourism are not pursued to the same degree as under World Markets, but are not entirely negated. High levels of environmental protection may slightly reduce these opportunities in the short-term, but preserve the 'foundations' of much coastal tourism in the long-term;
- Coastal regeneration is assisted by new and innovative construction techniques and high levels of coastal protection in areas of economic value;
- Regeneration opportunities are perhaps slightly restricted by tight planning controls and 'managed retreat' in certain areas;
- Increased flood risk, loss of land and expenditure on defences are offset to a degree by society's willingness to accept 'managed retreat'; and
- Habitat loss is offset by protection of the natural environment and the utilisation of 'managed retreat' where it offers the development of biologically diverse habitats.

Global Sustainability sees regional economic growth exceeding its linear projection, but not to the same degree as under World Markets. A focus on more eco-efficient businesses and the massive growth in innovation, information and communications technologies (ICT), along with global trade sees a slow decline in the region's industrial base and a corresponding slight growth in its service sector base. The regions agricultural base expands slightly on its position in the late 1990s due to increased demand for high quality, local produce. Under this scenario the region reverses its population decline due to reduced economic migration, the possibilities of tele-working and the increased desirability of the regions. The region also manages to accommodate this growth within a smaller number of new households than expected from the linear projection, due to a strengthening of community values. Due to the desire to nurture the natural environment, the region's urban area

increases only slightly and its forested area increases dramatically. Land needed for agriculture is reduced, due to high levels of innovation.

Key economic indicators	Late 1990s	2020s (linear)	Global Sustainability
GDP	£72.2 bn	£115 bn	£125 bn
GDP/capita	£10,400	£16,900	£17,800
Value added in sectors (% of GDP)			
Services	65%	75 – 80%	70%
Industry	34%	20 – 25%	29%
Agriculture	<1%	<0.5%	1%

Key planning indicators	Late 1990s	2020s (linear)	Global Sustainability
Population	6.9 m	6.8 m	7 m
Household numbers	2.8 m	3.1 m	3 m
Land use (%)			
Agricultural	80%	78%	77%
Forestry	6%	7%	8%
Urban	14%	15%	15%

Environmental and social baseline indicators all show improvements, though perhaps not to the same degree as under Local Stewardship. Economic baseline indicators are also improved, though probably not to the same degree as under World Markets. Whilst the immediate economic gains of Global Sustainability may not be as great as are possible under World Markets, they may be considerably less fragile due to the mitigation of many of the adverse climate impacts and the reduced emphasis on being a global specialist.

When linked with climate change impacts, it can be seen that none of the four UKCIP SES are entirely 'win-win' in nature. Scenarios that capitalise fully on the opportunities that climate change offers (e.g. World Markets) also seem to compound many of the problems. Under these scenarios, the detrimental climate impacts on the natural environment are particularly accentuated. These could create serious problems for the North West in the long-term, reducing its ability to compete with other regions.

Conversely, the Local Stewardship scenario which mitigates many of the negative climate impacts through its high level of environmental protection, fails to grasp the economic opportunities offered through climate change. The National Enterprise scenario is highly problematic to the North West when combined with climate change impacts. It neither mitigates detrimental climate change impacts nor capitalises upon opportunities. This is due to a combination of economic stagnation, limited environmental protection, low levels of innovation and technological development and the centralisation of power and wealth in the South East of the country. A peripheral region reliant upon traditional industries such as the North West could thus be compromised far more than others under this scenario.

This analysis of regional climate impacts against national socio-economic scenarios raises the question 'What sort of future does the North West need to attempt to plan for and create in order to maximise the opportunities and minimise the threats posed by climate change?'

To a greater or lesser degree the four UKCIP SES see the economic benefits of climate change being traded at the expense of environmental protection and vice-versa. This trade-off approach is at odds with the UK Sustainable Development Strategy which advocates a 'win-win-win' approach through meeting social, economic and environmental goals simultaneously.[77] In light of the combined effects of climate change and socio-economic futures, factors that the North West will

need to pursue include:

- high levels of innovation;
- regional autonomy;
- quick responses to changing global markets and circumstances;
- high levels of skills and education;
- protection of the natural environment;
- cheap and clean energy supplies (i.e. renewables) in conjunction with improved energy efficiency;
- inexpensive and sustainable transport; and
- balanced coastal zone management combining protection of assets with acceptance of 'managed retreat'.

A combination of the best aspects of the World Markets and Global Sustainability scenarios would enable the North West to progress in this manner.

4.3 Conclusions

This study provides a number of strong messages for policy makers in the North West of England. The impact of climate change within the region will vary greatly depending on a wide range of socio-economic factors. If the region is able to 'shape' itself towards a socio-economic scenario akin to the best elements of World Markets and Global Sustainability then it may be able to simultaneously exploit the opportunities and mitigate the threats posed by climate change.

Dissemination of these findings to organisations such as the North West Development Agency or the North West Regional Assembly is essential if they are to be incorporated into their policies and strategies. SNW is in an excellent position to begin this process having considerable direct involvement with both of these organisations.

Investigations into the relationship between more specific climate impacts and the UKCIP SES will be necessary to generate the greater level of detail required to understand the threats and opportunities presented to individual sectors. The UKCIP SES have been very useful in terms of developing an analysis of broader threats and opportunities such as 'new and expanded market opportunities' but were inconclusive in terms of their relationship with more particular climate impacts such as 'better storage conditions'. Sector based workshops and studies would therefore be a useful addition to regional level findings of this research. Inter-regional comparisons would also be extremely useful in helping the North West to understand how climate change will affect it in an increasingly competitive global market.

References *(see Bibliography for full references)*

[73] Sustainability North West, Giant's basin, Potato Wharf, Castlefield, Manchester, M3 4LA
[74] Extracted from a longer paper (Shearlock, 2000) available from UKCIP or SNW
[75] Sustainability North West, (1998)
[76] Northwest Development Agency, (1999)
[77] DETR, (1999)

Appendix D. Summary of the likely impacts of climate change in the North West (by landscape domain and economic sector)

	BENEFICIAL	DETRIMENTAL
URBAN CORE AND FRINGE	• More outdoor activities (community life, 'café society', etc.) • Healthier lifestyles • More active population, (walking, cycling, etc.) • Economic benefits for the leisure industry • Greater potential for community forests (temperature, growing season, carbon dioxide concentration, policy measures to off-set emissions) • Lower winter heating bills	• Water shortages for garden irrigation • Stresses on parks and gardens in their traditional form • stresses on street trees • Heat island effect: unpleasantly hot micro-climatic conditions in homes, workplaces, retail and recreational areas • Health risks through sunburn; greater air pollution from sunlight, temperature and inversion effects (e.g. PM10s, SO2, O3) • Structural damage from storms to buildings and other infrastructure • Additional stress for remnant semi-natural habitats • Flood risk from streams, rivers and sewers • Increased uptake of air conditioning, increasing energy costs • Rise of water tables upwards in industrial areas accelerated
COAST	• Opportunities for coastal zone regeneration (including nature conservation and enhancement of natural processes) • Higher incomes from tourism • Expansion of more temperature and moisture dependent species (e.g. blanket bogs, beech trees, reptiles and insects) •	• Higher sea water flood risk; • Intermittent or permanent loss of land; • Expenditure on coastal defences (with attendant loss of amenity value and biodiversity) • More unpredictable coastal dynamics (e.g. beach erosion) • Habitat loss (particularly salt marshes and mudflats) • Loss of distinct temperate maritime coastal ecosystems • Change in dilution and dispersal of effluents discharged to sea (industrial, sewage, power station, etc)
RURAL UPLANDS	• Migration of new species • Enhanced vegetation growth due to higher temperatures and longer growing season • New opportunities for farmers and landowners (e.g. extended stocking of land, higher productivity of grasslands) • Greater recreational opportunities and associated economic benefits (e.g. outdoor pursuits)	• Loss of niche habitats and species • Erosion (localised and widespread), especially of peat soils • More grazing opportunities on young shoots with detrimental effects upon vegetation • Potential for decreased vigour of vegetation due to water deficit • Increased fire risk in dry springs/summers • Increased risk of windthrow of forests • Potential for shifting and more intensive patterns of agricultural cultivation with adverse ecological impacts • Recreational pressures • Impacts of new water supply / transfer options • Low water flows / levels reducing water quality with impacts on biodiversity • Increased 'flashiness' of streams and rivers, increasing flood risk and affecting biodiversity

RURAL LOWLAND	• Farming opportunities (e.g. new crops, more productive grasslands) • Recreational opportunities • Migration of new species • More rapid vegetation growth and longer growing season	• Water supply problems, especially for currently irrigated farming • Vegetation change: competitive species will outgrow species with a greater conservation value • Stresses on particular plant and animal communities (e.g. ponds, meres and trees on light and clay soils) • Species migration limited by extent of development • Stream, river and sewer outlet flood risk • More cracking of land and higher soil moisture contents over winter, increasing risk of pollution runoff • Farm waste water systems not designed to cope with increased rainfall, especially given possibly reduced period for land disposal • Animal husbandry (heat stresses on animals) • Water logged soils more susceptible to damage from cattle and farm equipment, limiting time available for working / grazing
CHEMICALS	• Better storage conditions • Less freezing • Expanded and new markets (e.g. for soaps) • Plant re-design opportunities	• More cooling (increased capital/running costs) • Water management (abstraction; quality of incoming water due to low flows/turbulence; treatment of waste water, with high winter rainfall threatening to exceed capacity of treatment facilities and, in summer, low flows reducing permissible discharges) • Flooding and storm risk • Loss of markets (e.g. for anti-freeze agents) • Increased volatility of certain chemicals at higher temperatures
MANUFACTURING	• Lower running costs (less energy for winter heating) • Expanded and new markets (e.g. renewable energy and off shore support infrastructure; drinks and foods typically preferred in hotter weather)	• Working conditions • Potential increase in energy demand for cooling • Flood and storm risk
TOURISM/LEISURE	• Expanded markets • New markets • Benefits to other sectors through indirect ‘multiplier’	• Variability of weather • Flood and storm risk • Running costs of tourist facilities (e.g. insurance) • Loss of amenity value from sea defences

Appendix E. Baseline indicators for the North West

ENVIRONMENTAL BASELINE	
Energy	Energy consumption million tonnes of oil equivalent, 19.2m (1997) Electricity generated from renewable sources, 145,324.4 MWh (1998)
Waste	Landfilled 10,548,000 Lagoon / Borehole 7,582,000 Incinerated 78,000 Recycled 847,000 Treated 2,027,000 (Tonnes, 1997 – 98)
Land	Derelict Land 9,900 hectares SSSIs, 426 (137,830 hectares) SACs, 69 SPAs, 19 Ramsar, 3 (1999)
Water quality	Waterways classed as good or fair, 87% (1998) Bathing waters classed meeting minimum EC standards, 26 out of 37 (1999)
Air Quality	Number of air pollution days, 28 (Greater Manchester, 1999)
Built environment	Number of listed buildings at risk, 133 out of 1962 (1999) Level of unfit housing stock, 9.7% (1999)

SOCIAL BASELINE	
Health	Life expectancy, male 72.5 years, female 78 years Prevalence of coronary heart disease per 1,000 patients, male 41.3, female 25.6 (1996)
Educational attainment levels	Percentage of working age population with no qualifications, 20.3% (1999) Percentage of 21 year olds achieving 2 A levels or equivalents, 50% (1998)
Crime	Total notifiable offences, 724,278 Violent crimes, 73,761 Burglary, 142,274 Percentage of women afraid to walk alone at night, 22% (1998)
Employment	ILO unemployment, 6.9% (1999) Economic activity among working age population, 77% (1999)
Other	Number of local authorities within most deprived 50 in England (National index of deprivation), 11 (1998)

ECONOMIC BASELINE	
GDP per capita	90.7 % of UK average, 90% of EU average (1996)
Business formation rate (number per 10,000 population)	34 (1997)
Business survival rate (% surviving three years or more)	56.5% (1994)
Number and percentage of employees in high tech sectors	68,700, 2.6% (1997)
Percentage of employment in fast growing sectors	35.3% (1997)
Percentage of employment in declining sectors	29.2% (1997)
Percentage of workforce who are self employed	10.8% (1999)
Percentage of businesses with a formal human resource development plan	55% (1997)

Chapter 5

Socio-economic scenarios for use in regional climate change impact and response studies (RegIS) in East Anglia and the North West of England

Simon Shackley [78] *and Robert Wood* [79]
(with contributions from Mark Rounsevell, Robert Nicholls and other members of the RegIS team)

In view of the significance of the RegIS study to the development of UKCIP methodologies, a paper was commissioned to enable the results of the study to inform other work.

5.0 Socio-economic scenarios for use in regional climate change impact and response studies (RegIS) in East Anglia and the North West of England

5.1 Context

The RegIS study team is adopting a more quantified approach to the application of the socio-economic scenarios than the regional scoping studies, owing to the requirements of its integrated model. The UKCIP SES are critical for climate impact assessment because socio-economic changes may dominate climate change impacts. Therefore, both factors need to be considered when determining impacts and assessing different aspects of change.

A specific methodology is being developed within RegIS to combine climate and socio-economic scenarios, taking into account the numerous difficulties concerning consistency when making connections between these scenarios. A specific regional scenario which is relevant to the characteristics of the study region has also been developed. This is based on the 'high growth' scenario, which is characterised by considerable endogenous growth and which is independent of developments elsewhere in the UK. This scenario is needed as the regional scenarios in the UKCIP SES framework are either an environmentally conscious international one, or a stagnant region, neither of which is appropriate for the study.

Given the quantitative nature of the RegIS model, numerous indicators require quantification. For some variables this is a complex process given, for example, changes in technology and inflation. There is no mechanism, for instance, for finding the relationship between yield and price for 2050s. Expert judgement is required to assist in these decisions, and the range of opinion inevitably differs widely.

Conclusions on regional interpretations of the scenarios are presented:

- The UKCIP SES framework works and does lend itself to the generation of relevant storylines at the regional level;
- The framework exposes the right kind of differences that might exist in the future;
- The regional scenarios will need to be reviewed by stakeholders at a later stage; and
- It is possible to make consistent connections between climate change and socio-economic scenarios.

Comments:

- When linking socio-economic and climate change scenarios it will be necessary to consider the point at which mitigation actions will start to take effect. Awareness of the different time-frames of operation is needed; and
- Stakeholders recognise the need to place the RegIS scenario in a global context, as agricultural prices, for instance, would be determined largely by the international market. Others were struck by the complexity of the approach and questioned the confidence that could be placed in the results given that they would be based on only a few model runs. It was clear that much would rest on the interpretation and analysis of model results. Analysis might reveal that a simpler model would be preferable.

5.2 The need for socio-economic scenarios in RegIS

5.2.1 Direct and indirect use of socio-economic information in modelling

There are two principal ways in which socio-economic information is being used within RegIS: first as a direct numerical input into the models which are being applied and integrated by RegIS, and second as a qualitative and quantitative context within which to *interpret* the numerical outputs of the integrated modelling.

The IMPEL land use model is a decision-making model on land use which requires data on crop productivity, crop prices and the cost of inputs. In addition, as a spatially-based model, IMPEL requires data on land available for agriculture. The availability of land will also depend upon socio-economic scenarios, since more or less land may be taken out of production for biodiversity enhancement, urban development or forestry. The coastal zone assessment requires socio-political scenarios of coastal development and coastal management goals and objectives. The hydrological model requires scenarios on the water supply-demand balance taking account of all factors apart from climate change.

5.2.2 Use of socio-economic information for interpretation of model outputs

The biodiversity model, SPECIES, does not require socio-economic information directly. However, socio-economic scenarios are used to interpret the model results which show the distribution of species in response to climate change. Patterns of urban and coastal development will influence the availability of land for biodiversity protection. Therefore, the biological *potential* for change in species distributions illuminated by the SPECIES model has to be related to the availability of land under different socio-economic scenarios for that potential to be realised.

5.2.3 Incremental versus aggregate approaches/the role of adaptation

A methodology for climate change impact assessment has been developed for the coastal zone.[80] This proceeds through the determination of the:

1) effects of a given climate change scenario on the current coastline;

2) effects of the climate change scenario together with changed coastal population densities;

3) effects of climate change with coastal population densities and limited (spontaneous) policy response; and

4) effects of climate change plus coastal population densities with more extensive (planned) policy response.

This incremental process by which socio-economic change variables are added one by one, and by which the effects of different policy response options are then assessed in turn, is a useful way in which to conduct climate change impact assessment. This is because it allows the effects of each step change to be evaluated independently. Furthermore, this method lends itself to sensitivity analysis, through testing a range of values for each additional variable.

This incremental approach is not possible in RegIS since: a) the geographically-based integrated models absorb a large amount of computer processing time, limiting the number of runs which can be conducted; and b) the potential number of combinations of variables is too large, reflecting the multi-sectoral character of RegIS. This means that integrated socio-economic scenarios, containing a collection of reasonably consistent socio-economic assumptions and variables for all the four sectors, have to be employed instead. Current estimates are that RegIS will be limited to about ten model runs due to the sheer complexity and detail of the integrated modelling.

5.3 Developing the socio-economic scenarios

Having established the need for socio-economic scenarios, there is a need to establish both how many scenarios need to be run, and how to create the scenarios. An infinite number of future possibilities exist and no one is necessarily more likely than another: how then to choose from infinity? This particular question has been answered for RegIS by the provision of the UKCIP SES. The research team felt that an adapted version of the UKCIP SES (shown in Figure 2.1) was sufficiently robust to be used within RegIS. The reasons for this are as follows:

1) a small number of SES were required within RegIS given that the integrated model would only be run ten times;

2) whilst the conceptual framework of the SES has its problems – in particular that the two axes are not mutually exclusive – any two axes framework for scenario construction is problematic and a compromise; and

3) by using the UKCIP SES, consistency between different studies will be maximised. Since the framework is also broadly consistent with that of the IPCC, its use in RegIS should also provide comparability with international studies.

It is worth noting that an alternative approach could have been used, namely the derivation of scenarios from the stakeholder consultation groups which were held as an integral part of RegIS.[81] Indeed, the authors did manage to derive a set of four scenarios for each sector based on stakeholder workshops.

5.3.1 Selecting climate and socio-economic scenarios

Turning to the number of scenarios which might be employed, there are twenty combinations of SES (including baseline conditions) and climate scenarios over three time periods and two regions, meaning 120 runs, as expressed in Table 5.1 below. It is necessary to run each climate scenario with the current socio-economic baseline conditions in order to distinguish the effects of climate change from the influence of socio-economic changes (to be rigorous, each socio-economic scenario would be run against baseline climatology[82]).

Table 5.1: Matrix of Possible Scenarios: for 2020, 2050s and 2080s

Climate Change Scenario	**UKCIP Low**	**UKCIP Medium Low**	**UKCIP Medium-High**	**UKCIP High**
Socio-economic Scenario				
Current Socio-Economic Baseline	**X**			**X**
Regional (National) Enterprise				**X**
Regional (Local) Stewardship				
Global (World) Markets				
Global Sustainability	**X**			

How might scenarios for just ten runs be selected from the 120 possibilities? Major questions arise as to the degree of credible differentiation that can be made between the different scenarios, i.e. is robust information available (in the sense of working through an intellectually defensible process and coming up with a value), or must educated guesses be made which may be difficult to sustain against vigorous debate? How different are the UKCIP SES (e.g. Regional Stewardship and Global Sustainability scenarios do not appear to be as different with respect to the systems being modelled within RegIS as the Global Markets and Regional Enterprise scenarios)? How much more information is really obtained by looking at the three time periods? Can judgement be used to

extrapolate findings from 2050s to 2080s? Is the 2020s too early to really see any significant climate change effects? How much more information is really obtained by using all four UKCIP climate scenarios?

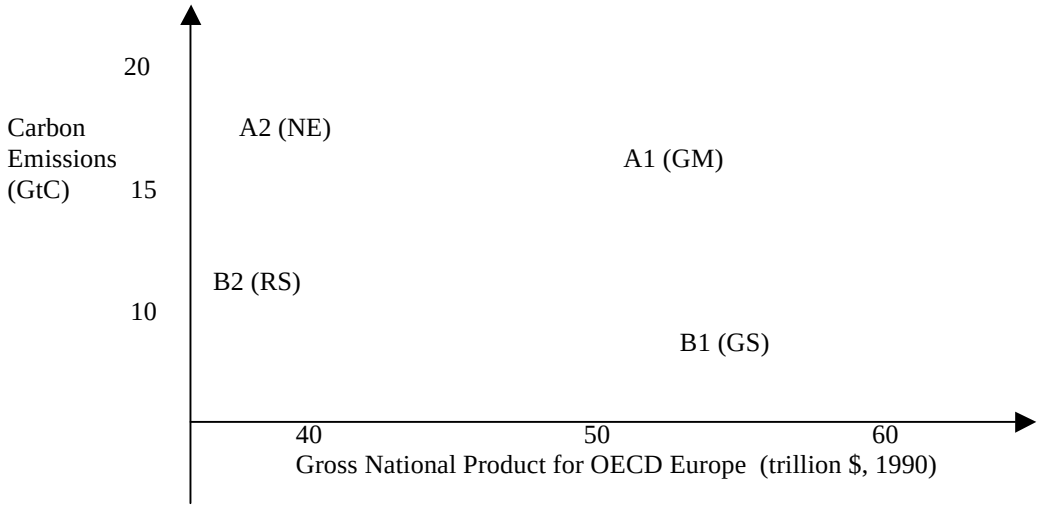
Within the project team and amongst the project sponsors and advisors, it was generally felt that the climate scenarios were obtained through a more robust method than the socio-economic scenarios. The climate scenarios are derived from a GCM which is constrained by physical principles and has been developed by hundreds of scientists over the past twenty years. By contrast, no socio-economic model or equivalent methodology exists by which to generate socio-economic scenarios, and there is little past experience to build upon.

The process of selection was made somewhat easier by linking the UKCIP climate and SES scenarios. This is based on the rationale that a strong market-driven socio-economic scenario implies higher emissions of carbon, whilst a community-based socio-economic scenario implies lower emissions of carbon. The following combinations of scenarios were subsequently proposed:

- Regional (National) Enterprise (IPCC A2): UKCIP High;
- Global Markets (IPCC A1): UKCIP Medium-High;
- Regional (Local) Stewardship (IPCC B2): UKCIP Medium-Low; and
- Global Sustainability (IPCC B1): UKCIP Low.

The rationale for these particular combinations can be explained by the origin of the socio-economic scenarios from the IPCC socio-economic 'SRES' scenarios known as A1, A2, B1 and B2. The latter scenarios have been tested in economic models and their carbon emissions calculated. A2 has the highest global emissions of carbon, followed by A1, B2 and B1 (see Figure 5.1 below).

Figure 5.1: The Global Carbon Emissions for the Four SRES IPCC Scenarios Compared to their GNP for OECD Europe



Whilst intuitively an appealing approach, a few problems with such linking of climate change and socio-economic scenarios must be highlighted. Firstly, as shown in Table 5.2, the UKCIP SES are not quite the same as the A1, A2, B1 and B2 scenarios (the latter generally being more complex and not being reducible to two axes). The B2 scenario, for instance, implies high community and reasonably high economic growth, which seems different from the Global Sustainability scenario. Secondly, the actual difference in global carbon emissions between B1 and B2, and between A1 and A2 (the basis for linking the UKCIP SES to the UKCIP climate scenarios) is not that great (see

figure 5.1). Thirdly, the carbon emissions described by the IPCC scenario-writing team were calculated using four different economic models, hence there might be consistency problems in comparing those emission levels.

Table 5.2: How consistent are the socio-economic and climate change scenarios?

Socio-Economic Scenario	**Climate Change Scenarios (UKCIP)**			
	High	Medium-High	Medium-Low	Low
Global Markets	More consistent		Less consistent	
Regional Enterprise	More consistent - assuming all regions respond in the same way		Less consistent – unless most other regions respond differently	
Global Sustainability	Less consistent - unless fossil fuel energy use is not a key issue for sustainable development		More consistent	
Regional Stewardship	Less consistent - unless most other regions respond differently		More consistent - assuming all regions respond in the same way; and that fossil fuel use is a key issue for sustainable development	

NB:

1) Whether the UKCIP climate scenarios are low or high depends upon global *emissions of carbon, whilst the SES operate at a range of scales from the local to the global. It is still quite feasible, however, that the UK or a region of the UK might be pursuing a different strategy to the 'global norm'. As a first attempt at using socio-economic scenarios, however, the global consistency of UKCIP SES strategy is accepted in the RegIS project.*

2) A perhaps more serious problem encountered by linking-up the socio-economic scenarios with the climate change scenarios is that the former are 'non-climate change' scenarios. Yet, the basis for linking-up, say, Global Sustainability with UKCIP climate change low or medium-low is that Global Sustainability is a world where carbon emissions are low. If the socio-economic scenario world is one without human-induced climate change, then the policy drive for carbon emission reductions would cease to exist. In this case, why should carbon emissions be low? Other policies (health, resource conservation, etc.) might exist for limitation of fossil fuel consumption in such a world, however. Despite these problems, and given the very few model runs available, as a first attempt, it has been decided to link up the socio-economic and climate change scenarios.

The final choice of the first four scenario runs is indicated by the crosses in Table 5.1 (with subsequent selections being informed by those results). The rationale here is that combining a high climate change scenario with the socio-economic scenario Regional Enterprise, is likely to bring along with it the highest socio-economic pressure upon water, agriculture, coastal zone and biodiversity i.e. the socio-economic changes which are expected to increase the *vulnerability* to climate changes are combined with the highest amount of climate change in a 'bad case' analysis. It is an 'adverse case analysis', but not quite a true 'worst case' analysis as no account is being taken of the higher climate change scenarios derived from climate models other than the Hadley Centre's GCM, or of possible surprises.

5.3.2 Derivation of the Regional Enterprise scenario

The framework provided to us by the UKCIP SES included a National Enterprise scenario in which global carbon emissions are high. However, as illustrated in Figure 5.1, the economic growth of the equivalent A2 scenario is significantly lower than that in the Global Sustainability/B1 scenario. The reason for this is that within the IPCC SRES scenarios, economic growth under B1 is uncoupled

from carbon emissions. National Enterprise/A2 represents a somewhat stagnating and insular world, where investment is low and inefficiency remains high due to the inward nature of societies, and the lack of sharing of investment capital and best practice technologies. Here, carbon emissions are high because of inefficiency, not because of high growth.

It was felt that there was a need to use a different interpretation of the top left hand quadrant of the two-axes graph shown in Figure 2.1, i.e. the high consumerism combined with high autonomy, which has been termed Regional Enterprise. In Regional Enterprise, the UK regions really begin to function as semi-autonomous economic units. There is a successful coalescence of economic, social and political interests and patterns of interaction at the regional scale, which reduces the dependency of the regions upon the traditional centres of power and decision-making (both public and private sector) in London and the South East. The highly successful northern and central Italian regions can be seen as a good model here, such as Emilia Romagna.[83] Economic development in those places does appear to have been a function of a strong regionalism, which has cultivated flexible and competitive economic partnerships and supply-chains, especially between smaller companies. This vision of the region is certainly one which is widely shared amongst policy makers at the regional scale, as indicated in regional economic strategies[84] and would imply high economic growth along with high carbon emissions. This justifies the use of the UKCIP High climate change scenario (though for a very different reason than the National Enterprise scenario).

As a regional study, it seemed important to provide policy makers with more of a choice of socio-economic futures than just the stagnating world of National Enterprise or the 'green' world of Global Sustainability. In particular, there was a desire to examine the consequences for water, biodiversity, the coastal zone and agriculture, of the implementation of many policy makers' own desired futures, well encapsulated by the notion of 'Regional Enterprise'. Regional Enterprise can be thought of as an alternative scenario within the same conceptual space occupied by the National Enterprise scenario.

The question is raised of whether the socio-economic pressures upon climate-change vulnerable systems will be higher due to a stagnating, insular and inefficient world like National Enterprise, or higher due to strong economic growth under Regional Enterprise? That is a difficult question to answer as suggested in Table 5.3. Ideally RegIS would explore both the Regional Enterprise and the National Enterprise scenarios.

Table 5.3: Different vulnerabilities under two versions of the high consumerism – high autonomy quadrant

Sector	Vulnerability under National Enterprise (UKCIP)	Vulnerability under Regional Enterprise (RegIS)
Coastline	Lack of resources for repairing existing defences? Unplanned and poorly protected development	Extensive new development increasing assets at risk Resources available for repair and maintenance, especially in areas strategically identified for development
Agriculture	Lack of resources for investment in response to change	High value of productive land – tendency to exploit to maximum
Biodiversity	Lack of resources for extension, protection and management of nature conservation sites	Extensive new development putting pressure upon existing nature conservation sites (but some high profile sites better protected, e.g. for tourism)
Water	Lack of resources for investment and research in improving supply options, reducing demand and allocating sufficient water to the environment	Extensive development increases demand. Apart from selected locations, wetland habitat conservation not a high priority

5.4 The regional RegIS socio-economic scenarios: qualitative characterisation

The characterisation of the RegIS scenarios are, in addition to the UKCIP SES, based upon the authors' own thinking, discussions within the RegIS team as a whole, the three stakeholder workshops held in 1999[85], the spatial scenarios developed by the North West Planning Team[86], subsequent discussion with stakeholders at a workshop in December 1999, meetings with regional planners in August 2000 and analysis of other scenario work.

The four scenarios – Regional Enterprise, Global Sustainability, Regional Stewardship and Global Markets – are explored below. In each case, the analysis is organised under three themes: economy, society and environment. The speculative nature of the scenarios renders them contentious in nature and inevitably subject to disagreement; however they are only illustrative and deliberately intended to demonstrate the potential for divergent futures and associated changes. The scenarios are not mutually exclusive and there could be elements in each of them which resonate, suggesting that the likely future is an amalgam of some or all of these, along with a host of characteristics not suggested here. As a complement to the four scenarios, a 'Planners' Scenario' is explored, based on discussions with planning officers in the two regions, and thought to be a closer approximation to the likely (short-term) future. Ironically, this 'business as usual' trend is proposed in the context of a world where climate change is not a significant issue.

5.4.1 Regional Enterprise

The Regional Enterprise scenario is the most bullish of the four, suggesting vibrant, semi-autonomous regions, keen to promote and maintain their distinctive qualities in a highly competitive world. A key to their success will be the imaginative development of assets and core strengths, some economic, some social, others environmental.

Economy: The Regional Enterprise scenario suggests a greater degree of economic autonomy than is currently the case, realising regional economic opportunities, but also taking risks in terms of investment strategies in particular sectors of the economy. A far greater degree of self-promotion is demanded, attempting to place the region within a national, European and global context. Clearly, not all regions would be able to compete to the same degree or on the same terms, and will have different alliances at the national level and between adjacent regions. Certain sectors such as agriculture will be much more exposed to the market and could decline as a result, although there would be support where this promotes regional cohesiveness.

Society: A high degree of devolution to regional government will encourage considerably more political involvement than is currently the case, with citizens able to make direct connections between their decisions and the character of their society and environment. The population will have a high degree of regional identity, recognising their place within the national, European and global context. Such interconnectedness will be uncomfortable for some, but an appreciation of its importance and potential will be the foundation for a dynamic economy.

Environment: A greater awareness of the role of the environment as an economic asset and a fundamental part of quality of life is characteristic. The environment is seen as a commodity which can be traded, although this does not necessarily imply degradation or loss of resources; where direct economic gain can be demonstrated, then assets will be highly valued.

East Anglia

Economy: Growth is higher than average for English regions due to proximity to London and the South East, along with the growing attractiveness of the region for the location of leading edge technological industries and services (especially Cambridgeshire and southern Suffolk). Many

forms of arable agriculture will be competing successfully on the global market, whilst subsidy-dependent activities will die-away.

Society: Demographic pressures upon the region will increase with an ageing population in the South East eager to retire to East Anglia (especially Suffolk and Norfolk). This will increase the demand for coastal development, including housing, roads, golf courses, etc. Existing settlements generally grow, whilst new towns and villages emerge in 'greenfield' sites throughout the region. The increasing demand for water will be met by stopping water transfers to Essex, and (if necessary) by more water transfers from other, less prosperous, regions, keen to create an income stream through water exports. Water abstractions will, however, create on-going problems for wetland habitats and waterways. There will be discussion on constructing a tidal barrage across the Wash to generate tidal power. Support for such a scheme is not sufficient, however, given the high capital expenditure required, and the lower costs of demand management and more efficient use of water. Other alternatives, such as desalinisation plants, will also be debated.

Environment: Some high profile environmental issues will be used for publicity by private agencies and NGOs (e.g. NT, RSPB) such as the creation of new habitats for the bittern. (There may also be unexpected opportunities to create new wildlife habitats arising from the cheap price of land which has gone out of agricultural production due to removal of subsidies – the integrated model runs in RegIS will be able to tell us if this is the case). This might be regarded as tokenistic 'wildlife gardening' and 'far too little too late' by environmentalists.

The coastal zone will be more intensively developed with housing and associated services. The landscape value of the coastline will not be entirely sacrificed to development pressures, however. Planning will consider the potential adverse impacts of development upon distinctive regional assets, the rationale being that coastal landscapes have an economic value to the region (through demand to live on the coastline and through tourism). Totally unplanned coastal development is regarded as reducing this economic value. Given that the East Anglian coastline has a long history of erosion and flooding without climate change, the increased level of coastal development implies a longer length of coast defences maintained than at present. One impact of more coastal protection in Norfolk and elsewhere would be a reduced supply of sediment to the large intertidal areas such as the Wash. (When combined with climate change scenarios of rising sea level, this would be likely to reduce the integrity of habitats there).

There will be managed realignment in coastal areas where low-lying, low-grade land is protected. The cost of defending such areas of low-grade agricultural land will be commonly regarded as excessive compared to the productive value of the land. However, there will be regional finance made available for preserving important cultural and historic areas of the coastline, especially where these are associated with tourism opportunities.

North West England

Economy: The North West will also grow, but just below the average for the English regions. Decline, however, will be halted and growth areas (especially in Cheshire and City of Manchester) will lead the way towards a new high-technology and service-based economy. The arc extending through northern Cheshire and southern Greater Manchester will be particularly important in realising the potential for growth in these sectors. The remaining traditional industries will have adopted new technologies and world best practice and will be competitive in global markets. Some agricultural activities – including dairy and horticulture – will flourish, whilst others – such as subsidy-dependent hill farming will die away. However, regional packages will be put together to preserve hill farming as a way of life and as the basis for landscape conservation and associated tourist activity in parts of Northern Lancashire and Cumbria.

Society: Population migration to the South East will have begun to level-off. Cumbria will be subject to increased development pressures as a result of demographic shift: there will be net migration into Cumbria, mainly of more elderly people looking for a retirement home. There will also be an increased demand for tourism in Cumbria, especially continued growth in the short-stay market. A new airport in the county will help to service this growing volume. Demand for water will grow slowly, as an increase in demand of water for gardening is offset by a continued decrease in industrial consumption.

Environment: Managed realignment will be implemented in relatively few areas in the North West, given the onus on protecting areas of the coastline that are already developed. The Solway Firth and areas around Morecambe Bay will be realigned (e.g. defences at some rural locations will be moved inland or abandoned). Pressures for coastal development will grow in certain regions, such as around Southport, Sefton, Blackpool, Morecambe Bay and parts of west Cumbria. This development will be less than in East Anglia, due to the relatively less vibrant growth, and hence disposable income, in the North West. As in East Anglia, there will be constraints on new development to preserve the aesthetic (and associated economic) value of the coastal landscapes where these are regarded to still be high, such as around Morecambe Bay, Sefton sand-dunes, and Solway Firth. The present level of flood and coastal defences will be maintained or even enhanced as in East Anglia. In response to a strong political identity in the region, development will occur throughout the North West, though will be concentrated in particular regions. These growth areas will be defined by important transport routes and 'interface' areas (e.g. Warrington, south Cheshire and south Wirral, City of Manchester and south Greater Manchester, Preston, Kendal and other selected locations in Cumbria, such as the Eden Valley). The high pressure for development and new homes will tend to promote refurbishment of buildings and urban landscapes in cities and towns, though problems of urban blight will remain.

5.4.2 Global Sustainability

Here the global approaches to achieving sustainable development take precedence over regional responses. The World is seen as an interconnected whole, functionally and morally, with a concentration on the wider impacts of individual actions.

Economy: Through the CAP, agriculture is directed towards what is most suitable to be grown locally in the context of a continental scale landmass. Development patterns reflect a desire to conserve 'greenfield' resources and cities become substantially more compact than at present, their character transformed through city greening and the establishment of pedestrian-oriented enclaves. Nevertheless, new 'greenfield' settlements are developed where these can demonstrate a high degree of self-containment and the enhancement of the landscape into which they are placed.

Society: The degree of popular awareness of development and sustainability issues is much enhanced under this scenario with a recognition of the impacts of individual actions on the local, regional, national, and global environments. People will actively seek ways of reducing the impact of their lifestyle choices on the environment and the wellbeing of people in other countries. Equity considerations are likely to be increasingly important in general, and this could lead to conflict over individual choices (such as a desire to find a higher quality of life in the countryside but being restricted in their options for travel and perhaps even migration).

Environment: Biodiversity resources, along with priorities for conservation and improvement, are seen in a broad spatial context, at the European and global scales. Water resources, for example, are managed as a national-level (and even an EU level) resource. Coastal protection policy is directed to the most vulnerable regions considered in a national context. Given the global outlook of this scenario, the protection of locally significant biodiversity resources could be downgraded and the loss of the stock of some regional resources could be acceptable provided that the global balance sheet is positive.

East Anglia

Economy: The intensive agriculture of the region has been transformed by subsidy payments which are geared towards sustainable production, such as taxes on fertilisers, pesticides and herbicides, and incentives for organic and low-intensity farming. This helps to reverse the decline of the agricultural economy which is increasingly valued as a central part of local solutions to global problems. Regionally significant centres of the industrial and service economies will stand as beacons of good practice in terms of their global impact. The Cambridge sub-region in particular could become a world leader in the development of communications technologies which help to promote interconnectedness, yet discourage the need for travel.

Society: The characteristic pattern of dispersed settlement in the region stimulates the growth of locally based solutions to aiding global sustainability such as co-operative ventures, farmers' markets and increased self-governance. Higher awareness of the global sustainability issue is likely to be reflected in increased involvement in local democracy.

Environment: Water resources are also regarded as a strategic national resource. Some water transfers to Essex are permitted due to greater demand there, but only if effective demand management in the South East has been undertaken, and only if strategically important wetland habitats (at the national level) are not threatened. Coastal zone protection is seen from a national strategic perspective. East Anglia receives considerable attention because it has so much vulnerable coastline. Managed realignment is the policy adopted in many regions. Resources are devoted to establishing procedures for achieving consensus on the future of the coastline. However, local objections do not stand in the way of national policy objectives. The consideration of biodiversity assets as global and EU-wide resources could bring a reassessment of protection priorities. Where EU-wide important habitats are forfeited to the sea, new areas of land will be identified for creation of replacement habitats. Coastal and inland habitats which support migratory bird populations (protected under SPA, SAC and RAMSAR designations) are examples. There could also be pressure for an increase in the overall area of EU-wide important habitats. Funding for such enhancement will come from a central EU fund for such projects. Collectively, the pressures suggest that, using natural hydrological dynamics, significant parts of the coastal plains of North West and North East Norfolk might be allowed to revert to Fenland habitat, also enhancing sustainable flood control.

North West

Economy: Agriculture as above, with stronger emphasis on movement towards low intensity farming in the uplands. New coastal development is resisted and the favoured option is consolidation and better planning of existing developed and urban sites. More legal protection from development is sought for those areas of coastline lying between urbanised zones.

Society: With the environmental impact of the Region's two conurbations recognised as significant on a global scale, there is considerably more awareness amongst the population of the global footprint of their everyday actions.

Environment: Using demand management and leakage reduction, some possible excess in water resources is identified which can be exported to needy regions (provided effective demand-side management has occurred in those regions). Significant reductions, compared to current levels, in carbon dioxide emissions will be characteristic. Biodiversity and coastal zones as above for East Anglia. The global agenda will be a significant influence over the exact nature of environmental management, and some unpalatable compromises are likely.

5.4.3 Regional Stewardship

Here, the emphasis is on recognising and conserving regional assets, accepting that this might result in a significantly reduced level of economic growth and even a contraction of the economy in some respects. This is accepted because of the pursuit of a more all-embracing means of living, one which recognises the importance of community and the value of local natural assets.

Economy: Sustainable development is increasingly the focus of industrial activity with significant encouragement for industries which benefit environmental integrity (such as renewable energy and clean technologies). These are developed as niche markets with particular regions and sub-regions striving to become centres of renown in their own specialised production capacity. The development of small businesses and co-operatives will be encouraged as part of more community-focused ways of living.

Society: Policy-making will involve extensive public consultation, including surveys, focus groups, citizens panels and juries, and possibly even referenda. Policy will reflect, as far as possible, local and regional concerns, which will tend to turn policy attention 'inwards' to valuing and conserving the regions' stock of assets, although the global context of these decisions will not be ignored.

Environment: The landscape setting and biodiversity resources will be seen as priorities for enhancement to build back the stock of environmental capital which has been eroded over the past two hundred and fifty years and particularly in the past one hundred. The lower level of economic growth limits the resources available for expensive response measures (such as hard coastal defence). There is some scepticism of 'technological fixes' as the solutions to environmental problems and a preference for regionally and community-oriented and participative responses. Policy on biodiversity, coastal zones, agriculture and water resources takes on a strongly regional focus, valuing and conserving what is found within the region. The aim will be 'nature in the countryside', rather than wildlife gardening, whereby only selected species and habitats are conserved.

East Anglia

Economy: The precautionary principle is implemented in regional policy and used to limit the amount of new development in the region, the main issue being lack of water resources. Water resources will be regarded as a major regional resource and the idea of water transfers from other regions will be rejected as unsustainable. The export of water to Essex would be permitted provided that sufficient actions are undertaken in that region to reduce demand. However, the construction of new reservoirs for export would be prohibited. The onus will be on compulsory water metering, more water charging for commercial use and more demand management programmes. A major issue will be the conflict between the water needs of agriculture, households, commerce and the natural environment. Certain sorts of agriculture will become unfeasible due to much higher water charges for irrigation. Construction of farm winter reservoirs and 'mini-reservoirs' will be encouraged, but rules will limit their development when they appear to be significantly reducing winter flows. Intensive agriculture will become more expensive through national and regional level policies, including new taxes or tradeable permits on fertilisers and pesticides, tighter controls on run-off, and planning restrictions. Incentives for less intensive agriculture will be provided through regional subsidy packages. The aim will be to combine employment on the land with traditional forms of agriculture and the conservation and creation of traditional local landscapes. Organic foods will grow as an important niche market and will serve a regional demand, e.g. through farmers' markets.

Society: As with Global Sustainability, the characteristic pattern of small settlements is regarded as a significant opportunity to develop community-focused activity reliant to a greater degree on self-help, local decision making and stewardship of their local resources. Where this demands that the

landscape be reconstructed in the wake of agricultural intensification then this will be supported as a community initiative and resources will be made available.

Environment: Planning controls are increased on the coastal zone to limit development and a far reaching policy of managed realignment is implemented. This will include public purchasing of coastal land that comes up for sale (land banking) such that it can later be abandoned or used for new habitat creation. Similar policies will be implemented in the Fens, Broads and river flood plains. Central to this policy of realignment will be attention to replacement of lost coastal habitats, either along the realigned coastline or inland. There will be a policy of extending the area of land given over to semi-natural habitats where distinctive regional assets (such as the bittern, or the wintering birdlife in the Wash) are involved. Biodiversity policy will be geared towards preserving, and improving upon, existing and traditionally found biodiversity assets throughout the landscape. Under this scenario, East Anglia might even be recreated as one of Europe's major havens for wildlife and parts of the region could be 'returned to nature' in a grand experiment to recreate the past wetland landscapes and associated habitats and species. This would attract large numbers of tourists from all over Europe, and a powerful sustainable tourism policy would be implemented. The amount of new development would be restricted and tourism-related transport would be controlled with no-car zones.

North West England

Economy: Upland farming would be preserved through regional subsidies: however, it would have to return to much less intensive methods, with far fewer sheep per hectare, and with biodiversity protection and enhancement as a major policy objective. Visitor and residential centres and sustainable tourism would go hand in hand with such upland land use management. Dairy farming would be subject to more controls on silage and effluent discharge and fertiliser application would carry an environmental tax. The organic foods sector and local farmers markets would grow in response to local demand for high quality. Areas such as Cumbria and Bowland would develop strong quality *marques* for organic agricultural product, equivalent to *appellation contrôllée* schemes in France. More attention will be given to water demand management and to the promotions of on-farm reservoirs in areas where irrigation water is required, along with water metering and charging, though less so than in East Anglia.

Society: The strongly metropolitan focus of the North West creates the opportunity for a recasting of urban structure to help build back the communities which urban growth enveloped. Reduced travel will help to develop more local identity, although there will be a strongly metropolitan feel to urban areas, capitalising on diverse cultural and economic assets.

Environment: As in East Anglia, biodiversity policy will be geared towards conserving and re-creating local and regional biodiversity assets. Biodiversity in rural parts of the North West will undergo a revival, as agriculture becomes less intensive. In the more urban parts of the region, however, opportunities for biodiversity will be inherently limited. Managed realignment of the coastal zone will be tested out in some areas, though there will be limited opportunities because of the extent of development and local public opposition. Some realignment will perhaps take place against local public opinion, where the regional sustainability issues (such as new habitat creation) are deemed to take precedence (an example might be Formby, where the existing pine plantations will be cut down to allow inward movement of dunes despite local public opposition). Those areas where realignment is less contentious will become test-beds used to promote the concept and win over more public support. Renewable energy development will become associated with coastal realignment (such as coastal based wind farms). Discussions of a tidal barrage in Morecambe Bay, along the River Wyre, or the River Mersey, will take place. The impacts upon ecosystems and natural processes arising from such schemes will tend to reduce support for such schemes, however, and they will remain in abeyance.

5.4.4 Global Markets

A global market orientation is one based on the pursuit of high and sustained growth within a global context. All regional assets will be brought to bear in this ambition and significant risks will be taken as to the precise composition of the development path.

Economy: Growth will be patchy, with high and low rates in different regions and within different parts of the regions. Certain areas within regions will be subject to particularly intense development pressures, with consequences for land uses, water resources and biodiversity. Meanwhile, other areas will suffer from under-investment and neglect, as global capital flows readily between currently favoured regions.

Society: The consequences for society are significant with the erosion of social capital. Intense competition in a deregulated economy will encourage migration to seek work and disrupt community links to places and people. Paradoxically, the dominance of global capital could stimulate the development of self-help co-operatives in those areas and for those people left outside the economic mainstream.

Environment: As with social capital there will be significant erosion in the face of the overriding demands of global capital. Strategic economic decisions will override local interests, although there will be recognition of the status of some environmental resources as economic assets, and these will be exploited for their leisure and tourism potential.

East Anglia

Economy: As for Regional Enterprise, but with a stronger disparity in intra-regional development patterns. The Global Markets scenario will tend to support strong rates of development in those parts of the region close to London and the South East. Cambridge and environs ('Silicon Fen') will consolidate its role as a global centre of the knowledge-based, high-technology economy and a stopping-off point for global tourism. Other parts of the region will become centres of expertise on biotechnologies, e.g. Norwich. There will be a stronger split than in Regional Enterprise between agriculture that competes on global scales and that which is not competitive. The latter will go out of business, freeing-up considerable land which can be used for development or for biodiversity. There will be some niche markets that are consistent with sustainable development, e.g. for organic foods and wildlife tourism. These may be aided by the availability of relatively cheap land in the absence of subsidies. However, these high value-added markets will remain marginal to the bulk of economic activity. Also, they will form part of a global-scale economy: hence demand for organic foods may be met from countries throughout the EU and beyond.

Society: As for Regional Enterprise, but a shrinking world in terms of telecommunications links will connect and inspire people of like mind to develop innovative solutions to working and living outside the 'mainstream'.

Environment: Market-based mechanisms will encourage water demand management, and managed realignment where protection would be very costly. Coastal defence will become substantially privatised, with government providing a significantly lower level of security than at present. This means that wealthier areas will be able to purchase more coastal defence than poorer areas. Higher rates of largely unplanned development will proceed in 'desirable' coastal locations, with accompanying sea defences funded by private initiatives. The privatisation of coastal defence will, however, limit excessive development. Most development pressure will concentrate on South Suffolk and East Norfolk, where there is sufficient resource to build new sea defences. New development in North Norfolk will be less pronounced because of the area's relative remoteness. The reduction in coastal protection of poorer towns will further disadvantage locations such as Lowestoft and Great Yarmouth. 'Wildlife tourism' will have to compete for visitors with other destinations within Europe. This means that resources will tend to be concentrated into supporting

particular nature reserves, usually privately-owned as money-making ventures. As for Regional Enterprise, such 'wildlife gardens' will be criticised by many biodiversity experts. Water resources will be seen as a marketable commodity. The onus will be on water charging as a way of distributing the limited resource. It may be more financially viable for water companies to buy water from outside the region to supply demand to those who can pay than to reduce demand. There may be renewed discussions concerning the tidal barrage as a freshwater storage facility in East Anglia. However, obtaining global finance for such a scheme is difficult.

North West England

Economy: Development in the North West is very patchy. Parts of Cheshire and several city centres do well. Warrington and environs grows because of its strategic location between Greater Manchester and Merseyside, Cheshire and Lancashire, and associated transport routes. Other southern towns and cities such as Chester and Macclesfield grow strongly, whilst the City of Manchester consolidates its status as the regional centre for administration, arts, finance, education and services. Development pressures are high in these areas, with new transport routes and office developments being promoted – in particular on the fringe of towns and cities and near motorway junctions. Large parts of urban Greater Manchester and Merseyside, the east Lancashire cotton towns and west Cumbria continue to languish with high unemployment and relatively high poverty levels. Development pressures in these parts remain suppressed. However, resources are not available for biodiversity protection and improvement. Marginal agriculture in the North West generally finds it difficult to survive with the removal of subsidies. Upland estates are consolidated, with diversification, e.g. conversion of farmhouses into holiday cottages, residential centres and second homes, use of land for game sports and for other outdoor activities such as off-road vehicle tracks. Dairy and beef farming and horticulture remain globally competitive and remain as intensive as today in larger farm units.

Society: As for East Anglia but the highly urbanised character of the region, with many small settlements and a strong community structure, encourages and allows a greater diversity of solutions to the challenge of the global market for those who choose not, or are unable, to fit into its demands.

Environment: The Lake District preserves its identity as a popular site for tourism. It attracts visitors from over the UK and to a lesser extent from abroad, who use new airport facilities. Blackpool becomes a major European centre of leisure and sports activities, and also sees an expansion of its airport facilities. Pressures upon this stretch of coastline are increased, requiring expensive sea defences, which are partly privately-financed. Other tourist destinations in the North West remain of more local value and are at threat from a lowered standard of protection along the coastline. Water resources are an important resource with potential for exporting to other regions of England. As a minimum, the region will attempt to benefit from its role as a conduit for water transfer from Scotland to the South East of England through water transfer fees. Charging, metering and demand management measures are put into place in order to reduce regional consumption. This frees up sufficient resource to export southwards.

5.4.5 Planners' scenario: 2020 commitments and 2050's vision

The scenarios for urban development by 2020 are based on the projections of Regional Planners for housing development over the next twenty years, and informal discussions with them. Effectively this is a 'business as usual' scenario, although there are hints of change in respect of the encouragement of the redevelopment of urban areas. The projections are based on figures for housing commitments contained in the draft Regional Planning Guidance for East Anglia[87] and for the North West[88] and reflect pressures for development that have been building over the past few years. These commitments are location specific, but are not necessarily a guide as to the type of development which will be permitted (in terms of density for example) or the extent of future development. The speculations for change into the 2050s largely centre on a reinforcement of

current trends, although the prospect of developments in ICT could prove highly influential in determining both the type and location of demands for growth.

East Anglia

The Cambridgeshire sub-region is the centrepiece of development activity up to the 2020s, based on the explosive growth of the knowledge-based economy here. The rapid development of adjacent Peterborough further enhances the vibrancy of this part of the region. New solutions for housing will be well advanced by the end of the 2020s, particularly new settlements surrounding Cambridge. However, the constraints of infrastructure capacity, water resources and health services will begin to bite during this period and significant investment dilemmas will appear, notably in respect of the continuing problems of rural depopulation in the less accessible east and north east of the region. Nevertheless, the allocation of significant housing growth to Norwich and smaller towns such as Thetford and Dereham reflects the desire to meet latent demand for housing and help stimulate economic growth. The further expansion of the Cambridgeshire sub-region emphasises the importance of inter-regional and national links and the role of this part of the region in the European growth arc, the so-called 'blue banana'.

The period to the 2050s is likely to see continued urban expansion, notably in the existing centres of economic activity (Peterborough, Cambridge, Norwich and the A14 Corridor). Limited scope for 'brownfield' development means that, building on trends evident by the 2020s, considerable attention will have to be paid to the development of new settlements. The tide of rural depopulation will have been halted by this time, using developments in ICT to establish new patterns of working and living. Dilemmas over further road development is likely to be a critical issue by this time, as areas without good communication links slip further behind those which are well connected inter-regionally and internationally.

North West

The pattern of development proposed in the North West is one of modest growth centred on existing settlements. The North-South axis is the focus for much growth, particularly in the towns of Warrington, Preston and Lancaster. The integrity of the Green Belt is respected with only relatively minor revisions to its current boundaries. The rationale of higher urban densities along with the reuse of derelict and 'brownfield' land is driving current thinking, with considerable areas of vacant land (notably in East Manchester) awaiting redevelopment. A difficult balance is being fought, however, between the urgency of regeneration and the desire of people (and builders) for specific kinds of property ideally in 'greenfield' locations. The development of the philosophy and practice of city greening will be central to the realisation of the aspirations of the reversing tide of urban out-migration. Complex commuting patterns will still characterise the next twenty years, reinforced by the success of some 'hot spots' within the region (such as Chester and Warrington) and the availability of cheaper housing immediately outside the region (principally North Wales).

By the 2050s, a halt to out-migration from the region is expected combined with a significant urban renaissance which attracts people back into the urban cores. Some of these could be second homes (as is already happening in Central Manchester), but the growth of ICT is likely to stimulate even more complex patterns of working and living. How far personal choice can be tempered by the demands of sustainable development cannot be predicted, although travel patterns are likely to be significantly different, based on restrictions, cost and the potential for home-working. The tourist sector is recognised as being a key sector in the future, with the region reaching for a significantly higher European profile and the development of stronger trading links both with adjacent regions and across Europe based on significantly increased rail-freight capacity. The structure of industry and agriculture is likely to be significantly different, particularly in respect of upland agriculture with the further development of landscape resources for tourism and recreation.

5.5 Quantification of the RegIS socio-economic scenarios

The variables which need to be quantified in the RegIS socio-economic scenarios, as they are numerical inputs to models, are outlined in the Table 5.4 below.[89]

Table 5.4: Summary of scenario indicators

Indicator	**Spatial Resolution**	**Use of the variable in RegIS**
Spatial indicators		
Change in urban areas (%)	As fine as possible	To define the area available for agriculture and as natural habitats
Change in population numbers (%)	As fine as possible	To estimate population density
Change in total agricultural area (%)	As fine as possible	To define the limits of the farm model runs
Change in non-agricultural area, e.g. woodland, amenity (%)	As fine as possible	To estimate the size and location of potential nature conservation areas
Change in agri-environment areas, e.g. NVZ, NSA, ESA (%)	As fine as possible	To modify the farm model management inputs
Non-spatial indicators		
Change in crop prices (%)	Great Britain	Input to farm model
Change in crop yields (%)	Great Britain	Input to farm model
Change in chemical usage (%)	Great Britain	Input to farm model and water model
Change in machinery size (%)	Great Britain	Input to farm model
Change in set aside (%)	Great Britain	Input to farm model
Change in subsidy (%)	Great Britain	Input to farm model

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