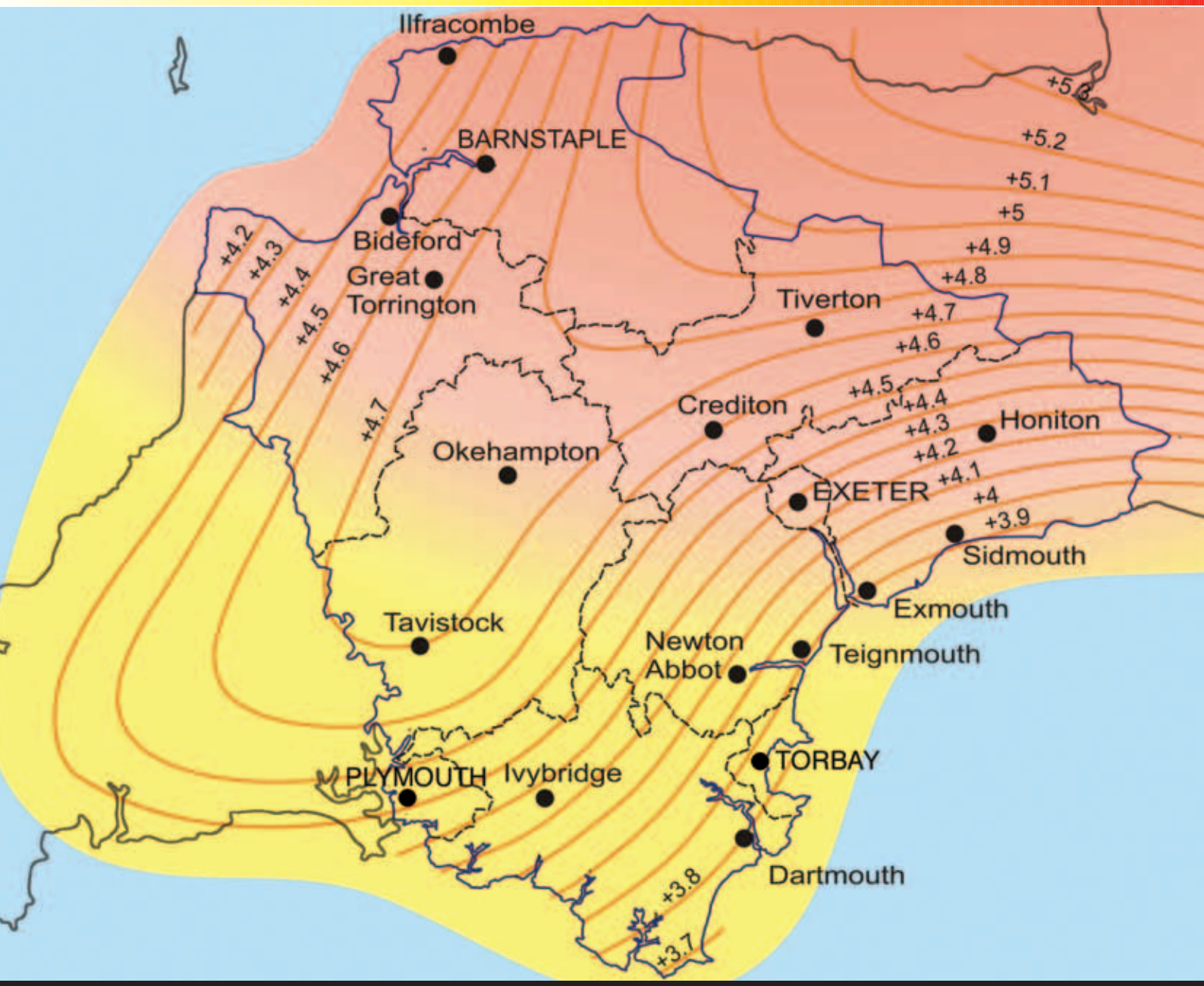
A Warm Response
Our Climate Change Challenge

A Devon County Council Strategy for 2005
. . . and the foreseeable future



Strategy Document

September 2005

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DEVON COUNTY COUNCIL

Access to Information

English

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Arabic

إذا أردت هذه الوثيقة بلغة أخرى أو بطريقة أخرى، أو إذا كنت بحاجة إلى خدمات مترجم، فنرجو أن تقوم بالاتصال بنا.

Bengali

যদি আপনি এই ডকুমেন্ট অন্য ভাষায় বা ফরমেটে চান অথবা যদি আপনার একজন ইন্টারপ্রেটারের প্রয়োজন হয়, তাহলে দয়া করে আমাদের সাথে যোগাযোগ করুন।

Cantonese

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Gujarati

જો તમને આ દસ્તાવેજ બીજી ભાષા અથવા રચનામાં જોઈતો હોય, અથવા જો તમને ઈન્ટરપ્રિટરની સેવાઓ જોઈતી હોય તો, કૃપા કરી અમારો સંપર્ક સાધો.

Turkish

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Urdu

یہ دستاویز اگر آپ کو کسی دیگر زبان یا دیگر شکل میں درکار ہو، یا اگر آپ کو ترجمان کی خدمات چاہئیں تو برائے مہربانی ہم سے رابطہ کیجئے۔

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Cover image: Projected change in average summer temperature (°C) by 2080s (Source data: UKCIP).

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Section 1

Foreword

"Nobody made a greater mistake than he who did nothing because he could only do a little".

Edmund Burke (1729-1797)
British statesman and political thinker

Since the phenomenon of anthropogenic climate change was discovered in the late 1970s, it has been variously described as an unintended, uncontrolled, globally pervasive experiment[1], a weapon of mass destruction[2], a huge problem[3], the most pervasive environmental threat of the coming century[4], a threat more serious even than the threat of terrorism[5] and a challenge so far-reaching in its impact and irreversible in its destructive power, that it alters radically human existence[6].

Such commanding rhetoric is powerful indeed. But what is the true nature of climate change and what are we doing to address the questions it poses?

As a challenge for the 21st century climate change is unique. Firstly, it does not respect traditional boundaries either in space or time. The climate change that is underway in Devon today has not been caused solely by the local emission of greenhouse gases. It is a global phenomenon to which each and every one of us has contributed. Secondly, there is a significant time lag of 30 years or so in the climate system which means that its full effects will not be felt until well after the time for meaningful decision-making has long passed. Whilst no one household, city, county, region or nation alone can resolve it, we should be in no doubt that our individual contribution is important.

As a County Council we have recognised that climate change is likely to be one of the key drivers of change within our community this century. We have appointed a Climate Change Officer to direct our response to global warming and have made a far reaching commitment to act by signing the Nottingham Declaration on Climate Change. This climate change strategy is our first important step in delivering on that commitment. As such it is concerned with reducing emissions today for the benefit of future generations for many decades to come. By adjusting our behaviour we can take effective action without disturbing the

[1] Statement by WMO, UNEP, and Environment Canada at The Changing Atmosphere: Implications for Global Security Conference, Toronto, June 1988.
[2] Sir John Houghton, co-chair of the Intergovernmental Panel on Climate Change, July 2003.
[3] President Bill Clinton at the Russian Duma, June 2000.
[4] International Federation of Red Cross and Red Crescent Societies.
[5] Sir David King, Chief Scientist, January 2004.
[6] Prime Minister Tony Blair, September 2004.

essence of our way of life. The strategy also highlights the need to put in place measures to cope with the impacts of a changing climate that we are already committed to as a result of past and present emissions. Finally, and perhaps most importantly, it deals with the issue of climate change communication – the need to inform, change attitudes, create ownership and alter behaviours.

Through the work of the Intergovernmental Panel on Climate Change, a scientific consensus on climate change has emerged – climate change is happening now and we are responsible. If we continue to conduct business-as-usual we may precipitate dangerous and unexpected changes to our climate by the end of the century. By then such changes may be irreversible.

We have been warned.

It's time to act.

Councillor Margaret Rogers BA(Hons) PCE AcDIP Ed
Devon County Council
Executive Member for the Environment

The Nottingham Declaration on Climate Change

Devon County Council recognises that Climate Change is likely to be one of the key drivers of change within our community this century.

We acknowledge that

- **Evidence continues to mount that climate change is occurring.**
- **Climate change will have far reaching effects on the UK's economy, society and environment.**

We welcome the

- **Social, economic and environmental benefits which will come from combating climate change.**
- **Recognition by many sectors, especially government and business, of the need for change.**
- **Emissions targets agreed by central government and the programme for delivering change as set out in the *Climate Change - UK Programme.***
- **Opportunity for local government to lead the response at a local level and thereby play a major role in helping to deliver the national programme.**
- **Opportunity for us to encourage and help local residents and local businesses - to reduce their energy costs, to reduce congestion, to improve the local environment and to deal with fuel poverty in our communities.**
- **Additional powers to address the social, economic and environmental well-being of our communities contained within the Local Government Act 2000, which will assist in this process.**

We commit our Council to

- **Work with central government to contribute, at a local level, to the delivery of the UK climate change programme.**
- **Prepare a plan with our local communities to address the causes and effects of climate change and to secure maximum benefit for our communities.**
- **Publicly declare, within the plan, the commitment to achieve a significant reduction of greenhouse gas emissions from our own authority's operations especially energy sourcing and use, travel and transport, waste production and disposal and the purchasing of goods and services.**
- **Encourage all sectors in the local community to take the opportunity to reduce their own greenhouse gas emissions and to make public their commitment to action.**
- **Work with key providers, including health authorities, businesses and development organisations, to assess the potential effects of climate change on our communities, and to identify ways in which we can adapt.**
- **Provide opportunities for the development of renewable energy generation within our area.**
- **Monitor the progress of our plan against the actions needed and publish the results.**

Councillor Channon **Leader of the Council**	**Philip Jenkinson** **Chief Executive**	**Lord Whitty, Parliamentary Under Secretary of State, DEFRA**

Photo of hurricane courtesy of NASA

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Section 2

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Section 3

Executive Summary

Background

Through the work of the Intergovernmental Panel on Climate Change (IPCC) a scientific consensus on anthropogenic global warming has emerged. Today there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities and that human-induced climate change, additional to that caused by natural variability, is now taking place (IPCC, 2001). Unless global measures are taken during the first half of the 21st century to reduce greenhouse gas emissions and stabilise their concentrations in the atmosphere, mankind may precipitate dangerous and unexpected changes to our climate by the end of the century together with a significant rise in sea level. Such changes would persist for many centuries and may indeed be irreversible.

The UK Climate Change Programme (DETR, 2000) has been developed in close consultation with key stakeholders and recognises that local authorities (LAs) are critical to its success. In addition to taking direct action to reduce emissions, LAs can influence the way others respond by raising awareness of the need for action and providing practical advice on what people can do to make a difference. Furthermore, they must prepare for the impact of climate change, which is already affecting local communities.

As a County Council we have recognised that climate change is likely to be one of the key drivers of change within our community this century. We have appointed a Climate Change Officer to direct our response to global warming and have made a far reaching commitment to act by signing the Nottingham Declaration on Climate Change on 14th July 2004. This climate change strategy is our first important step in delivering on that commitment.

Strategic Context and Goal

The climate change strategy has been developed within the context of sustainable development where *"the needs of the present are met without compromising the ability of future generations to meet their own needs".* Although the idea is simple, the emergence of anthropogenic climate change has put in to stark relief the potential of present (and previous) generations to compromise the needs of future generations for many centuries to come. Sustainable development is about delivering a strong, healthy and just society that lives within environmental limits through the promotion of good governance, use of sound science and creation of a sustainable economy. Our climate change response will need to

make compromises between competing agendas and can only be realised through effective partnerships at both corporate and community level. Accordingly, the goal of this climate change strategy is ***"to put in place effective and timely measures both at the corporate and community level to address the causes and impacts of climate change in Devon."***

Strategic Components

It is widely accepted that a twin-track approach comprising of mitigation and adaptation measures is the most appropriate strategy option. The mitigation agenda addresses the causes of climate change and is aimed at reducing greenhouse gas emissions and/or enhancing carbon sinks. The adaptation agenda is concerned with the likely impacts of a changing climate on our environment, economy and society. Its aim is to reduce vulnerability to the adverse effects of climate change and take advantage of the opportunities that climate change might present. However, there is a vital third element, communication, which is needed to identify target audiences, raise awareness of the issues, change attitudes, promote the behavioural change associated with mitigation and adaptation actions, and celebrate successes. This strategy adds communication to the traditional twin-track approach as the priority work stream.

Strategic Phases

Given current financial and planning horizons, and the potential for significant policy and technology advances as climate change rises up the political agenda, it makes sense for this strategy to operate for the climate change short term only i.e. to 2010. This does not mean that it should not consider impacts in the medium (to 2050) or long term (to 2100) where major infrastructure is involved. Over the next five years, the strategy will have two phases which may run concurrently;

- **Set up process** – there is a need to increase the receptivity of the public to climate change action by raising awareness and creating *"agency"* for change. In addition, a *"carbon footprint"* capable of replication on an annual basis for mitigation purposes is required together with a climate impact assessment at an appropriate spatial and temporal resolution on which to base the adaptation response. All of these activities are significant undertakings and necessary precursors to prioritised action planning and implementation.

- **Strategic actions** – this will consist of messages, measures, projects and programmes identified and prioritised by the set-up process. This strategy outlines example actions.

Strategic Space

Within the sustainable development framework, the strategic space occupied by Devon County Council (DCC) determines the depth and breadth of potential climate change action. DCC has three distinct roles each of which contains activity that contributes to or will be impacted by climate change as follows;

- **As a corporate manager** – This is about the management of the business and making sure that the Council's operations are sustainable in resource terms. It covers issues like asset management, energy consumption, building performance, composition of vehicle fleets, travel planning and procurement strategy.

- **As a service provider** – This concerns the contribution and impact of the Council's services, and covers such issues as transport, development planning, waste management, educational development and air quality.

- **As a community leader** - This is all about demonstrating leadership by example, and through partnership working and the community strategy.

Strategic Framework

The components of the strategy described above can be brought together to form a strategic framework (see Figure 1) for our climate change programme. The strategic framework identifies the three core strands of work (i.e. communication, mitigation and adaptation) operating at two levels (i.e. internally within DCC as corporate manager and service provider, and externally as part of the Devon Strategic Partnership Community Strategy). The framework also identifies the need for a set up process to create agency for action amongst stakeholders, a carbon footprint for DCC and Devon, and a climate impact assessment for Devon. Furthermore, it highlights the principal strategic outcomes (i.e. changed behaviours, reduced emissions and reduced vulnerability) of each work stream together with the channels and strategies needed to achieve these objectives. Finally, it recognises the contribution of existing initiatives which provide continuity of action on climate change whilst the core programme is initiated.

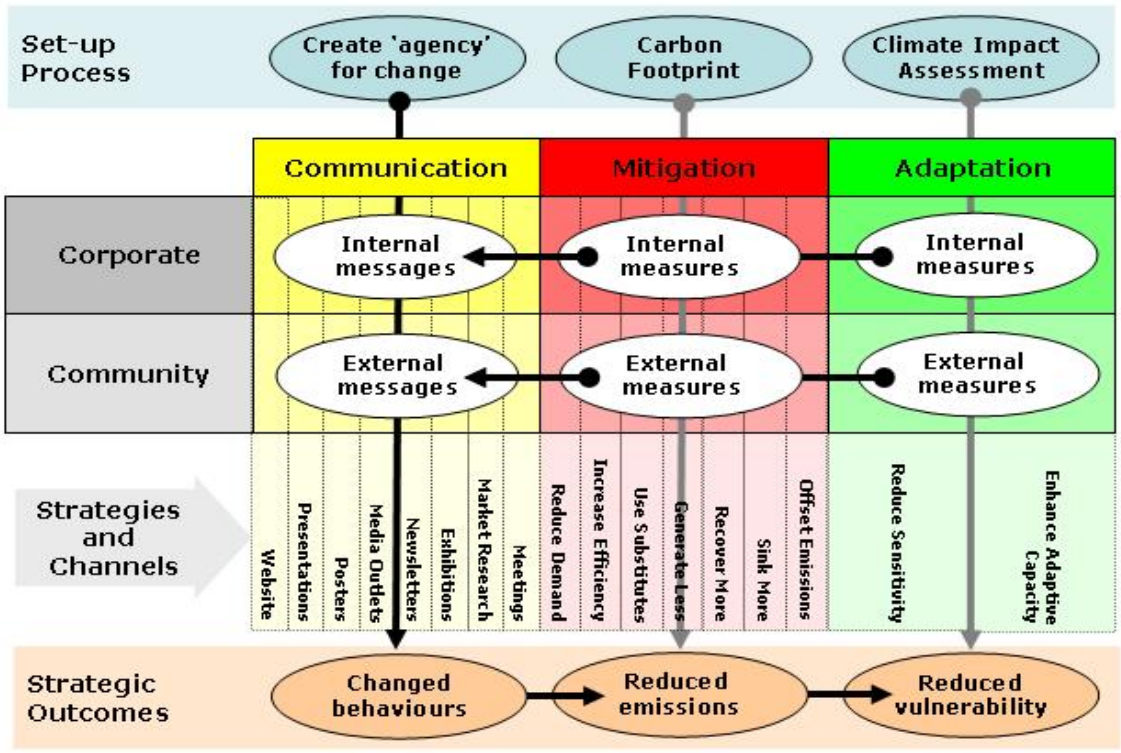

Figure 1. The strategic framework

Source: DCC

Strategic Objectives

In order to achieve the strategic goal, ten strategic objectives have been identified. These are identified in Boxes 1 to 3 and cover the communication, mitigation and adaptation work streams.

Box 1. Strategic Objectives (Communications)

1 – Attitude to Climate Change.

To create "agency" for action with the members and officers of Devon County Council, our partners and, most importantly, the people of Devon towards climate change by raising awareness of its causes and impacts, and outlining potential responses.

2 – Behavioural Change.

To promote behavioural change of specific target groups within the Council and community in support of the mitigation agenda.

Box 2. Strategic Objectives (Mitigation)

3 - DCC Approach to Carbon Management.

To scope, agree and implement a carbon management policy for application across both the capital programme and the operational items covered by the revenue budget.

4 - DCC Operational Carbon Footprint, Target and Measures.

To define a baseline carbon footprint, agree an emissions reduction target and identify, cost, prioritise measures to reduce the Council's emissions of greenhouse gases.

5 – DCC Capital Programme Carbon Assessment.

To identify, document, agree and implement an assessment process for identifying and minimising both the embodied energy/carbon content and the future operational carbon footprint of proposed programmes/plans, infrastructure upgrades and maintenance regimes.

6 – Implement DCC Mitigation Measures.

To implement, monitor and report progress on measures to reduce the Council's emissions of greenhouse gases.

7 – Management of Carbon in Devon *[As agent for the Devon Strategic Partnership]*

A. *To define a baseline carbon footprint for Devon, and recommend an emissions reduction target and measures to reduce community emissions of greenhouse gases.*

B. *To assist in implementing, monitoring and reporting progress on those measures.*

C. *To influence regional and local planning authorities to ensure that both the embodied energy/carbon content and the future operational carbon footprint of proposed programmes and plans are minimised.*

Box 3. Strategic Objectives (Adaptation)

8 – Climate Impact Assessment for Devon

To undertake a climate impact assessment for Devon for the short and medium term.

9 – Emergency & Contingency Planning

To review and update the Council's emergency/contingency plans for all vulnerable locations in the light of recently experienced weather-related hazards.

10 – Climate-proofing for Today's Weather Hazards

To ensure that when unexpected, unusual or extreme weather events cause problems the post hoc restoration is climate-proofed for the next 50 years against potentially more extreme events and the lessons learned are applied where practicable to similar locations countywide.

11 – Climate-proofing for Projected Weather Hazards

To climate-proof strategies, policies, programmes and plans that come up for review, infrastructure upgrades, maintenance regimes and new fixed infrastructure that has a life of 20 years or more against projected changes in climate over the next 50 years.

Conclusion

Over the course of the 21st century climate change has the potential to make a significant impact on the economy, society and environment of Devon. In the DSP and DCC Devon has the institutions and appropriate powers to lead the response at a local level. This climate change strategy establishes a framework for the creation and implementation of a prioritised action plan to address the causes and effects of climate change and to secure maximum benefit for our communities. In turn these actions will contribute to the delivery of the UK Climate Change Programme and assist UK plc in meeting its international obligations on climate change.

Section 4

Our Position Statement, Vision, Goal and Commitment

Our Position on Climate Change

We share the concern being expressed globally over the issue of climate change and accept the case that there is now incontrovertible evidence that most of the warming of the past 50 years is attributable to human activity. We support taking action now on climate change.

Our Vision

We aspire to be a leader in communicating and addressing both the causes and impacts of climate change for the benefit of present and future generations in Devon.

Our Goal

To put in place effective and timely measures both at the corporate and community level to address the causes and impacts of climate change in Devon.

Our Commitment

We will work with central government to contribute to the delivery of the UK climate change programme in Devon.

We will prepare a plan with our local communities to address the causes and effects of climate change and to secure maximum benefit for our communities.

We will strive to achieve a significant reduction of greenhouse gas emissions from our own operations especially energy sourcing and use, travel and transport, waste production and disposal, and the purchasing of goods and services.

We will encourage all sectors in the local community to take the opportunity to reduce their own greenhouse gas emissions and to make public their commitment to action.

We will work with key providers to assess the potential effects of climate change on our communities, and to identify ways in which we can adapt.

We will provide opportunities for the development of renewable energy generation within our area.

We will monitor the progress of our plan against the actions needed and publish the results.

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Section 5

Introduction

"An increasing body of observations gives a collective picture of a warming world and other changes in the climate system."

Intergovernmental Panel on Climate Change
Third Assessment Report, 2001

Climate change is a natural phenomenon that has occurred throughout the history of the Earth as a consequence of changes in the Earth's orbit around the Sun, the configuration of the continents, the output of solar radiation and volcanic activity. Such influences change the global energy balance, alter the composition of the atmosphere and impact on climate on all time scales up to hundreds of millions of years. However, since the Industrial Revolution of the 1750s atmospheric concentrations of naturally occurring, and latterly synthetic, greenhouse gases have increased at an accelerating rate as a result of human activities. In the late 1970s it was recognised that this anthropogenic influence may be precipitating a *'global warming'* resulting in changes to the climate system. Today there is new and stronger evidence that most of the warming observed over the last fifty years is attributable to human activities (IPCC, 2001[c]) and that human-induced climate change, additional to that caused by natural variability, is now taking place. Unless global measures are taken during the first half of the 21st century to reduce greenhouse gas emissions and stabilise their concentrations in the atmosphere, mankind may precipitate dangerous climate change together with significant sea level rise, which would persist for many centuries.

Clearly climate change is a global issue that needs a concerted global response. The international community has put in place a framework for action through agreement to the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and the 1997 Kyoto Protocol on greenhouse gas emissions reduction. The UK continues to play a leading role in the fight against climate change with its scientists at the forefront of the quest to understand climate change and predict its effects. On the national stage, the Government believes that the UK will benefit from strong action to tackle climate change and has promoted a partnership approach. The UK Climate Change Programme (DETR, 2000) has been developed in close consultation with key stakeholders and recognises that local authorities, amongst others, will be critical to the success of the programme. In addition to taking direct action to reduce emissions, we can influence the way others respond by raising awareness of the need for action and providing practical advice on what people can do to make a difference. Furthermore, we must also prepare for the impact of climate change, which is already affecting local communities.

Purpose

The purpose of this strategy is to identify and prioritise in a coherent and strategic manner the actions expected of Devon County Council by Government to tackle the causes of climate change and to prepare for its impacts.

Scope

The strategy seeks to put global warming and climate change in a Devon context by making the issue relevant to the people of Devon. In particular, it:

- Examines the evidence for climate change and uses projections of future climate to determine how it could affect life in Devon and the delivery of Council services,
- Outlines the actions already being taken at international, national and local level to tackle climate change,
- Identifies a strategic framework for raising awareness of climate change, addressing its causes and managing its impacts
  and
- Considers what action the Council could take to address both the causes and impacts,

Section 6

Climate Change Science

"What is climate change and why is it happening?

The Greenhouse Effect

The Earth's surface heats up as it absorbs short-wave radiation from the Sun. This energy is redistributed across the globe by the circulation of the oceans and atmosphere, and is radiated back to space at longer (infrared) wavelengths. Atmospheric greenhouse gases such as water vapour, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) trap some of this outgoing heat energy, which warms the troposphere - the lower part of the Earth's atmosphere. This warmed air radiates energy in all directions. Some of the radiation works its way up and out of the atmosphere, but some finds its way back down to the Earth's surface. An analogy is made with the effect of a greenhouse, which allows sunshine to penetrate the glass that in turn keeps the heat in, hence the greenhouse effect. The naturally occurring greenhouse effect (see Figure 2.) keeps the surface of the Earth 33°C warmer than it otherwise would be i.e. a frigid minus 18°C.

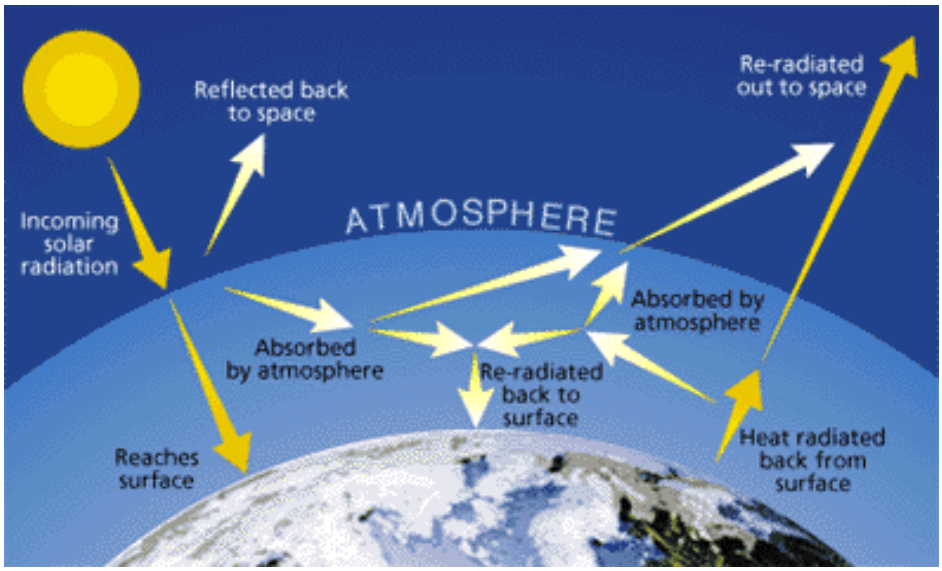


Figure 2. The Greenhouse Effect (Source: www.newscientist.com)

The Change in Atmospheric Concentration of Greenhouse Gases

Incoming solar radiation is always balanced by outgoing terrestrial radiation at an annual level and across the Earth as a whole. Any factor that alters this balance will create a

warming or cooling at the Earth's surface and in the lower atmosphere, and can affect climate. Prior to the onset of the Industrial Era around 1750, the background level of the three principal greenhouse gases had remained constant for a millennium or more. Since the beginning of the Industrial Revolution concentrations have increased directly or indirectly as a result of human activities.

- **Carbon Dioxide** - the atmospheric concentration of CO_2 has increased by a third to its highest level for 20 million years. Three-quarters of this increase is due to the burning of fossil fuels whilst the balance is attributable to changes in land use, particularly deforestation.

- **Methane** - CH_4 concentrations have increased by 151% with over half being attributable to human activities e.g. use of fossil fuels, and emissions from cattle and landfill.

- **Nitrous Oxide** - N_2O concentrations have risen by about 17% with about a third of the increase attributable to anthropogenic causes such as the use of nitrogen fertilisers and cattle feed.

In addition, modern industrial processes have introduced halocarbons (e.g. chloroflourocarbons - CFCs) and their substitutes (e.g. hydroflourocarbons - HFCs), perflourocarbons (PFCs) and sulphur hexaflouride (SF_6) into the atmosphere. These substances, some of which are also ozone depleting, are potent greenhouse gases which, in extremis, may have an atmospheric life of 50,000 years and a global warming potential (GWP) 22,000 times greater than CO_2. By comparison, methane and nitrous oxide are merely 23 and 296 times more effective than CO_2 in their GWP.

There is little doubt that the human influence will continue to change the atmospheric concentration of greenhouse gases throughout the 21st century. Projections of future concentrations are expected to be dominated by increases in CO_2 from the continued burning of coal and our remaining reserves of oil and gas, and further changes in land use resulting in the loss of the world's remaining tropical rainforests. In a '*business-as-usual'* world, CO_2 concentrations will be double the pre-Industrial level by the middle of the 21st century. They will double again by the end of the century. At such concentrations global average surface temperature will rise by up to 5.8°C and sea level by almost a metre. In order to stabilise atmospheric concentrations of greenhouse gases at lower levels and reduce the impacts of climate change, emissions need to drop below 1990 levels within a few decades and continue to decrease steadily thereafter until they are but a small fraction of what they are today (IPCC, 2001[d]).

Section 7

Observed Climate Change

"How has climate and sea level changed in the recent past?"

Observed Global Climate Change

The significant increases in concentrations of greenhouse gases since 1750 have made the atmosphere more efficient at trapping heat generated from solar radiation and have enhanced the natural greenhouse effect. In turn, the hydrological cycle has become more dynamic because a warmer atmosphere can also hold more moisture. The observed *'global warming'* during the Instrumental Period (since 1861) has been 0.6°C± 0.2°C. Most of the warming has occurred during two periods - 1910 to 1945 and since 1976 (see Figure 3). The 1990s was the warmest decade and 1998 remains the warmest year in the instrumental record followed closely by 2002, 2003 and 2004. New analyses of proxy data (e.g. tree rings) for the Northern Hemisphere indicate that the increase in temperature in the 20th century is likely to have been the largest of any century during the past 1,000 years. Moreover, it is very likely that rainfall has increased by up to 1% over most Northern Hemisphere mid-latitudes and that there has been up to 4% increase in the frequency of heavy precipitation events. In addition, global average sea level has risen by up to 0.2 metres during the 20th century mainly as a result of the thermal expansion of the oceans (IPCC, 2001[c]).

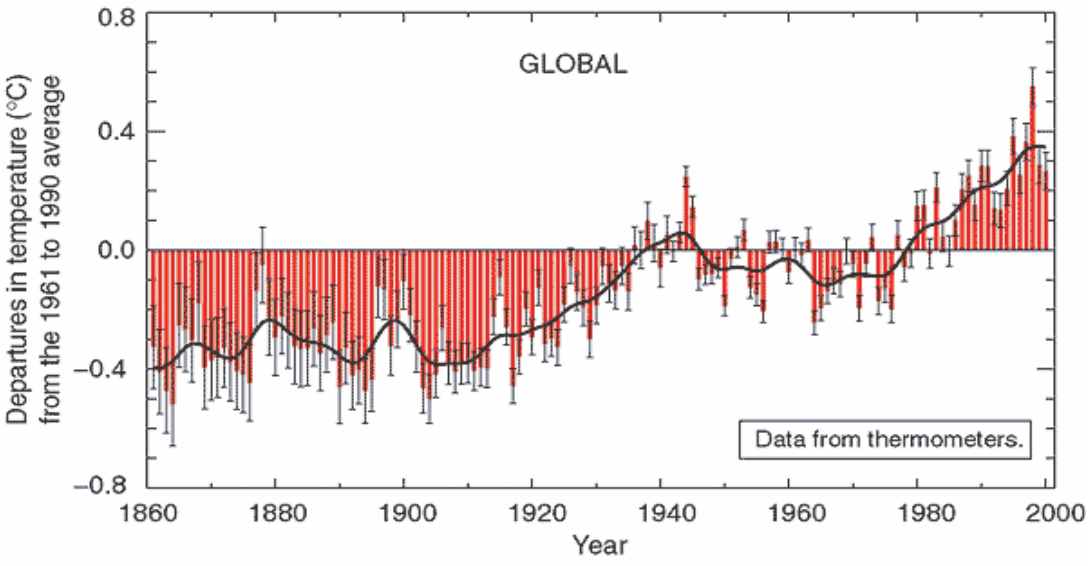


Figure 3. Variations of the Earth's surface temperature during the Instrumental Period. (Source: IPCC, 2001[c])

Trends in the UK Climate

Temperature. The climate of the UK is warmer now than it has been at any time since measurements began in the 17th century. Of the twenty warmest years in the 343-year Central England Temperature Record no fewer than ten have occurred since 1989. The 1990s is the warmest decade in the entire series and is 0.5°C warmer than the average 1961-90 climate i.e. the World Meteorological Organisation's current climate period which is used as the baseline throughout the global climate change community. The record also shows that winters of the last decade (1994 -2003) have warmed by 1.2°C since the beginning of the 19th century. The last 30 years have also witnessed an unusual sequence of warm summers - 1975/6, 1983, 1989, 1995, 1997 and 2003. The summer warming has led to more frequent hot (+25°C) and very hot (+30°C) days in the UK. The highest ever temperatures in the UK were recorded during August 2003 when the previous UK record of 37.1°C at Cheltenham on 3rd August 1990, was beaten by a number of stations on 10th August 2003. Brogdale near Faversham in Kent reported the highest at 38.5°C (101.3°F). These warm summer temperatures have been associated with high sunshine totals and 2003 was the sunniest summer (1720.8 hours) in the 90-year England and Wales Sunshine record closely followed by 1995, 1989 and 1990. The 20th century warming over Central England has resulted in the lengthening of the thermal growing season by about one month mainly as a result of the earlier onset of spring.

Precipitation. Unlike temperature there are no long-term trends evident in the amount of annual precipitation the UK receives and quantities vary greatly from year to year and from decade to decade. For example the year 2000, which was the wettest year (1232.5 mm) in the England and Wales Precipitation Series in the 20th century, had 62% more precipitation than 2003 (761.4 mm), a relatively dry year. There is, nevertheless, evidence of a changing seasonal distribution of precipitation over England and Wales, with winters getting wetter and summers drier. In this regard, 1995 was an exceptional year with a very wet winter and a very dry summer. The year 2000 also included the wettest autumn in the England and Wales series when very nearly twice the seasonal average rainfall of 257 mm was recorded.

Storms. Windiness is an important aspect of the UK climate. The 119-year record of gales over the country suggests that since 1988 a record number of severe gales (Beaufort Force 9) have been witnessed, although the frequency of ordinary gale events (Beaufort Force 8) has not changed. In 1990, for example, 20 severe gales occurred, two more than the previous highest total in 1916. That said, the evidence for the recent increase in gale frequencies being related to anthropogenic-induced warming remains unconvincing.

Sea Level. After adjustment for natural land movements, the average rate of sea-level rise during the last century around the UK coastline was approximately 1 mm per year. There is no evidence for a long-term change in UK storm surge statistics.

Changes in the Climate of Devon

Climate. The South West Peninsula is the mildest area in Britain being thrust well forward into the mild rain-bearing winds of the Atlantic. This oceanic location produces a warm temperate humid climate with only occasional frost that is tempered throughout the year by the influence of the sea. Such extreme Atlantic coastal areas are defined by Tansley as having *"low summer and high winter temperatures, moderate precipitation and below average sunshine for their latitude"* (Tansley, 1939).

Temperature. The sea of the western approaches has the highest average temperature of any sea area near to the UK i.e. 11 to 12°C. With winds blowing from the sea the annual average temperature of the coastal areas of Devon reflects the sea temperature. Woolacombe on the north coast is the warmest location at 11.2°C whilst the resorts of the English Riviera average around 10.6°C. Away from the coast altitude is the main factor affecting temperature. Princetown (414m) on Dartmoor has a mean annual temperature of 8.4°C whilst Hangingstone Hill (604m) records an average of 7.4°C. The long term average annual temperature for selected locations in Devon is shown at Figure 4.

Temperature shows both seasonal and diurnal variations but due to the modifying effect of the sea the range of these variations is less than in most other parts of the UK. The sea reaches its lowest temperature in February/early March thus making February Devon's coldest month. The strong maritime influence normally prevents extreme low temperatures but very low minima have been recorded when strong, cold easterly winds replace the dominant south-westerlies. Such an occasion was 13th January 1987 when a minimum temperature of -8.9°C was recorded at Exmouth. Away from the coast spells of frosty weather with clear and calm nights have produced records such as -15.0°C at Exeter Airport on 24th January 1958.

July and August are the warmest months in Devon with an average daily maximum temperature of around 18°C. Instances of extreme high temperatures are rare being associated with hot air brought from mainland Europe on south-easterly winds and accompanied by strong sunshine. The hottest day in Devon was 3rd August 1990 when 35.4°C (96°F) was recorded at Saunton Sands. Temperatures in excess of 31°C (88°F) were recorded at a number of locations in the county on 29th June 1976.

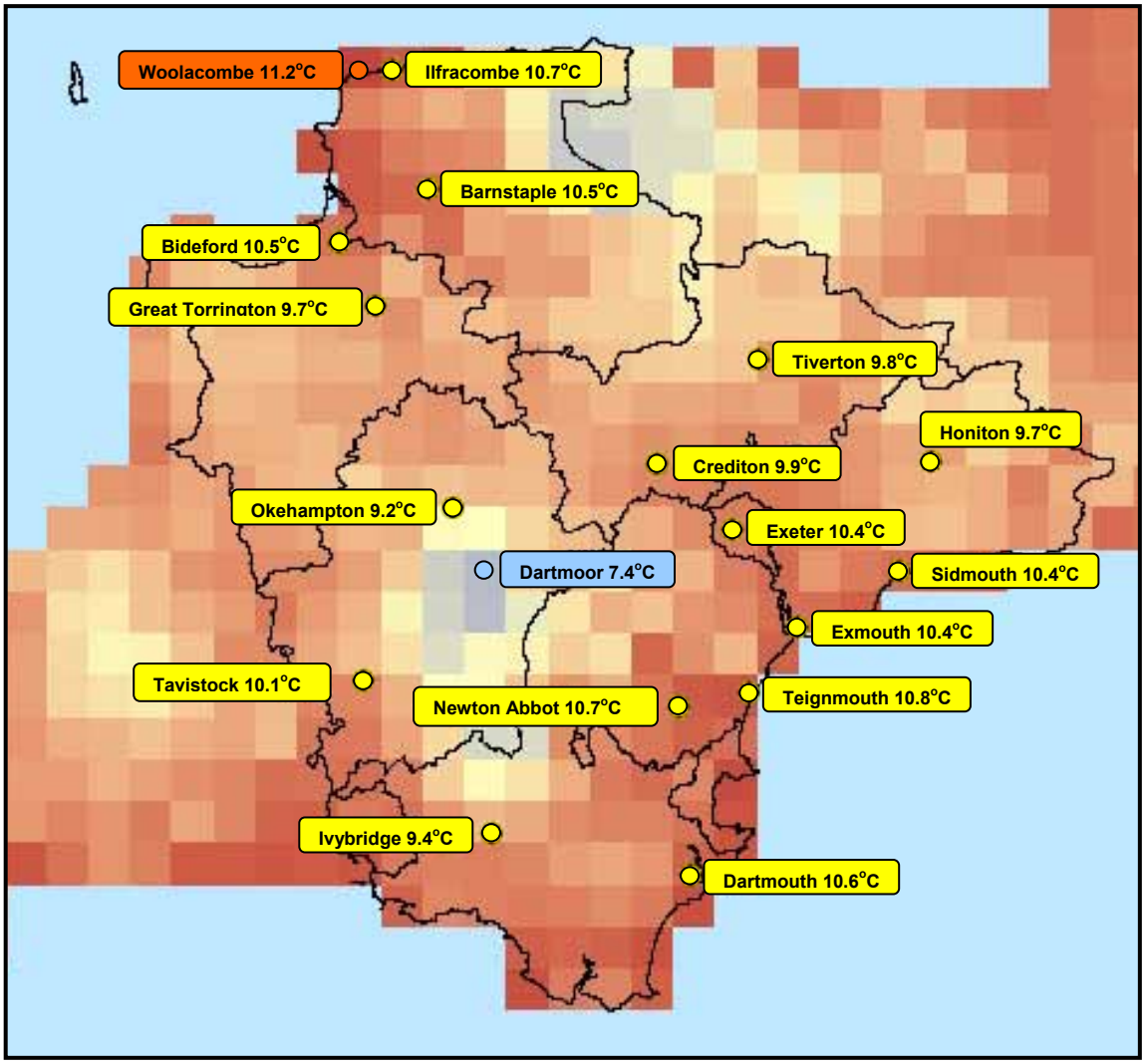
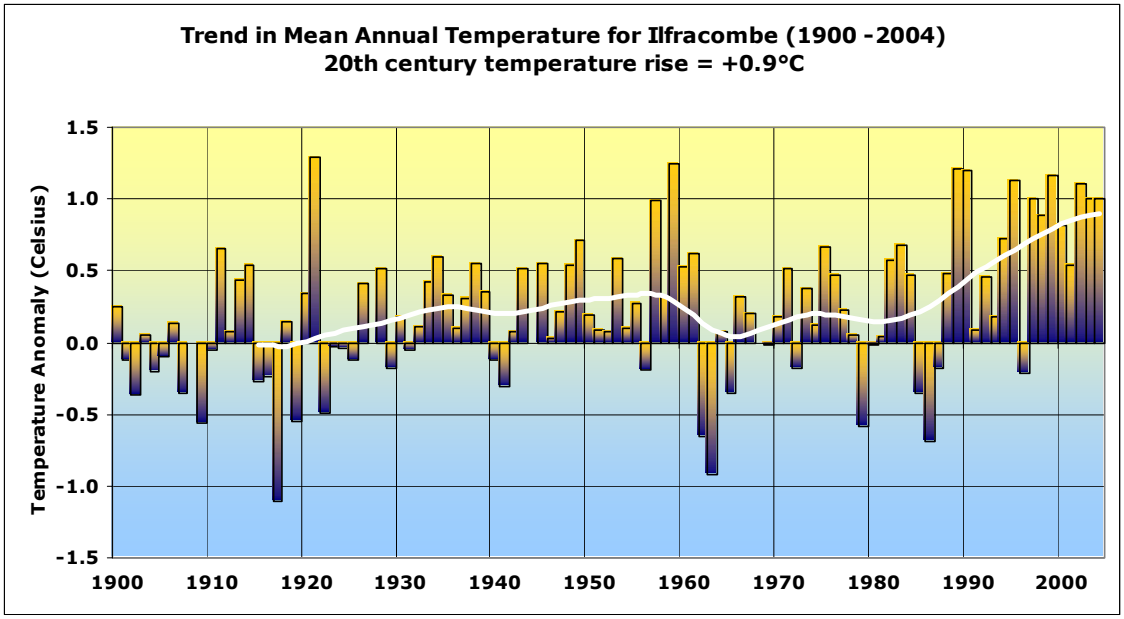
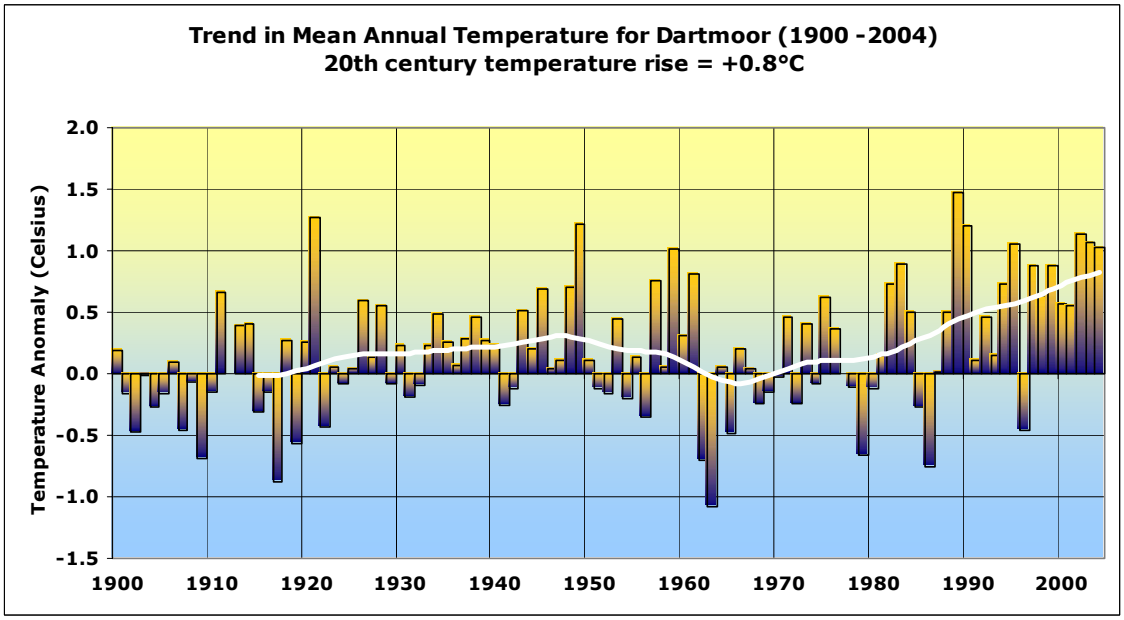
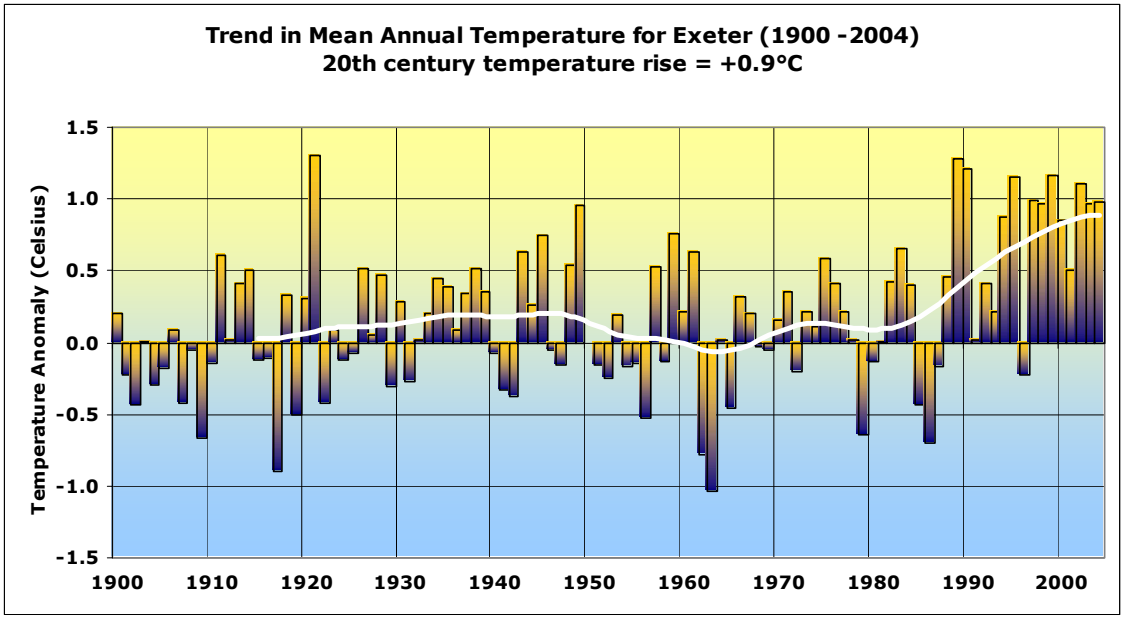


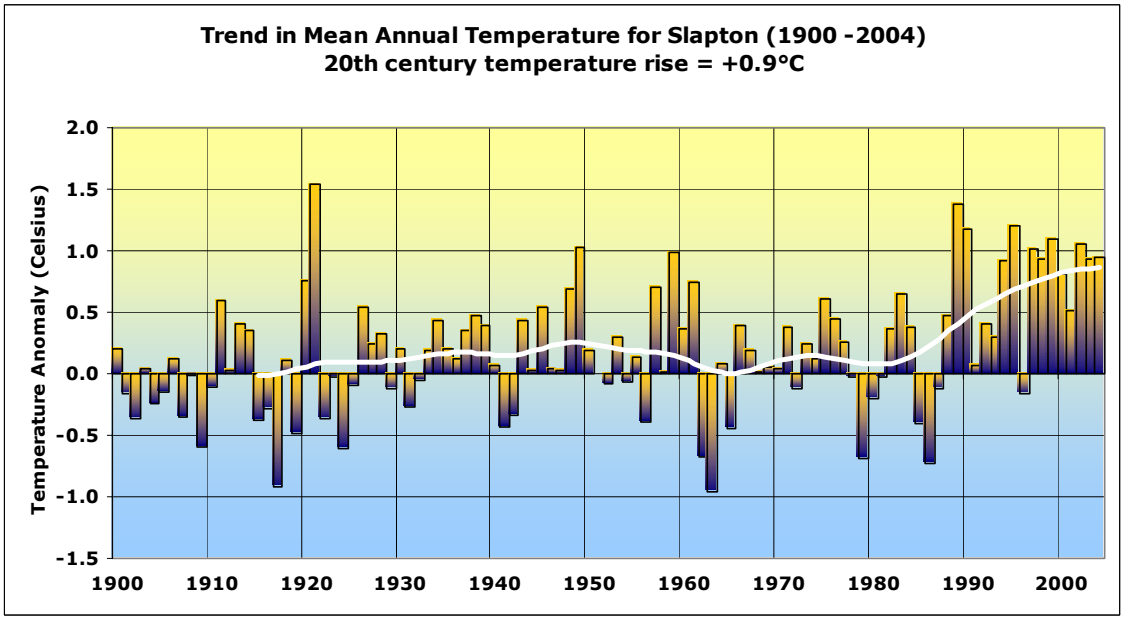
Figure 4. Long-term average annual temperature in Devon (1961 – 1990).

Using data supplied by the Met Office it is now possible to assess the temperature rise associated with climate change over the 20th century at most locations across the county. The details for Ilfracombe (north coast), Dartmoor (central moorland), Exeter (central lowland) and Slapton (south coast) are shown at Figures 5a – d. Each of the four locations has recorded a rise of between 0.8 and 0.9°C since 1900. Whilst some warming occurred during the first half of the century most of the warming has been since the mid 1960s. The warmest decade has been the 10 year period since 1995 during which 7 of the 10 warmest years recorded in Exeter have occurred. Only 1921, 1989 and 1990 were warmer.


Trend in Mean Annual Temperature for Ilfracombe (1900 -2004)
20th century temperature rise = +0.9°C
Temperature Anomaly (Celsius)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000


Trend in Mean Annual Temperature for Dartmoor (1900 -2004)
20th century temperature rise = +0.8°C
Temperature Anomaly (Celsius)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000





Figures 5a – d. Global Warming in Devon (1900 – 2003)

Data source: Met Office.

Precipitation. Rainfall is caused by the condensation of water vapour in air that is being lifted. This can occur within a frontal system associated with an Atlantic depression (i.e cyclonic rainfall), by convection during the warm summer months and where moist air is

forced to ascend hills (i.e. orographic rainfall). As Atlantic depressions are more vigorous in autumn and winter, most of the rain that falls in these seasons is cyclonic. Such rainfall totals are often increased by the impact of altitude on the passage of fronts across the south-west peninsula. In summer, rainfall in the form of showers and thunderstorms results from convection currents caused by solar heating.

Annual rainfall totals of 900 to 1000mm are normal around the coasts of Devon. This amount doubles over the upland areas of Dartmoor (2278mm) and Exmoor but may be somewhat less in the rain shadow to the lee of high ground (807mm in Exeter). The driest place in Devon is Exmouth with 749 mm. The long term average annual precipitation for selected locations in Devon is at Figure 7.

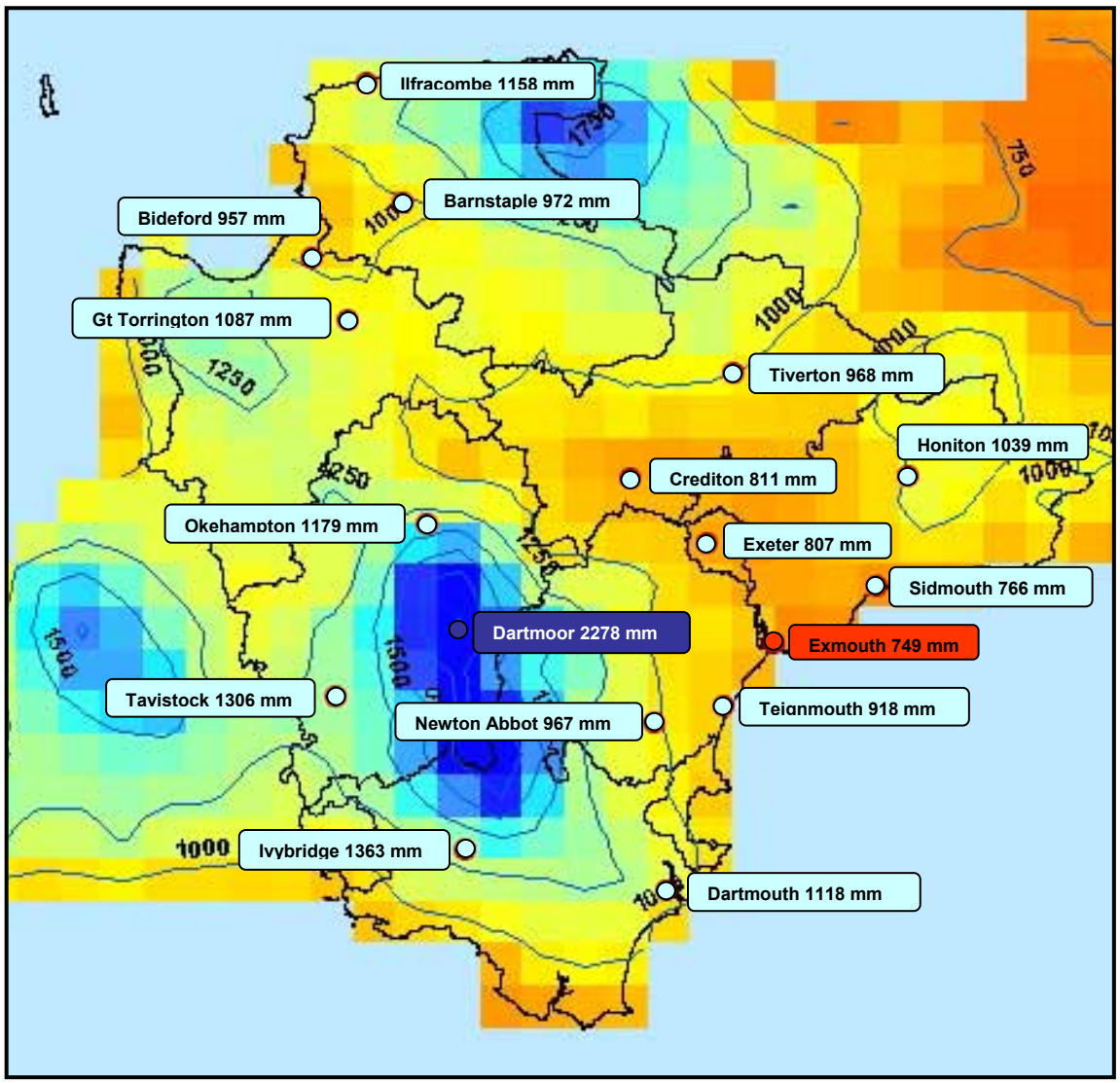


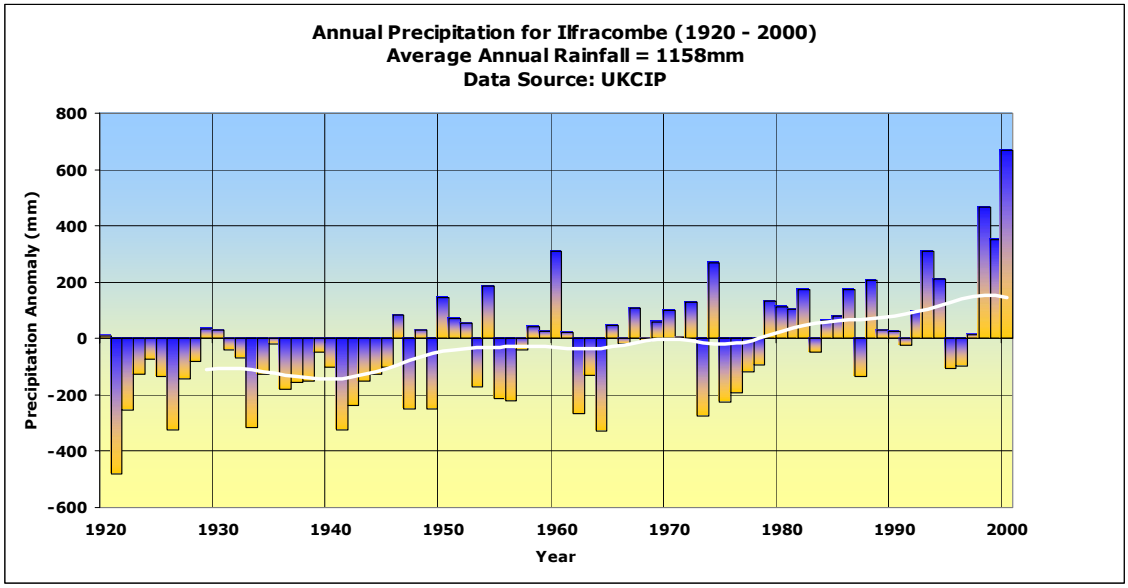
Figure 6. The long term average annual precipitation in Devon (1961 – 1990).

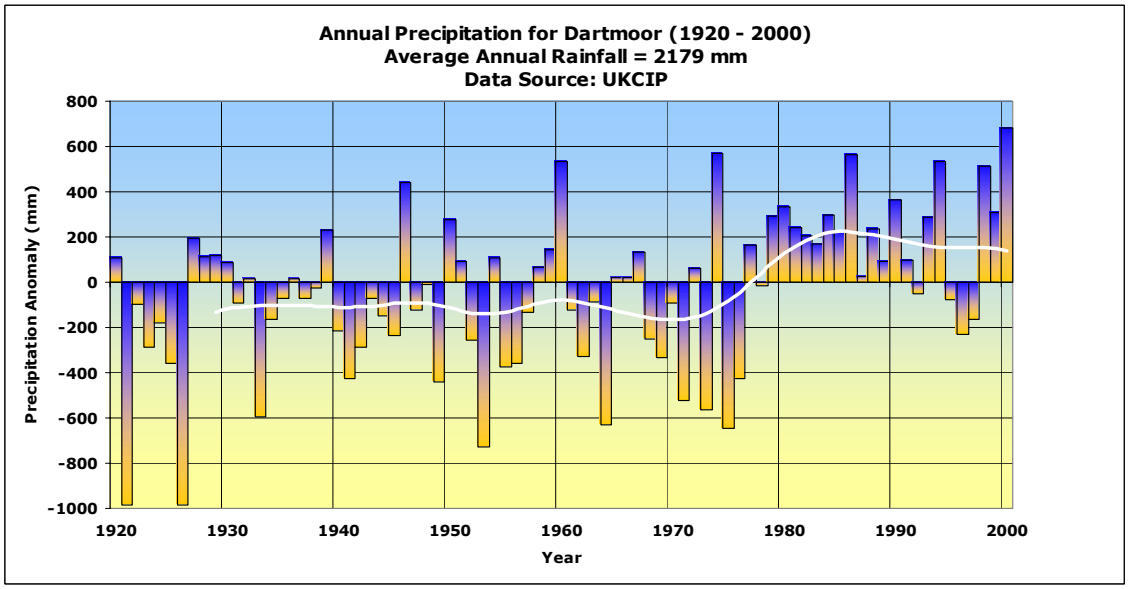
The south-west peninsula is prone to rare but very heavy rainfall events of relatively short duration. On 15th August 1952 228.6mm of rain fell on Long Barrow, Exmoor in 12 hours. The swollen East and West Lyn rivers destroyed the centre of Lynmouth in north Devon and claimed 34 lives.

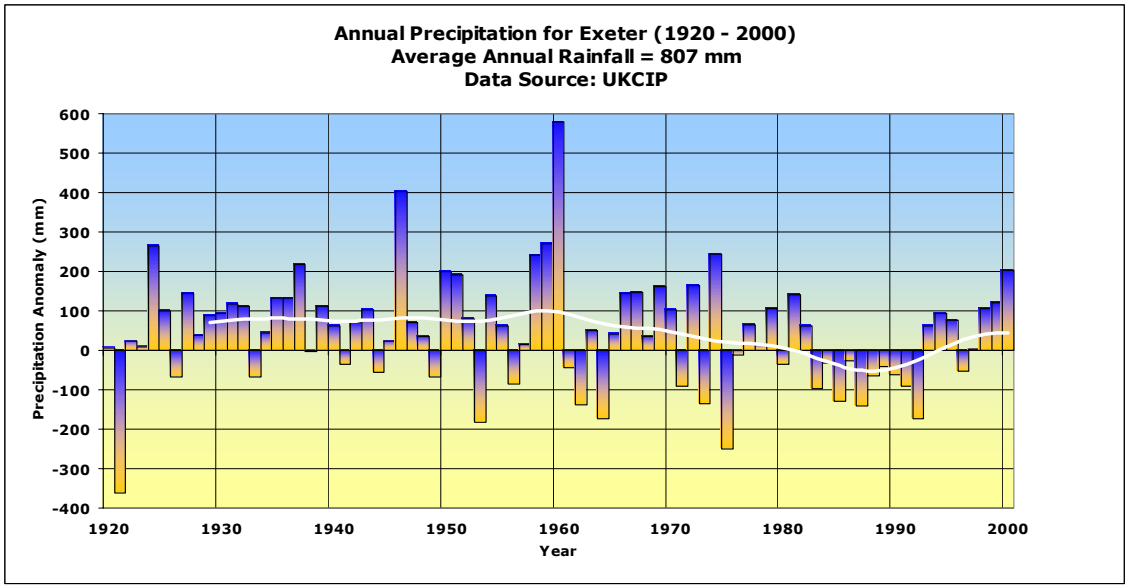
Unlike temperature, which can be averaged on an annual or seasonal basis over a wide area, rainfall varies considerably between location and on a daily, monthly, seasonal, annual and climatic (i.e. over 30 years) scale. In Devon there are many rainfall gauges reporting daily precipitation quantities and some stations like Teignmouth have continuous records stretching back to 1900 (see Burgess, 2001). Such data has been collated by the Met Office and it is now possible to assess the variation in precipitation associated with climate change over the 20th century at most locations across the county. The details for Ilfracombe, Dartmoor, Exeter and Slapton are shown at Figures 7a – d.

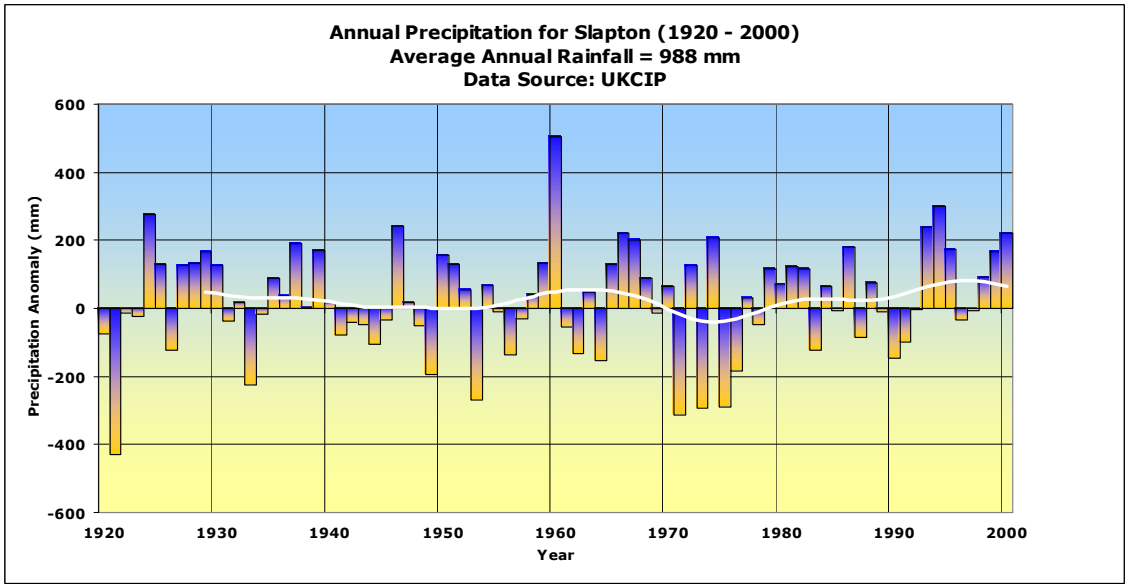
Analysis of these records shows some statistically significant trends in the annual amount of precipitation. On Dartmoor and at Ilfracombe rainfall has increased since the late 1970s. Conversely, there has been significant drying in Exeter but no measurable change on the south coast at Slapton. In all records 1921 was a very dry year being over 40% drier than the average. 1960 and 2000 were extremely wet when over 50% more than the average annual precipitation fell.

In addition to these regional changes in annual rainfall, there are some important changes taking place in the seasonality of rainfall as measured by the changing ratio of winter to summer rainfall. This index, known as the '*seasonality ratio'*, shows a significant difference in all 4 records between the periods before and after 1976 denoting that summers are getting drier and winters wetter. This is largely due to the unusual sequence of hot summers experienced across the UK as mentioned above.


Annual Precipitation for Ilfracombe (1920 - 2000)
Average Annual Rainfall = 1158mm
Data Source: UKCIP
Precipitation Anomaly (mm)
800
600
400
200
0
-200
-400
-600
1920
1930
1940
1950
1960
1970
1980
1990
2000
Year


Annual Precipitation for Dartmoor (1920 - 2000)
Average Annual Rainfall = 2179 mm
Data Source: UKCIP
Precipitation Anomaly (mm)
800
600
400
200
0
-200
-400
-600
-800
-1000
1920
1930
1940
1950
1960
1970
1980
1990
2000
Year





Figures 7a – d. Changes in Precipitation in Devon (1920 – 2000)

Data source: UKCIP.

Sea Level. In addition to climate-induced changes in sea level, regional land movements also need to be considered to provide an estimate of relative sea level rise. One of the main reasons for regional land movement in the UK is the on-going isostatic adjustment caused by deglaciation at the end of the last Ice Age about 18,000 years ago. Whilst much of northern Britain is rebounding now that the weight of ice sheets up to 1.5 km thick has been removed, much of southern Britain is sinking forming features such as the distinctive ria coastline of southern Devon. For the South West the present rate of subsidence is estimated at between 0.1 and 1.4 mm/year. Therefore, it is likely that relative sea level rise along the coasts of Devon has been greater than the average sea level rise around the coast of Britain over the 20th century i.e. +0.1 metre.

Summary

The mean annual temperature in Devon has increased since the cooler period of the 1950s and 1960s in line with both global and UK warming trends. Most of the warmest years on record have occurred over the last fifteen years. There has also been an unusual sequence of warm summers during this post 1960s period with summer 2003 now being acknowledged as a climate change event. From an annual precipitation perspective there have been some significant changes in rainfall totals in both directions which contradict a projected marginal drying caused by climate change. That said, annual rainfall totals remains inherently variable due to entirely natural causes. However, there is a significant change in the seasonality of both UK and Devon rainfall with winters becoming wetter and summers drier. This is in line with modelling predictions. Relative sea level continues to rise.

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Section 8

Climate Change Projections

"How might climate change in the 21st century?

When will it happen and how long will it last?"

Simulating Future Climate

Climate change projections are carried out using sophisticated computer models to simulate future global and regional climates. The Meteorological Office's Hadley Centre for Climate Prediction and Research in Exeter has both global and regional climate models which provide the UK's input to the international and domestic effort to project future climates. Whilst the UK Climate Impacts Programme's (UKCIP) Climate Change Scenarios for the UK (Hulme et al, 2002) use the Hadley Centre's output, different models produce different patterns and magnitudes of climate change over the UK. This variation between models is a primary source of *'uncertainty'* in projecting future climate. Based on projected seasonal changes in temperature and rainfall, the Hadley Centre's global climate model simulates changes close to the middle of the range for winter but is *'drier'* in summer than most models.

Emissions Scenarios

The progress of climate change in the 21st century depends on future greenhouse gas emissions which in turn will be determined by how population grows and how economies, energy technologies and societies develop. These socio-economic factors provide further sources of uncertainty in projecting climate change. The Intergovernmental Panel on Climate Change (IPCC) has developed a range of projections for future emissions known as *'emissions scenarios'* based on four socio-economic *'storylines'* each describing a possible future world. The storylines are designated A1FI, A2, B1 and B2 and are outlined at Box 4.

Summed over the 21st century, the A1FI storyline – the '*business as usual'* scenario - has the highest emissions total which is more than twice that of B1, the lowest scenario. The UKCIP has designated these two extremes the *'high emissions'* and *'low emissions'* scenarios respectively, which in turn could be considered as worst and best case projections from today's perspective. This concept of a range of climatic change defined by upper and lower limits is used throughout the next sections on projected climate change.

Box 4. The Storyline Description for Emissions Scenarios

A1FI. World Markets – Fossil Fuel Intensive.
Very rapid economic growth; population peaks mid-century; social, cultural and economic convergence among regions; market mechanisms dominate.

A2. National Enterprise.
Self-reliance; preservation of local identities; continuously increasing population; economic growth on regional scales.

B1. Global Sustainability.
Clean and efficient technologies; reduction in material use; global solutions to economic, social and environmental sustainability; improved equity; population peaks mid-century.

B2. Local Stewardship.
Local solutions to sustainability; continuously increasing population at a lower rate than in A2; less rapid technological change than in B1 and A1FI.

Global Climate Projections

The principal consequences of climate change are usually described by changes in four key attributes - temperature, precipitation, extreme weather events and sea level - over a specified time period. Box 5 outlines the projected global changes in these attributes by the end of the 21st century.

Box 5. Global Climate Projections to 2100

Temperature. The global average surface temperature is projected to rise by 1.4 to 5.8°C. This rate of warming will be much larger than observed changes during the 20th century (+0.6°C) and is very likely to be without precedent during the last 10,000 years. Nearly all land areas will warm more rapidly than the oceans; warming will be greater at the poles than at the equator.

Precipitation. Globally, average precipitation is projected to increase although there will be regional differences. For Northern Europe, winters will become wetter and summers may become drier. Where average rainfall is projected to increase, larger year to year variations are likely.

Extreme Weather Events. As average surface temperature rises it is very likely that both higher maximum temperatures and more hot days, and higher minimum temperature and fewer cold/frost days will occur over nearly all land areas. More intense precipitation events are also expected.

Sea level. Global mean sea level is projected to rise by 9 to 88 cm due to the thermal expansion of the oceans and loss of mass from glaciers and ice caps.

...and for how long?

Emissions of long-lived greenhouse gases like CO_2 have a lasting effect on climate. In order to reduce this impact, emissions need to be reduced to a fraction of what they are today in order to stabilise greenhouse gas concentrations in the atmosphere. Once stabilisation has been achieved global average surface temperature is projected to rise for several centuries as a consequence of the time it takes for the deep ocean to adjust to climate change. Sea level will also continue to rise for hundreds of years as a result of the thermal expansion of the oceans. Melt water from ice sheets and glaciers will continue to contribute to sea level rise for thousands of years after emissions have been stabilised. This sequence of events is shown graphically at Figure 8.

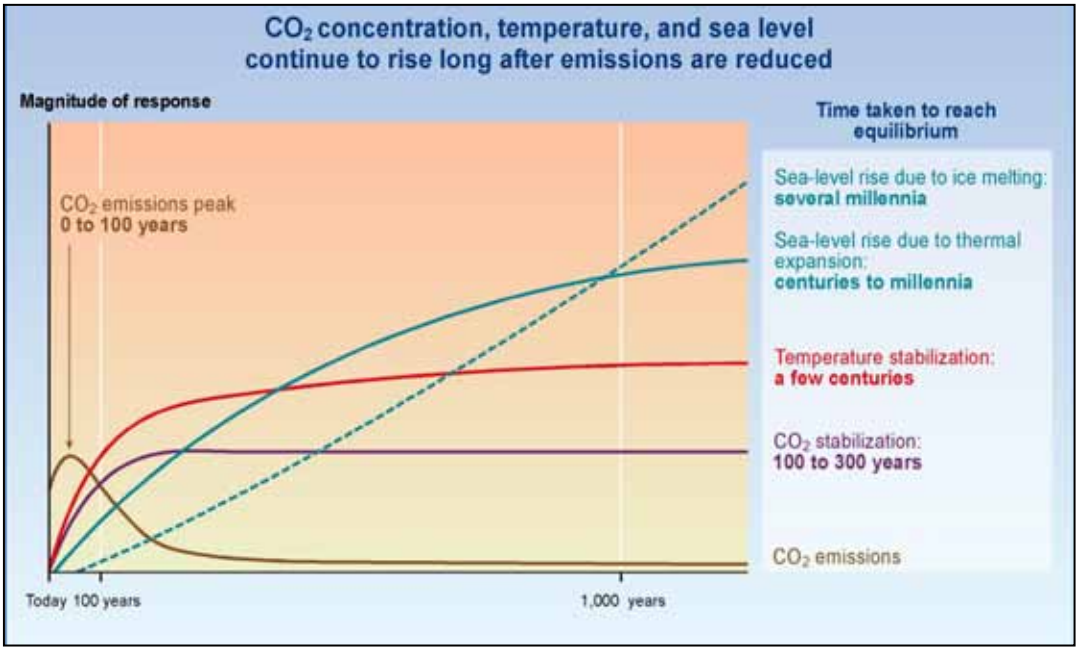

Figure 8. ...and for how long? Answer: Millennia.
Source: IPCC, 2001[d]

UK Climate Change Scenarios

For projections of climate change in the UK, the Hadley Centre's regional climate model has been used based on a 50 km resolution grid. The analysis has been carried out under the auspices of the UKCIP and climate projections have been made for each of the four IPCC scenarios over three time periods. These periods are designated the 2020s, 2050s and 2080s

which in effect represent the 30-year climate periods of 2011 to 2040, 2041 to 2070 and 2071 to 2100. The key results for the UK for the 2080s are in Box 6.

Box 6. UK Climate Change Scenarios for 2080s.

Temperature. The UK climate will become warmer with annual average temperature rising by between 2.0 and 3.5ºC. The warming will be greater in the south and east than in the north and west and there may be greater warming in summer and autumn than in winter and spring. The temperature of UK coastal waters will also increase.

Precipitation. Winters will become wetter and summers may become drier everywhere. In the south and east UK summer precipitation may decrease by more than 50% and winter precipitation may increase by more than 30%. Snowfall amounts will decrease throughout the UK.

Extreme Weather Events. High summer temperatures will become more frequent and very cold winters will become increasingly rare. A very hot August such as that of 1995 may occur as often as three years in every five. Heavy winter precipitation will become more frequent with daily precipitation intensities that are experienced once every two years becoming up to 20% heavier.

Sea Level. Relative sea level will continue to rise around most of the UK's shoreline by up to 86 cm. Extreme sea levels from storm surges will be experienced more frequently than they are now.

... and what about the Gulf Stream?

In a UK context an important feature of the global climate system is the oceanic thermo-haline circulation which transports heat from equatorial regions into high latitudes of the North Atlantic. As the Gulf Stream, this flow is responsible for the relatively mild climate of UK. Over the course of this century the Gulf Stream may weaken reducing heat transport from the Tropics into the North Atlantic region. However, this cooling effect is likely to be more than offset by the warming effect of increased greenhouse gases. This has been taken into account in the UK climate projections. The model does not show a complete shut-down by 2100.

Climate Change in the South West

The South West Climate Change Impacts Partnership (SWCCIP) has conducted its own assessment of the regional impact of climate change using Hadley Centre/UKCIP data (SWCCIP, 2003). A summary of these changes for the period to 2050 is in Box 7.

In addition to the warming effect of the Gulf Stream, the winter climate of the UK is also affected by a large scale atmospheric circulation known as the North Atlantic Oscillation

(NAO). The NAO Index is the difference in pressure between the Azores High and the Icelandic Low and is used as a measure of the *'westerliness'* of winter weather. When the NAO index is positive (a strong Azores High and deep Icelandic Low) as it has been since the 1980s the North Atlantic storm track is enhanced producing windy but mild and wet winters. A negative index, as experienced during the 1960s, is associated with colder, drier winters with fewer and weaker storms. Simulations show that the future trend is for the NAO Index to become increasingly positive suggesting that UK winters will become more westerly in nature. In addition, the modelling indicates that this enhanced storm track will shift southwards resulting in the strengthening of winter winds over the south of England. Furthermore, winter depressions will become more frequent including deepest ones.

Box 7. Climate change in the South West by 2050s

Temperature. Annual warming of 1.0 to 2.5°C is expected with greater warming in summer and autumn than in winter and spring. On a diurnal basis there will be greater night-time than day-time warming in winter; in summer the reverse may occur with greater warming during the day.

Precipitation. Whilst annual rainfall will decrease by up to 15%, a greater contrast is expected between summer (15 to 30% drier) and winter (5 to 15% wetter). Winter and spring precipitation will become more variable and snowfall totals will decrease significantly. Summers as dry as 1995 (37% drier than average) will become more common.

Extreme Weather Events. Winter depressions will become more frequent including the deepest ones. Heavy rainfall in winter will become more common. In summer the most extreme intensities of rainfall are expected to decrease.

Sea Level. Sea level will rise by between 10 and 39 cm with a consequent change in storm surge potential.

... and the forecast for Devon is...

The data used to produce the UKCIP scenarios is available at a 5 km grid resolution and can be used to provide an indication of future temperature and precipitation changes across Devon. Whilst absolute average temperatures and precipitation figures can be derived for each grid square, one has to be wary of attaching any significance to the differences in the climate parameters at this resolution. With this health warning in mind, the UKCIP data has been used to create a contoured change surface as the indicator of climate change at a county level. Temperature and precipitation projections on an annual, summer and winter basis for the high emissions scenario over the three climate periods have been used to produce Figures 9 to 14. The high emissions scenario has been selected as the "business-as-usual" scenario and therefore reflects the likely impacts of proceeding along our present development path. A summary of these projections is at Box 8.

Change in mean annual temperature (MAT) (°C) in Devon

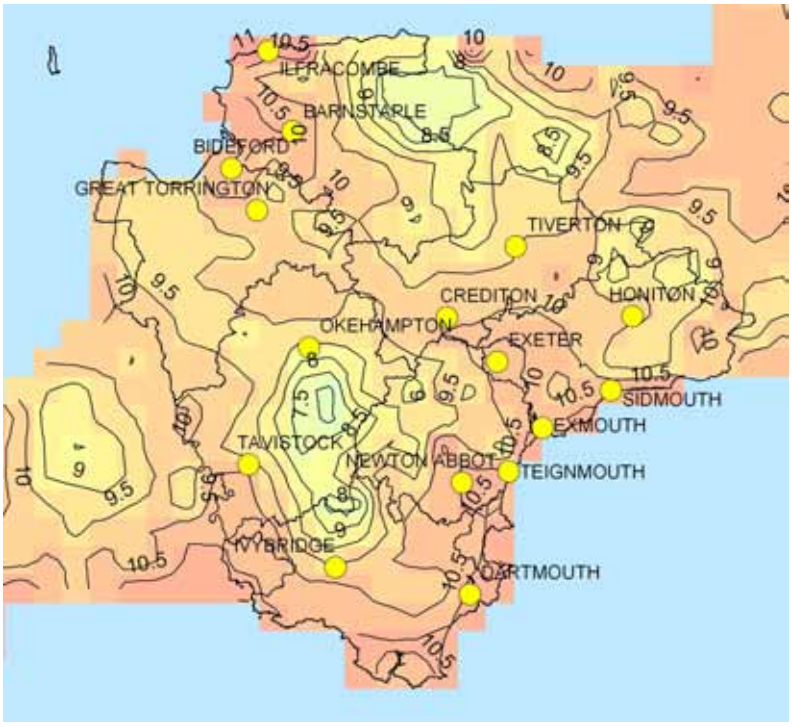

Figure 9a. The baseline MAT (°C) (1961 – 1990).

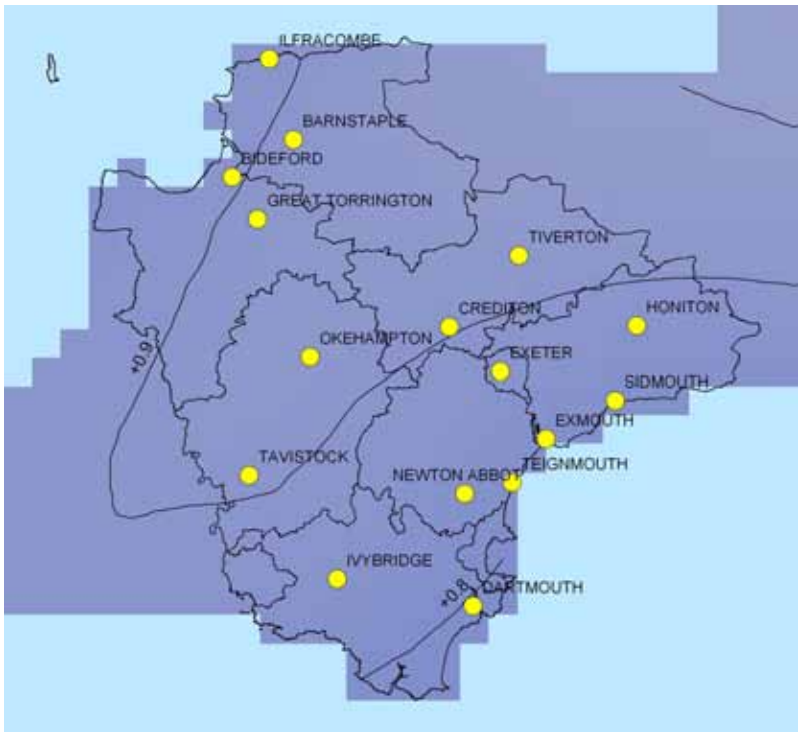

Figure 9b. The change in MAT (°C) by the 2020s (high emissions scenario).

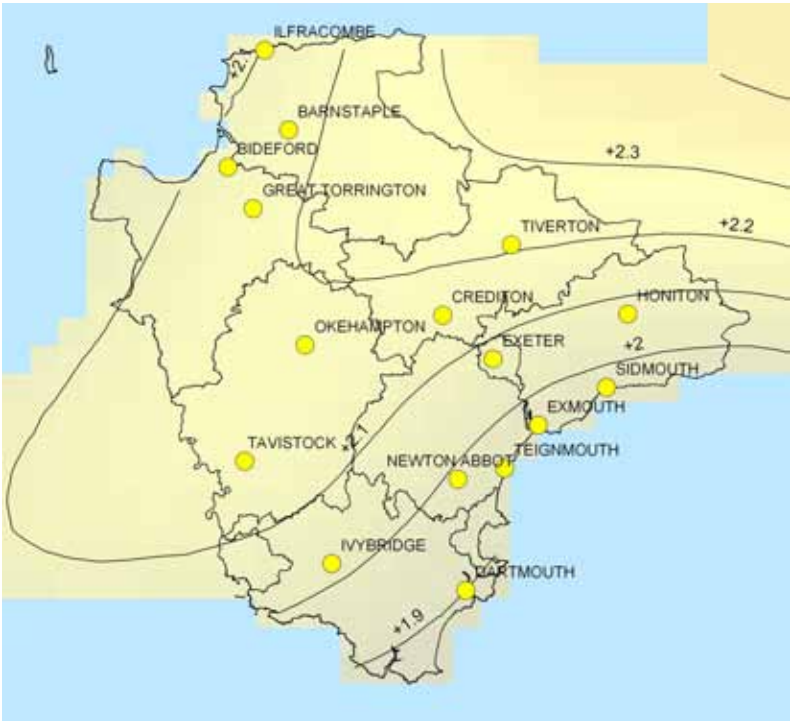

Figure 9c. The change in MAT (°C) by the 2050s (high emissions scenario).

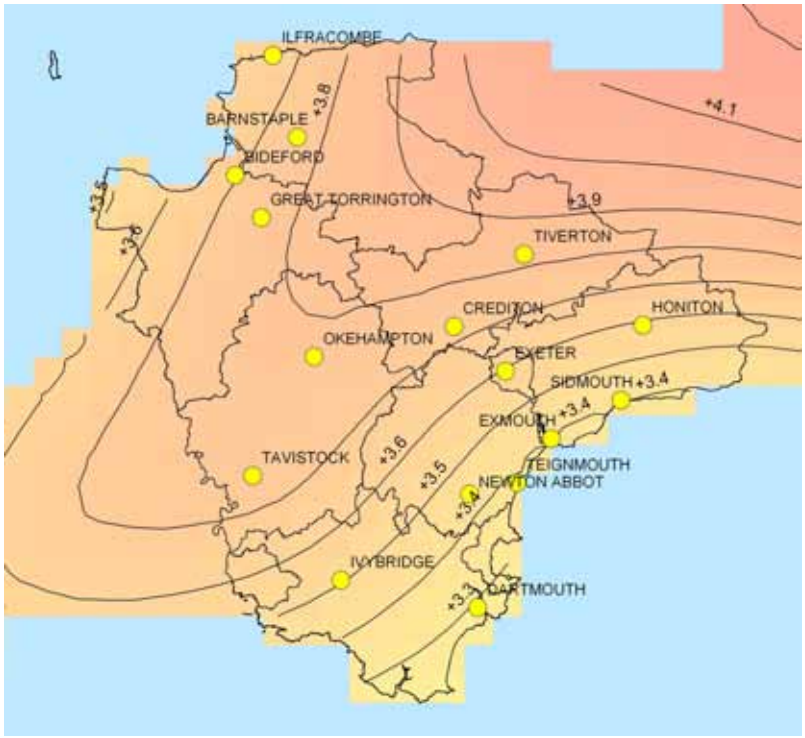

Figure 9d. The change in MAT (°C) by the 2080s (high emissions scenario).

Change in mean summer temperature (MST) (°C) in Devon

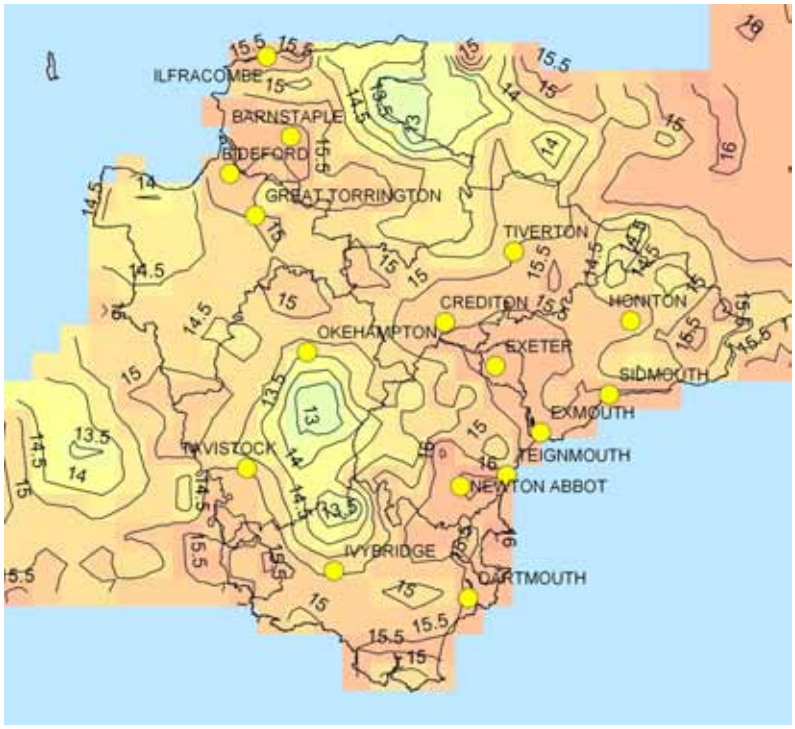

Figure 10a. The baseline MST (°C) (1961 – 1990).

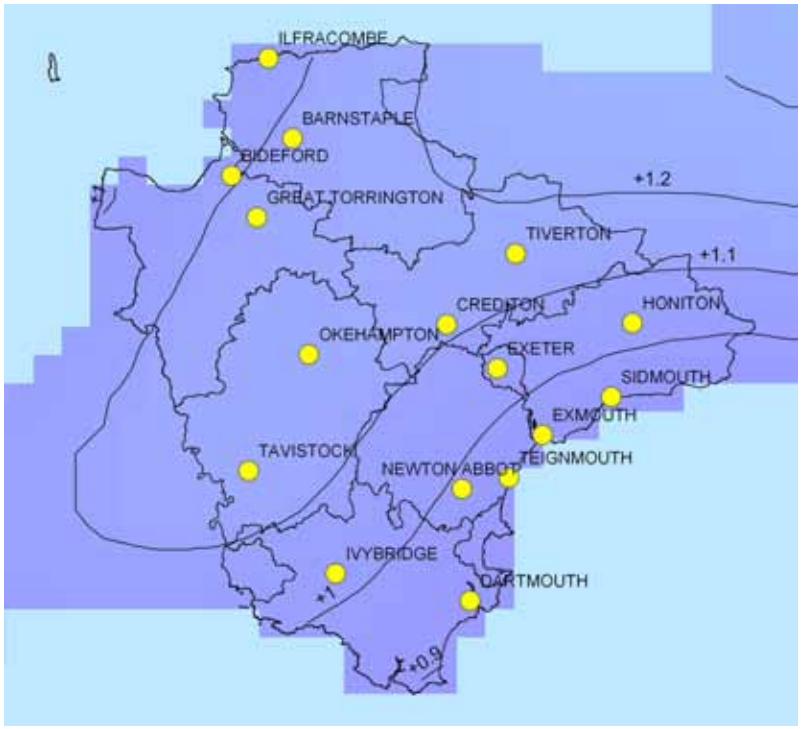

Figure 10b. Change in MST (°C) by the 2020s for the high emissions scenario.

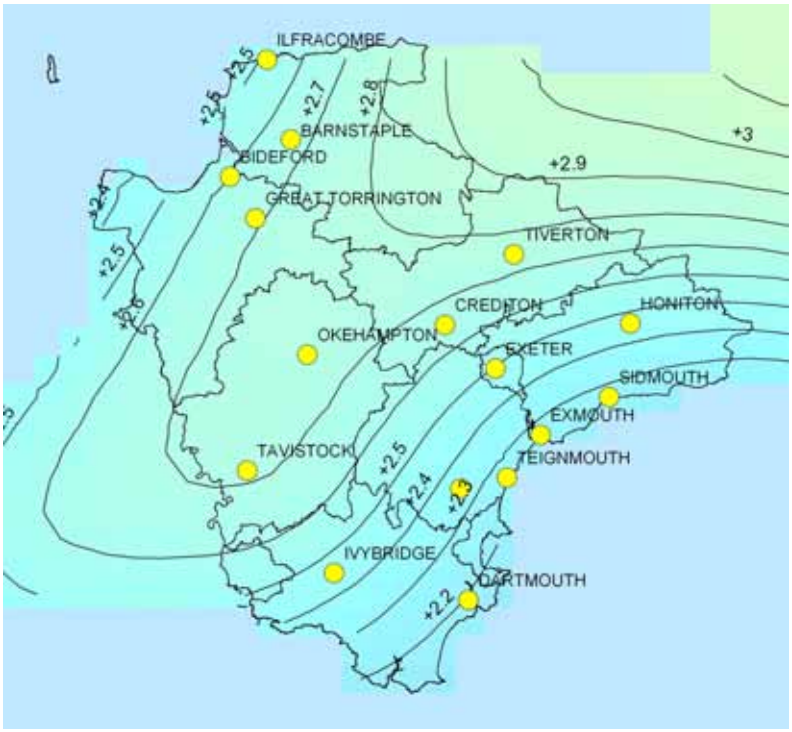

Figure 10c. Change in MST (°C) by the 2050s for the high emissions scenario.

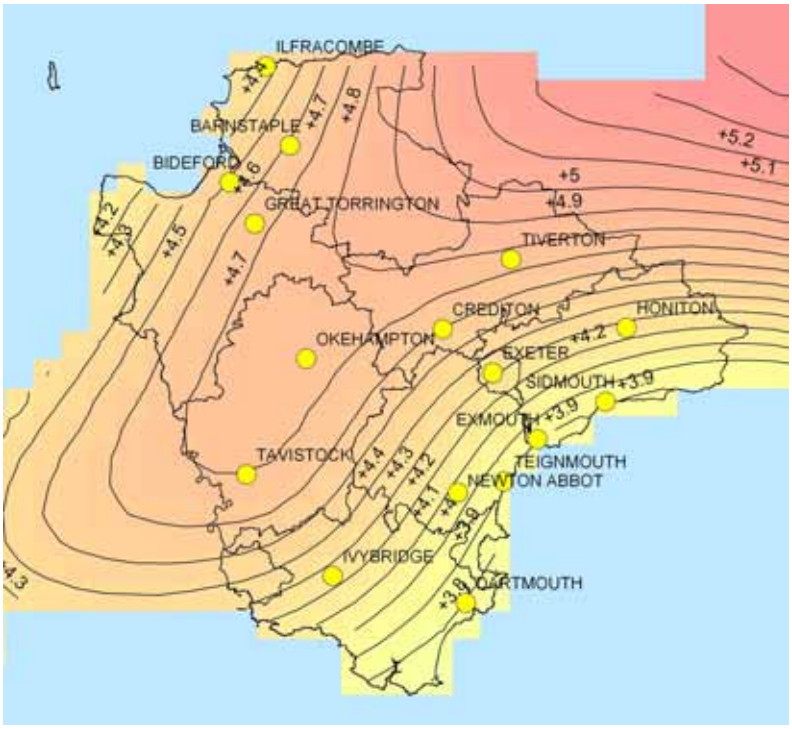

Figure 10d. Change in MST (°C) by the 2080s for the high emissions scenario.

Change in mean winter temperature (MWT) (°C) in Devon

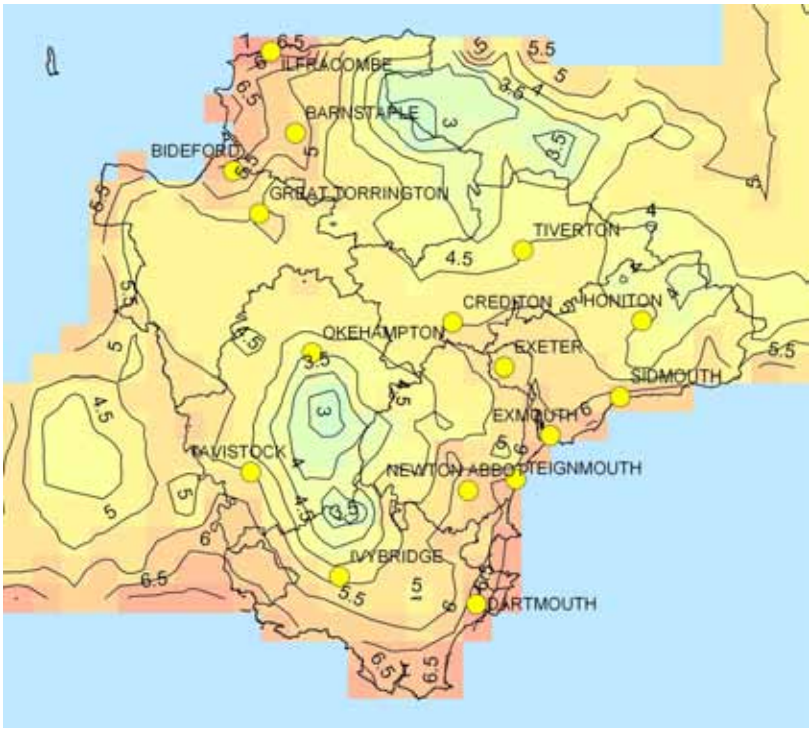

Figure 11a. The baseline MWT (°C) (1961 – 1990).

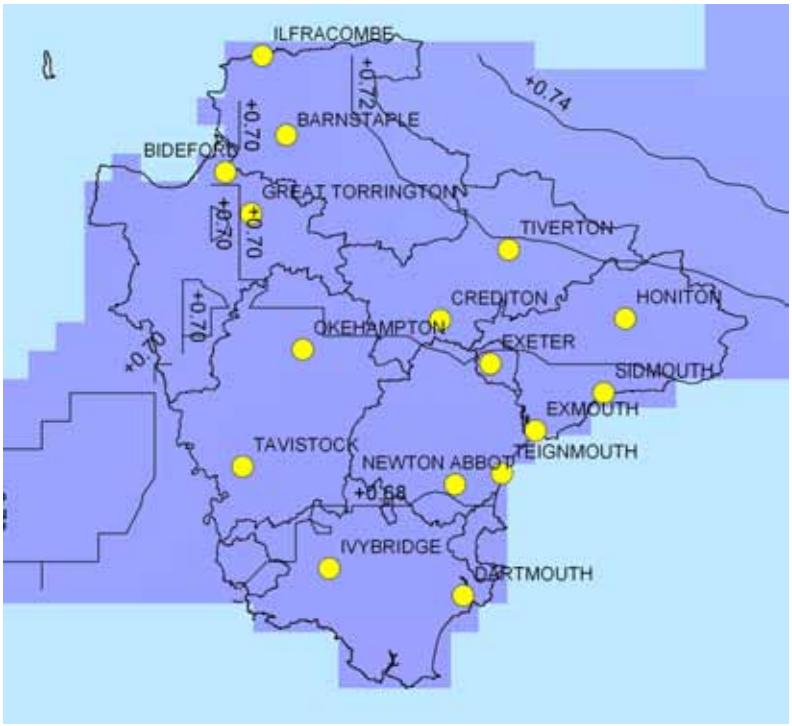

Figure 11b. Change in MWT (°C) by the 2020s for the high emissions scenario.

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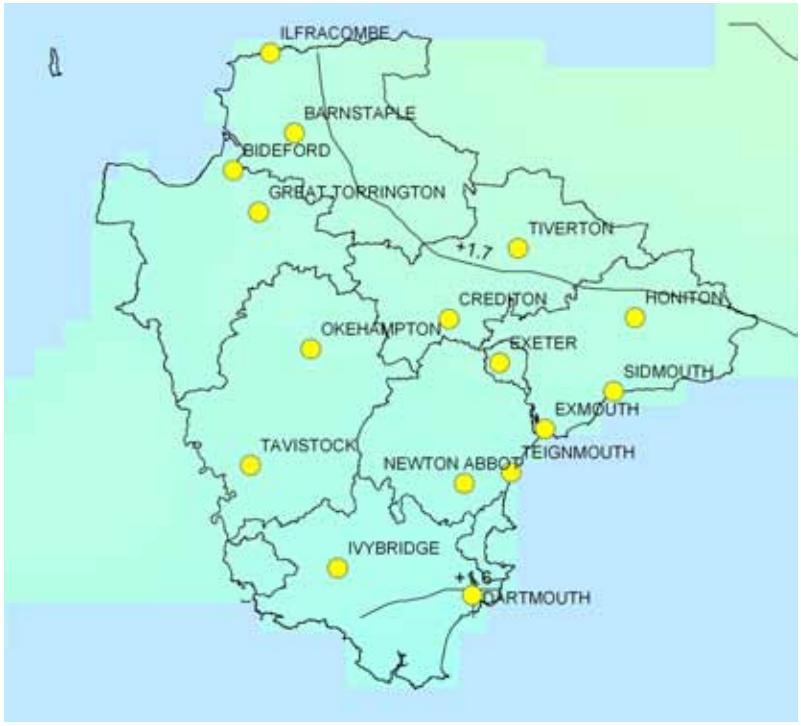

Figure 11c. Change in MWT (°C) by the 2050s for the high emissions scenario.

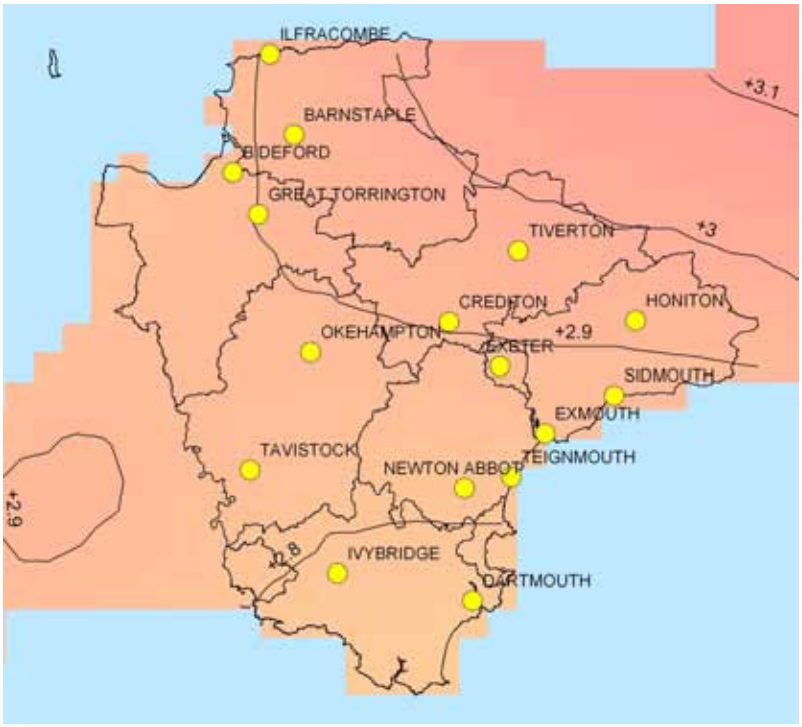

Figure 11d. Change in MWT (°C) by the 2080s for the high emissions scenario.

Percentage (%) change in mean annual precipitation (MAP) in Devon

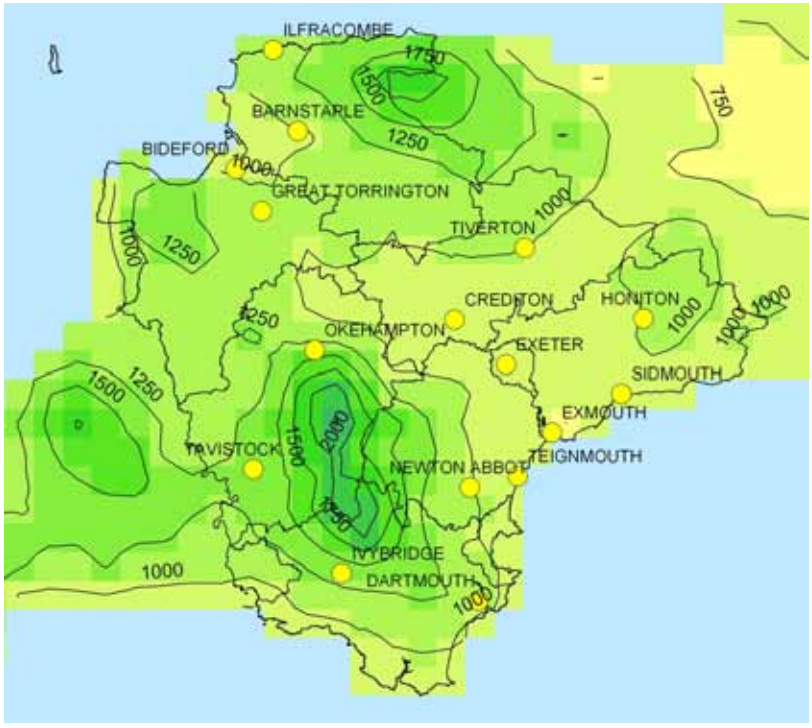

Figure 12a. The baseline MAP (mm) (1961 – 1990).

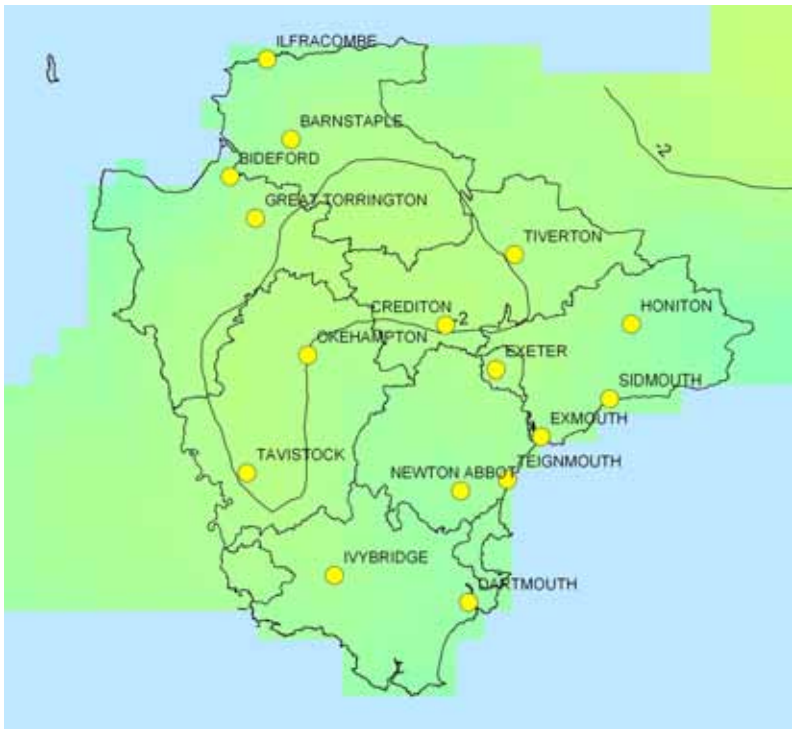

Figure 12b. Percentage (%) change in MAP by the 2020s for the high emissions scenario.

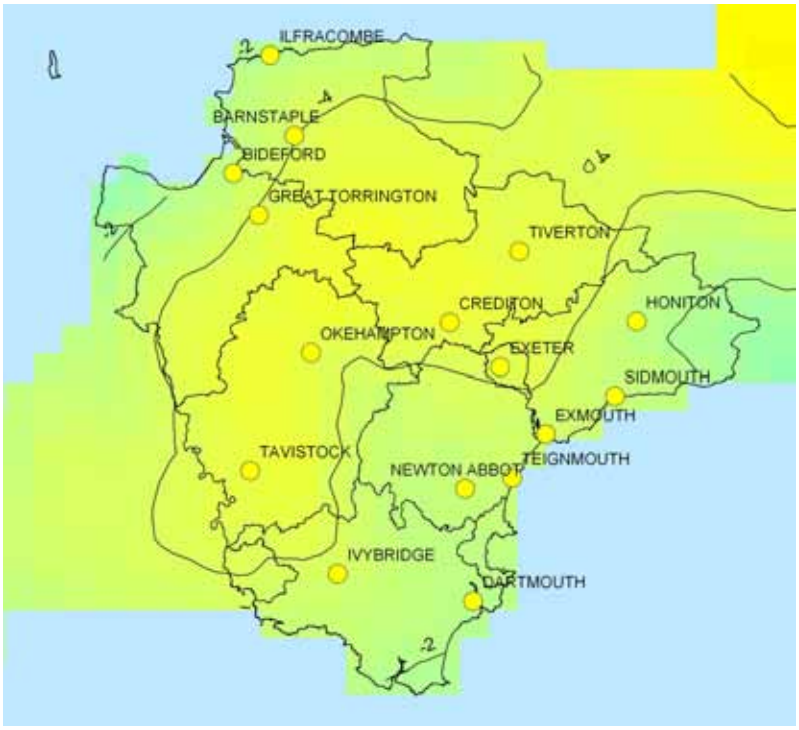

Figure 12c. Percentage (%) change in MAP by the 2050s for the high emissions scenario.

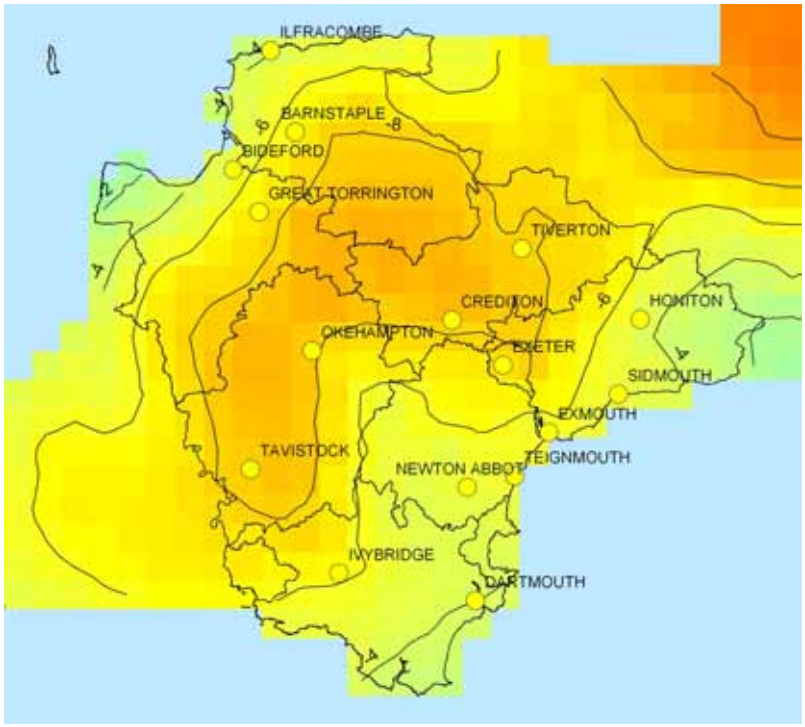

Figure 12d. Percentage (%) change in MAP by the 2080s for the high emissions scenario.

Percentage (%) change in mean summer precipitation (MSP) in Devon

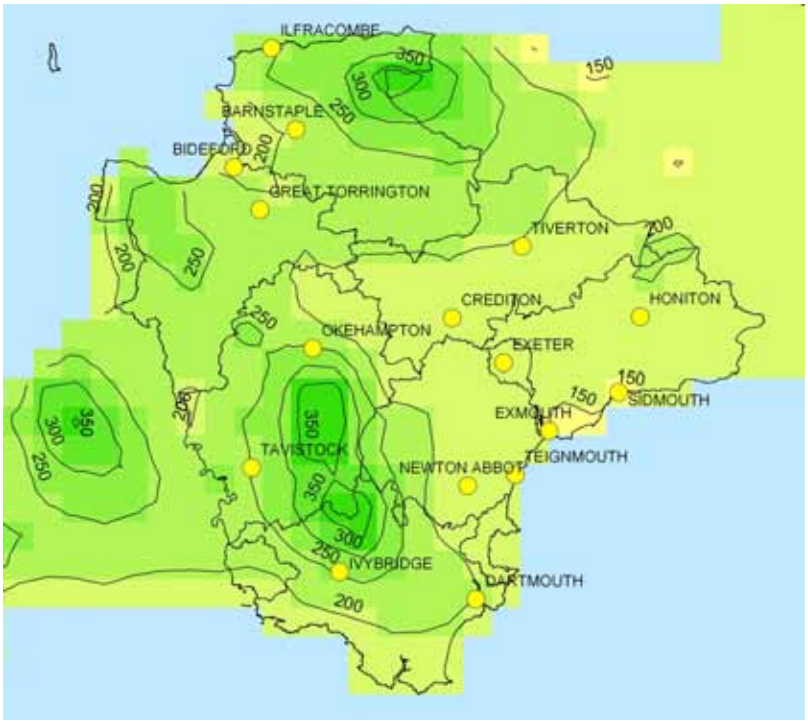

Figure 13a. The baseline MSP (mm) (1961 – 1990).

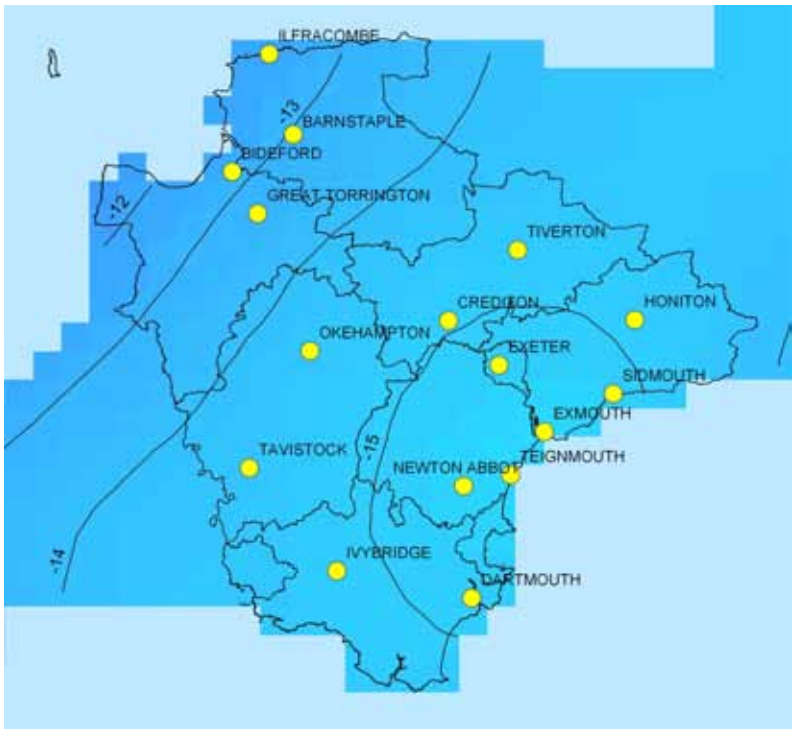

Figure 13b. Percentage (%) change in MSP by the 2020s for the high emissions scenario.

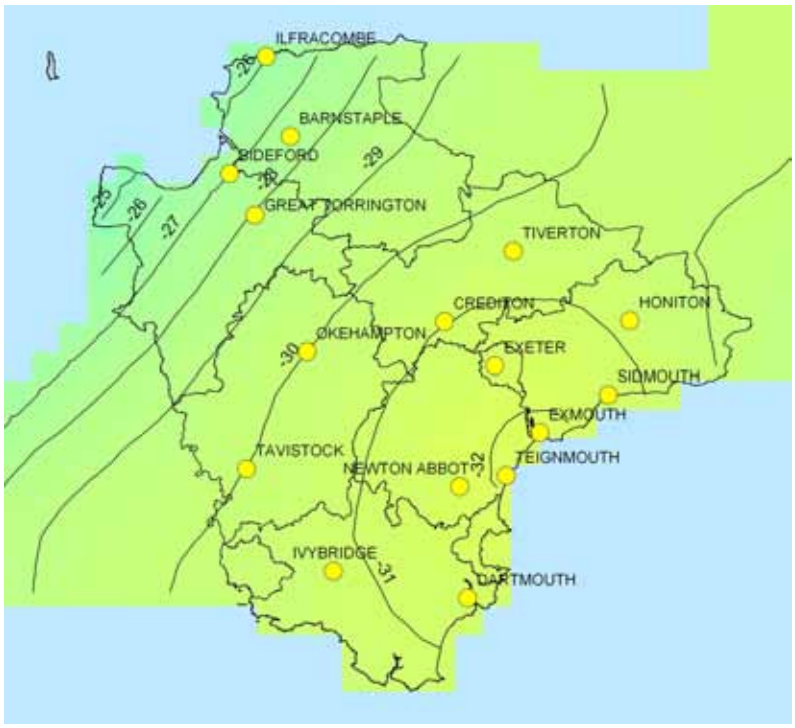

Figure 13c. Percentage (%) change in MSP by the 2050s for the high emissions scenario.

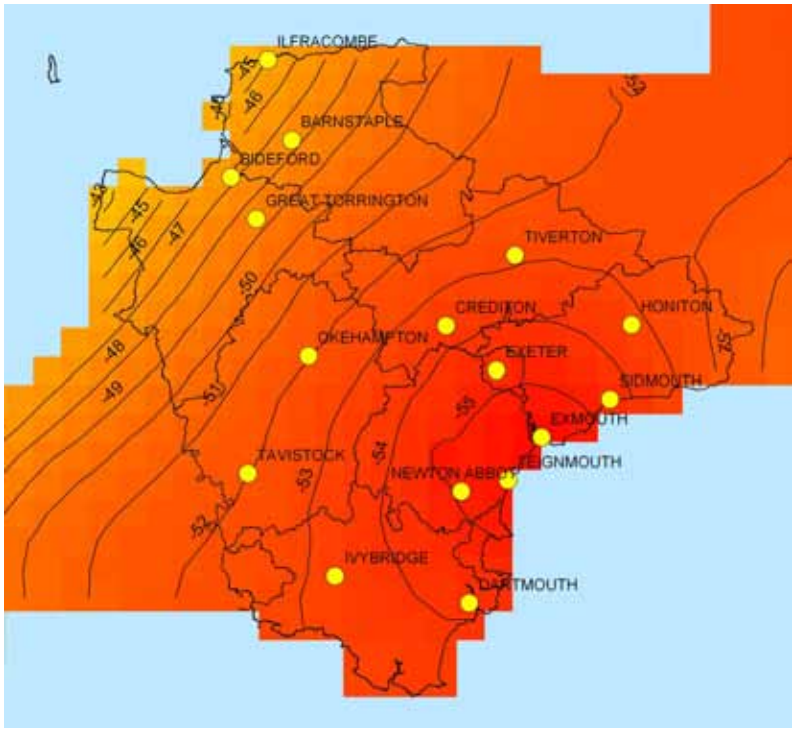

Figure 13d. Percentage (%) change in MSP by the 2080s for the high emissions scenario.

Percentage (%) change in mean winter precipitation (MWP) in Devon

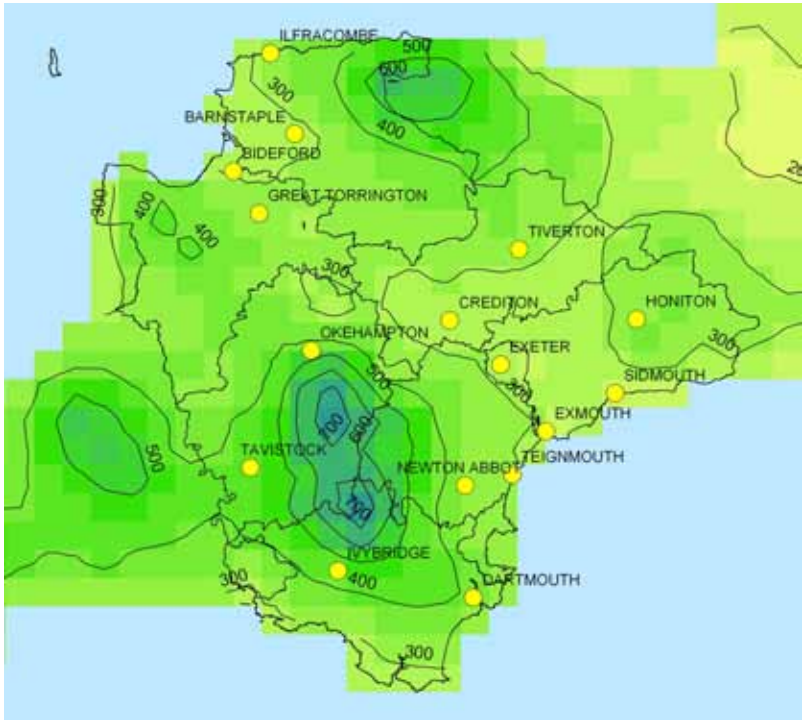

Figure 14a. The baseline MWP (mm) (1961 – 1990).

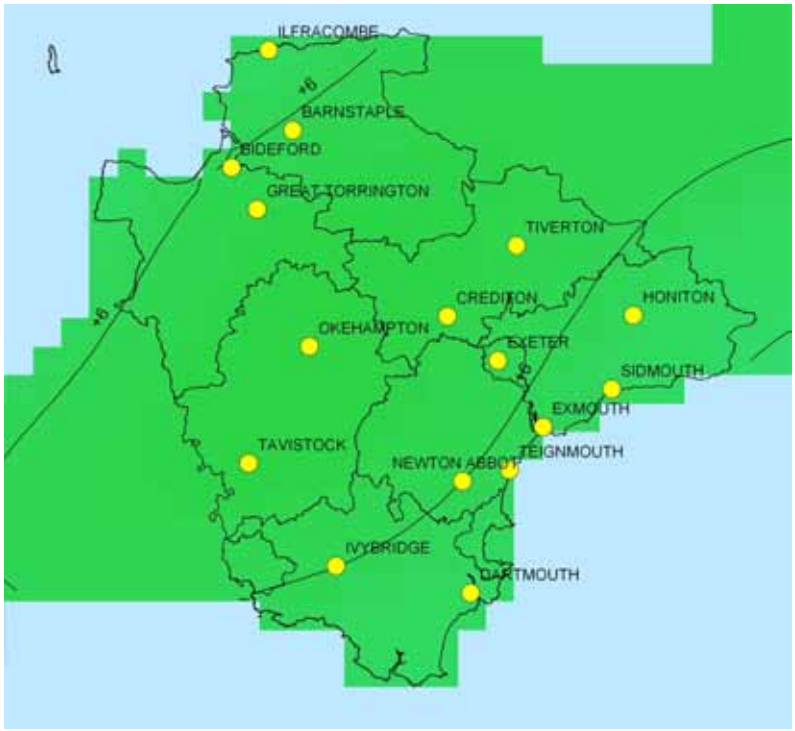

Figure 14b. Percentage (%) change in MWP by the 2020s for the high emissions scenario.

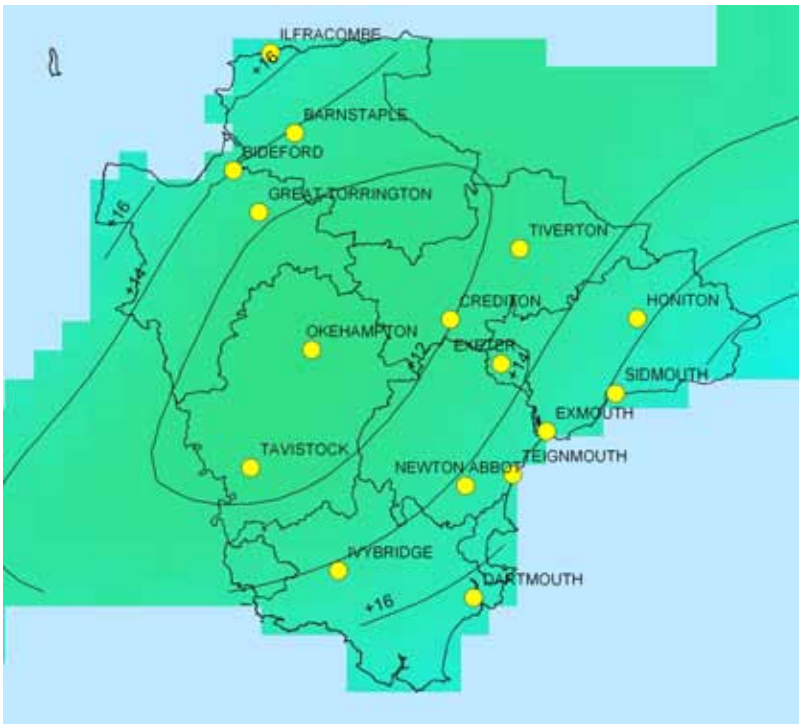

Figure 14c. Percentage (%) change in MWP by the 2050s for the high emissions scenario.

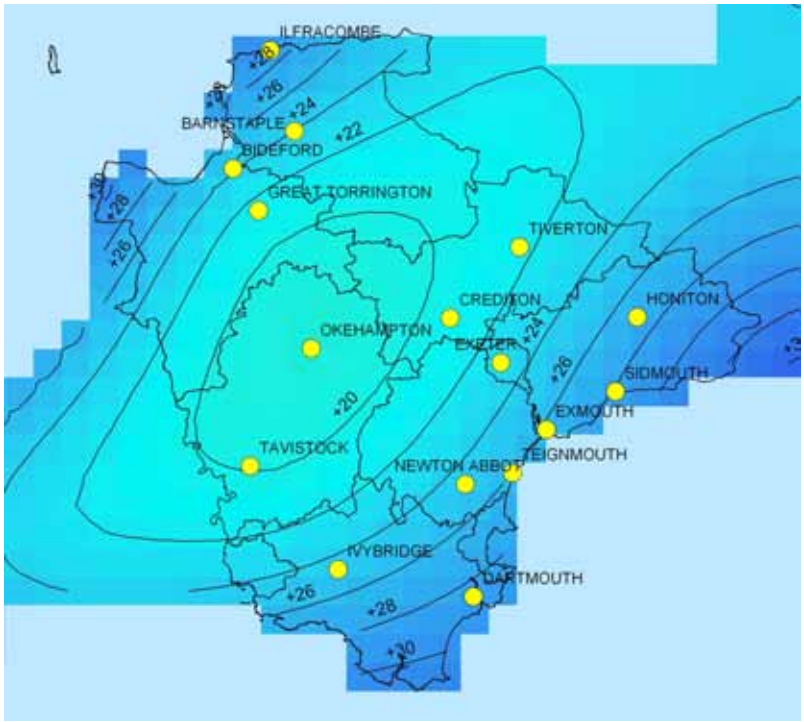

Figure 14d. Percentage (%) change in MWP by the 2080s for the high emissions scenario.

Box 8. Climate Change in Devon

Temperature. On an annual basis the rise in average temperature is likely to be less than 1°C by the 2020s regardless of scenario. About half of this increase has already been realised since 1990. The temperature rise by the 2050s may be between 1.4 and 2.3°C accelerating thereafter to up to 4.0°C by the 2080s. Seasonally, there may be greater warming in summer than winter. Spatially, there may be more warming in the north and east of the county than in the south and west reflecting the moderating influence of the sea around the coast and a marginal increase in continentality further inland.

Rainfall. On an annual basis the precipitation total shows a marginal decrease by the 2020s reducing further by up to 8% by the 2080s. All of these changes are within the current annual variability of ± 30%. Seasonally, winters may become up to 30% wetter in coastal regions by the 2080s. In the same time frame summers may become up to 55% drier; the epicentre of this drying is the Exmouth/Teignmouth/Newton Abbot area. There is already evidence that this trend is established.

Extreme Weather Events. From the preceding analysis increases in the frequency and intensity of winter storms and heavier winter precipitation events are the most likely extremes. Whilst one might also conclude that progressively higher maximum temperatures will be experienced, there is evidence that cooling sea breezes provide a limit (currently about 32°C) to the extremes experienced in the coastal margins. However, rising sea temperatures may contribute some further warming to these maxima.

Sea Level Rise. Modelling shows that there is a difference in the height of storm surge between the north and south coasts of Devon. Whilst the tidal range will continue to be highest on the north coast, higher storm surges are likely to occur on the south coast increasing in height in an easterly direction. For Start Bay a current 1 in 200 year extreme storm surge event will become a 1 in 20 year probability by the end of the century.

... so when will it happen?

From a World Meteorological Organisation perspective climate is the 30-year average of principal weather variables such as temperature, precipitation, humidity, soil moisture etc. Therefore, by definition climate change is a slow process requiring the identification of statistically significant differences from ever changing 30-year means. In human terms, such changes are almost imperceptible given the daily, seasonal, annual and decadal variability of our weather. However, the evidence from instrumental records going back as far as 1659 (i.e. the Central England Temperature record) indicates that climate change as a result of human intervention in the climate system has been taking place for at least half a century. Most of the warming of the past 50 years is attributable to human activity and detection studies consistently find evidence of the anthropogenic signal in the climate record of the last 35 to 50 years (IPCC, 2001[c]).

As a consequence of the significant time lag in the climate system between cause and effect, the climate change that is occurring today is a consequence of global emissions released during the second half of the 20th century. Moreover, we are already committed to the level of climate change projected for the 2020s as a result of historic and present emissions. Any action we take today to reduce emissions will not have an impact on climate until mid 21st century and thus the longer we delay the societal shift to a low carbon economy the more likely are our progeny to experience the more extreme and potentially dangerous scenarios of the 2080s.

Finally, we should not ignore the potential for unexpected and rapid climate shifts as the global climate system seeks to find a new equilibrium. Such events have happened at least twice in the North Atlantic region since the last Ice Age.

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Section 9

Action on Climate Change

"What action is being taken to tackle climate change?"

International Action

In response to increasing concerns about climate change, the United Nations Framework Convention on Climate Change (UNFCCC) was agreed at the Earth Summit in Rio de Janeiro in 1992. The aim was *"to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system."* In total 188 countries signed the Convention which committed all developed nations to return their greenhouse gas emissions to 1990 levels by 2000. In response UK emissions were 13.4% below the 1990 level by 2000.

It was quickly recognised that the UNFCCC commitments could only be a first step in the international response to climate change. Climate prediction models had begun to identify that much deeper cuts in emissions would be needed to prevent serious interference with the climate system. In December 1997 the Kyoto Protocol was agreed imposing legally binding emissions reduction targets on countries. Developed nations agreed to reduce emissions by 5.2% below 1990 levels by 2008-2012. The European Union agreed to an 8% reduction in its emissions of which the UK's contribution would be a 12.5% reduction. Whilst the UK had achieved its Kyoto target by 1999, since 2002 emissions have been rising and provisional figures for 2004 show a 12.6% reduction below 1990 levels. With the Russian Federation ratifying the protocol on 18th November 2004, the agreed criteria on the percentage of developed nations' emissions covered by the treaty was met. The protocol became legally binding on 16th February 2005. Whilst Kyoto itself will not solve global warming, it is an important first step on the road to building a legally binding international agreement to tackle climate change.

National Action

The UK Government considers climate change to be one of the most serious threats facing the world's environment, economy and society. Consequently, it has committed itself to a global leadership role by putting in place a strong national programme of measures to achieve, and move beyond, its Kyoto target. The UK Climate Change Programme (DETR, 2000) was published in November 2000 and details how the UK plans to deliver its Kyoto target and move towards its domestic goal to cut carbon dioxide emissions by 20% below 1990 levels by 2010. This domestic goal is challenging but is designed to signal the start of a

transition to a low carbon economy that will be essential for the longer term. Subsequently, the Energy White Paper entitled *"Our energy future – creating a low carbon economy"* was published in February 2003 (DTI, 2003) and sets out the longer term strategic framework for UK energy policy. It builds on the clear signals in the Climate Change Programme and sets an aspirational target of reducing carbon dioxide emissions by 60% by 2050. Unfortunately, provisional figures for 2004 indicate that progress towards the meeting the emissions reduction targets is falling well short of expectation at 4.2%.

In addition to promoting emissions reduction, the Government recognises that we are already committed to a degree of climate change as a result of historic emissions. Consequently, there is a need to identify the impacts and prepare appropriate adaptation responses. The UK Climate Impacts Programme was set up in 1997 to encourage private and public sector organisations to assess their vulnerability to climate change and plan their own adaptation strategies. UKCIP provides help and guidance for those undertaking such studies including a comprehensive set of climate change scenarios (Hulme et al, 2002) for the UK and adaptation and risk assessment toolkits (Willows and Connell, 2003).

Changing public awareness, attitudes and ultimately behaviour are all going to be vital if the UK is to achieve its climate change goals. On 16th February 2005 Defra announced a £12m package of funding over three years as the first part of a communications initiative to change public attitudes towards climate change. The initiative will focus on communicating at a local and regional level where the evidence suggests that it can be most effective. A toolkit will be published to help local communicators.

Regional Action

At a regional level the importance of climate change is recognised in Integrated Regional Strategies, Regional Sustainable Development Frameworks and Regional Environmental Strategies. Action is focused on the adaptation agenda with a number of regional stakeholder partnerships formed under the UKCIP umbrella. In the South West, the South West Climate Change Impacts Partnership (SWCCIP) published its scoping study entitled *"Warming to the idea"* in January 2003 (SWCCIP, 2003) and is now embarked on a programme of raising awareness through a number of key sector groups including one for local authorities.

The Role of Local Government

Given the ubiquitous nature of climate change, effective action can only be achieved through a partnership approach. The Government is clear that local authorities are critical to the success of the UK Climate Change Programme in that they can take direct action to reduce their own emissions and can influence the way others respond by raising awareness of the

need for action and providing practical advice on what people can do to make a difference. The Local Government Association works closely with a range of agencies including the Energy Saving Trust, Carbon Trust and IDeA Sustainable Development Commission to explore the challenges of effective energy use. It has also established working partnerships with the Environment Agency and UKCIP to communicate to local authorities the threats to, and opportunities for, local government that climate change issues hold. Our climate change strategy is about identifying those actions required by DCC in its roles as corporate manager, service provider and community leader. This latter responsibility is being discharged in part through the Devon Strategic Partnership's Community Strategy (DSP, 2004[a]).

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Section 10
Climate Change Activity

"What are we already doing?"

Introduction

The UK Climate Change Programme is co-ordinated by Defra in close collaboration with a wide range of other government departments. It is currently being updated following a public consultation and is scheduled for publication by the end of 2005. The programme has the widest possible scope across businesses, local government, the general public and many other stakeholders, and has been developed within existing departmental policy frameworks. As a consequence there are many policies and measures already being implemented that contribute to emissions reduction and climate change adaptation. Whilst it may not always be obvious what these policies are and how they contribute to the national response on behalf of UK plc, the key measures include:

- The climate change levy.
- The renewable energy obligation and target.
- European level agreements to improve fuel efficiency of new cars.
- The 10 year Transport Plan.
- A number of schemes to improve energy efficiency in the residential sector.
- Appliance standards and labelling.
- Improved performance standards in Building Regulations.
- Action on local air quality.
- A shift in the Common Agriculture Policy from production-related subsidies to an environmental focus.
- Programmes for woodland creation and management.
- The EU Landfill Directive and landfill tax.

The actions implicit in these and other measures are being manifested in Devon through the initiatives highlighted below.

Planning – the Devon Structure Plan

Sustainable development underpins the planning system. The County Structure Plan entitled *"Devon to 2016"* (DCC, 2004[b]) contains a range of policies and proposals that seek to reduce emissions of carbon dioxide and minimise the impact of development on the environment.

These policies and proposals are interpreted by the Local Development Frameworks prepared by district and unitary councils. The statutory basis of the planning system is an important factor that ensures policies are implemented consistently. The Structure Plan links to the climate change issue in four main ways:

- The development strategy of the plan directs most new development to urban areas where there is the best opportunity to locate housing, jobs, services and facilities close together, to reduce the need to travel and to create communities that are sustainable. The transport strategy element of the plan promotes the use of walking, cycling and public transport over the use of the private car. Policy CO11 aims to minimise the direct and indirect energy consumption of new development.

- The Structure Plan aims to reduce dependence on fossil fuels and for Devon to contribute to national targets to reduce the production of greenhouse gases. Policy CO12 contains a renewable energy target of 151MW of renewable energy for Devon, and positively promotes the development of a range of renewable energy technologies in the County. The implementation of this target is being taken forward by the DSP Renewable Energy Action Plan (DSP, 2004[b]), which aims to create the conditions for the renewables industry to thrive.

- The frequency and intensity of flooding is addressed through policies which aim to minimise the impact new development has on run off and to protect the natural functioning of river corridors and systems. There is a need to improve the management of drainage and to protect existing development from the risk of future flooding. Policy CO13 asks for new development to be subject to an appropriate drainage assessment and wherever possible appropriate sustainable drainage systems are promoted. Development is not permitted where it would lead to a deterioration in the quality, quantity or natural flow of underground, surface or coastal waters; where water resources and current uses will be compromised; where there is a direct risk from flooding or where development would increase the threat of flooding elsewhere; and where it is likely to adversely affect the natural environment.

- The plan includes habitat restoration targets which encourage planting of new woodland and restoration and encouragement of wetland habitats.

Waste Management

Devon County Council is the Waste Disposal Authority for Devon and is responsible for the safe disposal of household waste. It is putting in place a Municipal Waste Management Strategy for Devon (DCC, 2003) under the campaign banner of *'Don't let Devon go to waste'*. This strategy is due for formal approval in Winter 2004/5.

In 2003/4, Devon's 289,000 households generated 376,500 tonnes of waste - that is approximately 1.3 tonnes per year or 25 kilograms per week for each household. Currently, we recycle 27% of this total. However, as about two-thirds of the average Devon dustbin is biodegradable, the annual amount of household refuse going to landfill could produce 1.4 million tonnes of CO_2 equivalent over its lifetime. This is equivalent to the greenhouse gas emissions of every one of Devon's 370,000 cars being driven 11,000 miles a year! Clearly, household waste has the potential to make the most significant contribution to the carbon footprints of both the Council and the county.

Whilst Devon has one of the highest recycling and composting rates for a Shire county, challenging statutory targets for improving performance have been set. Measures are in place to recycle or compost 36% of household waste by 2005/06. This target rises to 65% by 2025. In addition, by 2010 we are required to reduce the amount of biodegradable municipal waste sent to landfill to 75% of that produced in 1995. This target becomes increasing more challenging as the biodegradable content has to be reduced to 35% of the 1995 level by 2020. Our waste management strategy also has a target of reducing the rate of growth of household waste to 1% by 2010. By meeting these targets the expected amount of household refuse in 2025 will have the potential to produce 0.94 million tonnes of CO_2 equivalent over its lifetime in landfill. This is roughly equivalent to a 2% year-on-year reduction in present emissions and is in line with the Government's target to reduce greenhouse gas emissions by 60% by 2050.

As landfill will continue to play a role for municipal waste management in Devon, the waste management strategy will put in place additional measures to recover value from residual waste through energy recovery processes. Landfill gas at Heathfield, Chelson Meadow and Deep Moor is collected and used to generate 9 MW of renewable electricity which is fed into the National Grid. It is also planned to introduce a similar facility at Broadpath as soon as there is sufficient gas generation to do so. In the long term landfill will only be used for those wastes which arise as residues from other treatment processes or cannot be managed in any other way.

In addition, Devon County Council retains a degree of responsibility for fifty-five closed landfill sites. The majority of the closed sites are small, have been restored to agricultural land and give no cause for concern. The more recently filled sites and those containing high levels of dustbin waste are closely monitored for landfill gas. The Council has a duty to restore former landfill sites to prevent pollution and monitor them until they are seen to be environmentally benign. The remediation work is largely complete.

Renewable Energy

Renewable electricity can be generated from wind power, wave, tidal, solar photovoltaics (PV), small scale hydro and geothermal sources. In addition, electricity generation from biomass (i.e. energy crops, forestry products and agricultural waste) is considered renewable as it releases only the carbon already absorbed from the atmosphere when growing. Landfill gas is also classed as renewable under the Government's Renewables Obligation introduced in 2002 to provide incentives to generators to supply progressively higher levels of renewable energy over time.

If the UK is to achieve a 60% reduction in carbon emissions by 2050, renewables will need to be contributing at least 30% of our electricity generation by then. As a start, in January 2000 the Government announced (DTI, 2000) the target to supply 10% of UK electricity from renewable sources by 2010 with an aspiration (DTI, 2003) to double this by 2020. A variety of measures to support this ambitious programme have been put in place including exemption of renewable electricity from the climate change levy, and a strategic framework, organisation and financial support to expand offshore wind and improve the capability of the UK renewables industry to compete internationally. The UK will need to install 10,000MW of renewables capacity by 2010 to hit the 10% target – this is equivalent to a build rate of 1000 wind turbines (average capacity of 1.3 MW) per year. At the end of 2003 renewables accounted for nearly 4% of UK electricity supply with nearly half being provided by large scale hydro. Wind energy is the fastest growing renewable source with 4,560 MW of capacity operating, approved or planned.

In the South West, the Government Office for the South West (GOSW) in partnership with the South West Regional Assembly (SWRA) funded the REvision 2010 project to promote the installation of renewable capacity through the adoption of county-based targets. As a consequence the South West is committed to generating 11-15% of the region's energy from renewable sources by 2010 requiring over 550 MW of renewable energy generating plant to be installed. Regen SW has been set up by the South West of England Regional Development Agency (SWRDA) as a not-for-profit company with responsibility for driving forward the Regional Renewable Energy Strategy.

At county level, Devon's present installed capacity is 17MW with a target of 151 MW by 2010. Assessments suggest that two-thirds of this target will be provided by wind power. The target has been approved and incorporated in the Devon Structure Plan (DCC, 2004[b]). Devon's first wind farm consisting of 3 turbines with 2.7 MW capacity at Forest Moor, Bradworthy will start producing power in February 2005. There are also plans for a further 3 turbines at Higher Darracott near Torrington and 22 turbines at Fullabrook Down near

Ilfracombe. These arrangements will generate up to 70% of the estimated contribution that wind power can make in the period to 2010. The composition of installed and target capacity is shown at Table 1.

Source	Installed Capacity (MW)	Target Capacity (MW)
Landfill gas	9	9
Small scale hydro	6	5
Biomass – Anaerobic Digestion	1.5	3
Sewage gas	1	1
Solar PV	-	0.4
Energy Crops/Forestry	-	26
Biomass - Poultry Litter	-	4
Onshore Wind	-	103
Total	**17.5**	**151.4**

Table 1. The composition of Devon's installed and target renewable energy capacity. Source: REvision 2010.

The Devon Strategic Partnership has produced a renewable energy strategy and action plan for Devon (DSP, 2004[b]) which is due for launch in Spring 2005 through a partnership of delivery organisations including DCC, EnVision, Devon EEAC, Global Action Plan, DARE and Trans-send. The project's working title is Renewable Energy Devon (RED) and will consist of an integrated programme of actions to grow the local market for RE installations and build the capacity of local businesses to meet the increased demand. In addition, a Devon Sustainable Energy Network (DSEN) is to be set up to bring together all those working on energy efficiency, renewable energy and fuel poverty issues in the county to develop co-ordinated actions and strategy.

It should be noted that the DCC County Estate Management Strategy 2002 - 2012 includes a commitment to take a lead role in exploring sources, development and use of renewable energy.

Energy Consumption by Devon Property

Devon County Council holds a property estate with an asset value in excess of £650m. The estate comprises over 680 establishments (some 4000 buildings) including schools, libraries, farms, offices, day and residential centres plus other premises required to deliver services to the community of Devon. The Devon Property Business plan 2003/4 contains a commitment to contribute to the prosperity and sustainability of Devon through using local labour and

suppliers, purchasing renewable energy, and reducing CO_2 emissions and water consumption.

At an operational level DCC is a large consumer of electricity using about 75 gigawatt hours annually. Whilst 26% of UK electricity is generated from non-fossil fuel sources (large scale hydro, renewables and nuclear) only that certificated under the Renewables Obligation scheme can be regarded as non-polluting "green" electricity and zero-rated for greenhouse gas emissions. Consequently, despite ongoing attempts to purchase ROCs (Renewables Obligation Certificates) all of the electricity used by DCC produces CO_2 at the rate of 0.43 kg per kwh. The total CO_2 output from electricity consumption is about 32,000 tonnes annually, 55% of which comes from buildings and the remainder from streetlighting. In order to reduce CO_2 emissions from its 600 buildings, DCC monitors energy consumption and benchmarks performance against best practice figures. High usage properties are targeted for energy audits and advice is given on improving energy efficiency.

Local Transport

In 2002 the Department for Transport estimate of traffic flows for Devon was 7.3 billion vehicle kilometres. This figure has been growing at a rate of 2.1% year-on-year for the last decade. As the traffic figure is about 1.5% of the total UK traffic flow (i.e. 474.1 billion kilometres in 2001), the total emissions from road transport in Devon is estimated at 1.9 Mt of CO_2 annually. Based on the national picture, half of these emissions are likely to come from private vehicles with a further 25% from HGVs.

In July 2004, the Government set out its transport strategy in "The Future of Transport: a network for 2030" White Paper. This made clear that while good transport is central to a prosperous economy, a balance must be struck between the increasing demand for travel and the goal of protecting the environment effectively. The environmental goal is being promoted by a shift to low-carbon vehicles and fuels (DFT, 2002) through measures that include voluntary agreements with the automotive industry to reduce the CO_2 emissions of the average car sold to 140 grams per kilometre by 2008/9 and a graduated Vehicle Excise Duty for new vehicles based on CO_2 emissions and fuel type. However, even with these measures the Government expects emissions from road transport to grow by 10% from 2000 levels by 2010 as the growth in traffic continues to exceed fuel efficiency gains. Thereafter, emissions are expected to fall by 5% between 2010 and 2015 as a consequence of slower traffic growth and continued fuel efficiency improvements. By 2015 vehicle CO_2 emissions may be marginally below the present level.

At a local level Local Transport Plans (LTPs) set out to deliver integrated transport opportunities in line with the Government's Ten Year Transport Plan. The local policy response is based on the promotion of *'soft'* measures which affect travel choices made by individuals. Under the LTP strategy, Council's work in partnership with public transport operators, the Highways Agency and the private sector to develop walking, cycling and public transport facilities to enable more travellers to have the option of choosing sustainable transport modes. Present implementation is seen as *'low intensity'* and may result in a one-off 2% to 3% nationwide reduction in all traffic (Cairns et al, 2004) providing sufficient supporting policies are used to prevent induced traffic from eroding the effects. Soft measures include workplace and school travel plans, personalised travel planning, travel awareness campaigns, public transport information and marketing, and car sharing schemes. The supporting measures involve the re-allocation of road capacity and other measures to improve public transport service levels, parking control, traffic calming, pedestrianisation, cycle networks, congestion charging or other traffic restraint, other use of transport prices and fares, speed regulation, or stronger legal enforcement levels. It is worth noting that in order to meet the Government's aspirational target for emissions reduction these putative one-off savings need to be made year-on-year for the next four decades.

In Devon a mix of soft and supporting transport policies is being used through such initiatives as school and workplace travel plans, Devon Travelwise, CarShare Devon, public rights of way and cycling strategies, demand management strategies including variable message signing, intelligent transport systems and park and ride schemes, and the promotion of public transport via Traveline. In addition, the LTP capital programme directly supports three of Devon's Public Service Agreements targets – improving access to the countryside, increasing cycling and increasing public transport use. To date there has been no quantification of the effect of present policies on greenhouse gas emissions. However, unless the potential reduction of traffic from a successful low intensity implementation can be measured and realised, transport emissions will continue to rise.

South West Forest

South West Forest is an independent, non-commercial partnership providing a service that is agreed and paid for by its funding partners. Devon County Council is one of those partners. In a climate change context the aim of the partnership is to promote the role of woodlands as a means to offset some of the negative impacts of climate change and explore the possibility of releasing the value of *'carbon credits'* into the rural economy. Moreover, it seeks to investigate the feasibility of developing the South West Forest as the regional focal point for carbon storage through woodland creation.

The forest covers 300,000 hectares and is broadly bounded by Bodmin Moor, Dartmoor and Exmoor. Since 1998 500 hectares of new woodland have been established each year. The aim is to increase tree cover to 15% from the current level of 10% over the next 15 years by increasing the rate of planting to 1000 hectares per year. With new planting being 75% broadleaf and 25% conifer it is estimated that the average figure for carbon stored in new woodland is 100 tonnes per hectare for a forest that grows to maturity. This is equivalent to 367 tonnes of CO_2. Therefore, once the 15000 hectares of new woodland in the South West Forest is planted the potential exists to sequestrate an additional 5.5 million tonnes of CO_2 over the course of this century. This is approximately 55,000 tonnes annually.

Emergency Planning

Within Devon there currently exists the Devon Flood Warning and Response Plan, which sets out the response to potential flooding of major urban areas and covers nearly 14,000 properties. At present this plan is based on the Environment Agency's modelling of 1 in 100 year fluvial flooding events and 1 in 200 year tidal flooding events. A major review of this plan is ongoing and will take account of recently produced changes to the Environment Agency's flood risk maps which alter the potential extent of flooding to reflect possible changes in climate.

Devon County Council is also involved in the revision of the Joint Emergency Services Major Incident Procedures (JESMIP). This revision will enhance the multi-agency response capability to all major incidents within Devon taking account of recent work to identify future risks, including extreme weather events. DCC is also continuing to work with the parish councils in order to improve the level of community resilience within the county. As of November 2002, 45% of parishes had undertaken a local risk assessment to identify whether there was a requirement to develop a Parish Emergency Plan; a third of these risk assessments have resulted in Parish Emergency Plans being developed. It is intended that this work will continue, targeting key areas where there is a known risk, particularly if changes in weather patterns are likely to exacerbate this risk.

Environmental Procurement

Devon County Council has adopted a socially responsible environmental procurement policy based on the principles of sustainable development. Wherever possible the Council sources and specifies environmentally friendly goods and services having due regard for the following sustainable attributes:

- Durable, reusable, refillable or recyclable.
- Containing reused or recycled materials.

- Energy and resource efficiency.
- Using minimum packaging and encouraging waste reduction.
- Non (or minimal) polluting.
- Promoting fair-trade.
- Locally produced.
- Free from ozone depleting substances, solvents, volatile organic compounds and any other health and environmentally damaging substances.
- Traceable through legal and sustainable sources e.g. FSC accredited (Forest Stewardship Council) or equivalent.
- That cause minimal damage to the environment through sustainable production, distribution, usage and disposal qualities.
- Obtainable on competitive terms having regard to Best Value legislation.

In addition, when awarding contracts and when appraising on-going supplier performance consideration of suppliers' environmental policies and their impact on the environment are taken into account. The Council works with key suppliers to improve performance and develop appropriate environmental policies. Furthermore, all appropriate and significant purchases are made on the basis of whole life and environmental costing profiles. The procurement policy is promoted to a wide audience both internally and externally through procurement guidance and training.

Highway Maintenance

A number of climate change adaptation measures have been introduced since 2000 to improve the performance of highway surfacing materials in both warmer summer and wetter winter conditions. These measures include the use of penetration grade bitumen and anti-stripping additives, asphalts designed for optimum deformation performance at 60°C rather than national norm of 45°C, binder additives to impart greater flexibility in the construction of pavements on soils prone to movement in variable moisture conditions and limiting permeability of asphalts to air and water in order to reduce the increased effect of oxidation in warmer conditions.

In addition, a number of measures are being taken to ensure highway drainage is able to cope with an increase in rainfall intensity. Designs for increased drainage capacity to 20% above current national guidance are being used together with gulley gratings with better drainage characteristics and better resistance to blockage by debris. In addition, gulley spacings for new developments have been reduced and sustainable drainage techniques that have low maintenance requirements are being evaluated. Alternative materials for road marking are also being trialled to provide greater durability in warmer conditions.

In terms of mitigation, low energy alternatives to conventional construction and maintenance materials and processes are being trialled. These include cold and foam mix asphalts, and the use of cement replacement materials for a number of applications from structural concrete to base layers in roads. The minimisation of road haulage of materials is a major element in specifications. The measures include:

- Use of thinner layers in road construction requiring less material to be transported.
- In-situ recycling of road layers means that less material needs to be transported away from site and less new material need to be brought in.
- Blending of aggregates to produce suitable levels of performance in order to maximise the use of locally available materials.
- Specifying back-haulage of quarry materials to reduce lorry movements.

Finally, negative textured road surfaces are being used to reduce rolling resistance leading to lower fuel consumption.

Sustainable Building

"Sustainable Building"' is a term applied to construction and refurbishment that minimises environmental impact, including mitigation of climate change, whilst maximising local economic impact and providing affordable, healthy environments for living and working. Such building techniques include the use of "environmentally friendly" materials, the incorporation of efficient waste management techniques, the recycling of water and other resources, and the use of renewable energy.

Globally, the building industry is responsible for 40% of the total flow of raw materials such as sand, gravel and clay. Moreover, it takes one quarter of all timber used and 16% of water withdrawals. The UK industry consumes 366 million tonnes of material each year – equivalent to 6 tonnes per head of population Around half of the total UK CO2 emissions arise from energy used in heating, lighting and cooling buildings, and 10% from energy used during the production and transportation of materials and construction of buildings. .In addition, construction generates 72 million tonnes of waste per year - the South West region produces about 12.5 million tonnes of this waste figure. Clearly, the way in which we construct and operate buildings in Devon is key to reducing both emissions and waste.

The Government set out its commitment to sustainable building in 'Building a Better Quality of Life' (DETR 2000)[b] and has subsequently incorporated its thinking into Building Regulations and the publication of the Planning White Paper, the Communities Plan and the Energy White Paper. The sustainable building agenda is supported at regional level through

the 'Future Foundations' Initiative of Sustainability South West (Sustainability South West, 2001) as wells as the Regional Assembly's Environment Strategy (SWRA, 2004)[a] and Waste Strategy (SWRA, 2004)[b].

DCC along with key partners has been developing the Devon Sustainable Buildings initiative aimed at addressing sustainable construction on a county-wide basis by providing contacts, expert advice and guidance to all those involved in building in Devon. It has applied the sustainable construction principles enshrined in this initiative in its own construction programmes in order to reduce the environmental impact of new build and refurbishment schemes. The strategy is aimed at maximising the amount of recycled material used during construction and ensuring that materials are from sustainable sources and waste generation is minimal. The initiative will also work to localise building supply chains, reducing the distance goods have to travel and supporting the local economy. Reducing the energy consumed during the operation of the building is also a key concern. These principles are being applied in the design and development of the new communities at Sherford and in East Devon.

In an education context, Devon Property has been involved in developing the BRE's Environmental Assessment Method (BREEAM) for schools, which will enable an effective evaluation of the overall sustainability of school construction projects. Devon Property has also been looking into the procurement of sustainable materials and the design principles that will lead to more sustainable schools in the future.

Devon Food Links

Devon Food Links is a local food initiative based in DCC's Economy and Regeneration department. Its purpose is to contribute to sustainable development in the county by encouraging sustainable agricultural and by streamlining the supply chain between grower and consumer. The principal climate change benefits arise from a reduction in CO_2 emissions from road transport by reducing food miles.

The County Farms Estate

The management of the County Farms Estate has an important role to play in reducing the Council's carbon footprint. As part of the current 10 year Estate Management Strategy and Plan 2002 – 2012, the on-going delivery of the following key objectives will enable this process:

- The support, promotion and uptake of organic farming practices.

- The imposition of site specific conservation and land management clauses in all new tenancy agreements.
- The imposition of good agricultural and environmental management practices in all new tenancy agreements.
- The delivery of a robust landscape and conservation plan including an annual programme of deciduous woodland planting and development of farm 'conservation areas'.
- The use of 'set aside' ground for the production of renewable energy crops.

Coastal Management

DCC has a role in ensuring that information relating to coastal issues is exchanged between the key players. The Devon Maritime Forum has an important part to play in ensuring that the appropriate interests are brought together to exchange information and experience. The Forum may also have a role in agreeing collaborative action to adapt to the effects of climate change on the coast. DCC also supports initiatives such as the Devon Living Coasts Conference and the Devon Area Estuary Officers Meeting, which provide an opportunity for estuary-based partnerships to meet and exchange knowledge. DCC also promotes the prioritisation of essential coastal defence works and the value of favouring natural processes where these can be accommodated.

Biodiversity and Countryside Management

The present approach is towards landscape-scale conservation which seeks to influence land management practices over large areas, in particular concentrations of important sites and in areas with good opportunities for enhancement. This approach will maximise the potential for ecological adaptation, by providing the widest possible range of niche sites. For example, butterflies currently associated with warm, south-facing bracken-covered hillsides might, in the future, require less warm locations and so revert to cooler north-facing hillsides. This will only work if suitable sites are available for them to move to, even though such areas are currently not considered to be so important for their wildlife interest.

In order to promote effective wildlife adaptation strategies, robust ecological data and associated monitoring systems must be developed to track changes. DCC is helping to identify the monitoring priorities and systems. The Devon Biodiversity Record Centre will have a role in such work.

Vehicle Fleet Management

DCC has a diverse fleet of more than 560 vehicles that includes minibuses, cars and light vans together with specialised vehicles like winter maintenance gritters, snow blowers and

library vans. This fleet is essentially diesel powered but does include 21 LPG-powered light vans.

Alternative-fuel vehicles (i.e. electric, hybrid diesel/electric, LPG, compressed natural gas – CNG, and bio-diesel) have been considered and/or trialled for use within the DCC fleet however, the proportion of alternative-fuelled vehicles remains small as a result of economic and environmental factors. Given the limited endurance of electric vehicles in a Devon context, the non-availability of hybrid vehicles of an appropriate type and the absence of service stations in Devon selling bio-diesel, the "alternative" choice is limited to LPG and CNG. In a climate change context where the emission of CO_2 is the principal consideration, LPG is more polluting than the diesel alternative. Moreover, whilst CNG is cleaner than LPG on both CO_2 and street level pollution counts, the experience is that CNG-powered vehicles are unreliable especially at higher mileages where cylinder head problems emerge. The CNG refuelling process is also a lengthy overnight operation using specialist facilities not available at local service stations. Therefore, for the majority of DCC vehicle fleet requirements there is no real alterative to the existing diesel-powered units which, in practice, actually represent the "cleanest" alternative in respect of CO_2 emissions.

In sum, the DCC vehicle procurement strategy is based on ordering appropriate vehicle types with the most fuel-efficient engine available. This is usually a diesel powered unit. If there is a growth in the availability of bio-diesel as the most realistic "green" alternative fuel, the implications of its use especially in terms of manufacturer's warranty and street level pollution will need to be considered.

Education

The Devon Education for Sustainability Working Group (DESWG) provides a co-ordinated framework of support, training and resources for the development of Education for Sustainable Development (ESD) initiatives within the curriculum and across subject areas. In addition to addressing climate change directly through science and geography, the DESWG provides support for actions which reduce school community's negative environmental and economic impacts. Current initiatives include encouragement for sustainable modes of transport through School Travel Plans, support for waste reduction and sustainable waste management programmes through a Waste Education Strategy, guidance on energy reduction and conservation, and promotion of the use of school grounds to include food growing under the Local Food for Local Schools initiative. In addition, a pilot project is underway to illustrate how a whole school approach to ESD can successfully combine curriculum entitlement and school premises management.

Tourism

The quality of Devon's natural environment is an important draw for tourism. In 2003 visitors spent over 33 million nights in Devon and contributed in excess of £1.1 billion to the county's economy. With such numbers the potential impact on the natural environment could be significant and DCC actively promotes sustainable tourism. Walking, cycling and horse-riding opportunities are continually being developed and the county has a comprehensive network of footpaths, cycle paths and bridle ways including elements of the National Cycle Network and the South West Coastal Path. In addition DCC promotes the use of sustainable transport by publishing online car-free itineraries for local attractions. DCC is also working with tourist attractions to develop green travel plans and with South West Tourism to develop a Green Accreditation Scheme to encourage tourism businesses to reduce their energy consumption and recycle waste efficiently. Information panels on climate change are planned for key visitor sites across Devon. Climate change is also a key theme for the proposed visitor centre in Exmouth.

Section 11

Climate Change Strategy

"What do we need to do – what is our strategy?"

Definition: *Strategy - the means, methods and approaches used to achieve objectives and goals*

The Strategic Context - Sustainable Development

Sustainable development is defined as *"development which meets the needs of the present without compromising the ability of future generations to meet their own need".* Although the idea is simple, the emergence of the threat posed by climate change has put in to stark relief the potential of present (and previous) generations to compromise the needs of future generations for many centuries to come. Increasing economic growth through the use of finite resources has meant more pollution and damage to the environment. This in turn can impair quality of life and, from a climate change perspective, threaten long term economic growth. However, in a techno-centric world the need for development is as great as ever. There is little prospect that this global, market-driven philosophy will change in the near future. In the UK, strong economic growth remains vital for education, healthcare and housing, to tackle poverty and social exclusion, and to improve standards of living through better goods and services. It is also necessary to generate the technology needed to reduce emissions and put in place adaptations to prevent damage caused by climate hazards of the future.

So, how do we square this circle?

Future development cannot simply follow the model of the past which has been described by the World Wide Fund for Nature as *'three planet living'* (WWF International 2002). We need ways to balance economic, social and environmental objectives whilst considering the longer term implications of decisions. In March 2005 the UK Government launched its strategy for sustainable development entitled "Securing The Future" (DEFRA 2005). It contains four priorities (i.e. sustainable consumption and production, climate change, natural resource protection and sustainable communities) and is based on the five principle identified in Figure 15. Our strategy must reflect these principles.

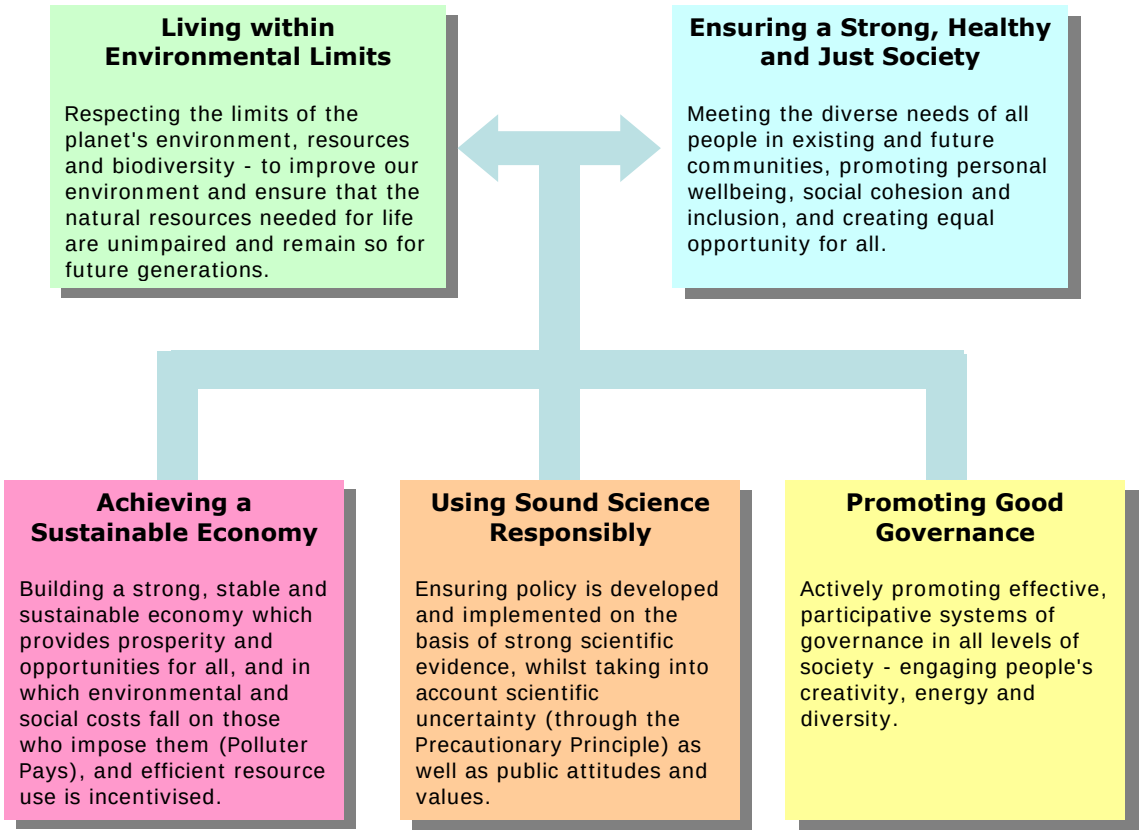

Figure 15. The five principles of sustainable development.

Source: DEFRA, 2005

The Strategic Elements

The goal of this strategy is *"to put in place effective and timely measures both at the corporate and community level to address the causes and impacts of climate change in Devon."* Traditionally, a twin-track approach has been adopted comprising of mitigation and adaptation measures. The mitigation agenda addresses the causes of climate change and is aimed at reducing greenhouse gas emissions and/or enhancing carbon sinks. The adaptation agenda is concerned with the likely impacts of a changing climate on our environment, economy and society. Its aim is to reduce vulnerability to the adverse effects of climate change by promoting action that reduces sensitivity to climate hazards or enhances capacity to adapt. It also contains actions to take advantage of the opportunities that climate change might present. In addition, there is a vital third element to the strategy, the communications plan, which is needed to identify target audiences, raise awareness of the issues, change attitudes, promote the behavioural change associated with mitigation and adaptation actions, and celebrate successes.

The Strategic Priorities

Whilst the elements of a climate change strategy can be actioned concurrently, given the inevitable time, resource and budget constraints it is useful to prioritise the strategic elements in advance so that competing requirements and interests can be resolved. The communications plan attracts the highest priority as it is a *'must do now'* activity needed to facilitate the other agendas. The mitigation agenda is the second priority as it is a *'can do now'* activity. It does not require a detailed understanding of local climate impacts prior to implementation and has the potential to defer adaptation action. The adaptation agenda therefore attracts the lowest priority. In the UK our society has developed well-founded institutions, capabilities and practices which provide us with a very high level of adaptive capacity both in the face of emergencies and emerging opportunities. Whilst climate change adaptation is a *'could do now'* activity, these inherent capabilities far exceed the starting points of both the communications plan and mitigation agenda.

The Strategic Timescale

The timescales associated with actions to address climate change are very long indeed. The short-term can be defined in terms of the UK Government's domestic targets of a 20% reduction in CO_2 and the 10% contribution of electricity from renewable sources by 2010. In this time frame the UKCIP climate change scenarios for the UK will have been updated and published, and the post-Kyoto agenda (beyond 2012) may have begun to emerge. Moreover, the emerging UK Climate Change Communications strategy is likely to have been implemented - a 2 to 5 year timescale is proposed. The medium term has a 2050 horizon matching the Government's aspirational 60% reduction in CO_2 target (and a 30 to 40% contribution to electricity generation from renewable sources). It also represents the timeframe in which our actions today and over the next few decades can start to make a difference to climate outcomes in the long term. The long term is beyond 2050.

From a mitigation perspective, significant technological innovation will be necessary over the medium term so that industrial nations can make the large cuts in emissions required to produce low carbon economies. Whilst such research is underway, it is unlikely to have a major impact on actions implemented in the short term. From an adaptation perspective, we are already committed to providing a response for the medium term using existing technology. Moreover, whilst it may be prudent to take cognisance of the projected long term climate outcomes in formulating our adaptation response, waiting for more effective future technologies should not be discounted as an effective policy.

The Strategic Phases

Given these considerations and the current financial and planning horizons, it makes sense for this strategy and its associated action plan to operate for the short term only i.e. to 2010. This does not mean that it should not consider impacts in the medium or long term where major infrastructure is involved. Over the next five years, the strategy will have two phases which may run concurrently;

- **Set up process** – there is a need to increase the receptivity of the public to climate change action by raising awareness and promoting attitude change. In addition, a *'carbon footprint'* that is capable of being replicated on an annual basis for mitigation purposes is required together with a climate impact assessment at an appropriate spatial and temporal resolution on which to base the adaptation response. All of these activities are significant undertakings and necessary precursors to prioritised action planning and implementation.

- **Strategic actions** – this will consist of messages, measures and projects identified and prioritised by the set-up process.

The Strategic Space

Within the sustainable development framework, the strategic space occupied by local authorities determines the depth and breadth of potential climate change action. LAs have the following three distinct roles;

- **As a corporate manager** – This is about the management of the business and making sure that the Council's operations are sustainable in resource terms. It covers issues like asset management, energy consumption, building performance, composition of vehicle fleets, travel planning and procurement strategy.

- **As a service provider** – This concerns the contribution and impact of the Council's services, and covers such issues as transport, housing, development planning, waste management, educational development and air quality.

- **As a community leader** - This is all about demonstrating leadership by example, and through partnership working and the community strategy.

In addition there are many portfolios with responsibilities that cut across these roles. The key areas of responsibility in a climate change context have been identified and incorporated with the three roles to provide an indication of the extent of strategic space in which the climate

change strategy will operate. Figure 16 provides the detail and demonstrates the corporate nature of both the problem and solution.

Figure 16. The Strategic Space

Source: DCC

The Communications Plan

The communications challenge is twofold. Firstly, there is a need to change attitudes about climate change by positioning it *'front of mind'* so that we create *'agency'* for action. We have *'agency'* when we know what to do, we think our contribution is important, we can decide for ourselves and we have the infrastructure and resources to act. This attitude change must involve making the issue relevant to each and everyone of us. In short, it must identify the role that our lifestyle and professional working activity play in the problem. In the jargon this means making climate change a *'home'* (rather than *'away'*) issue.

Having improved our understanding and receptiveness towards the climate change message and created agency through ownership of the problem, the second action is to promote behavioural change by persuading individuals and groups that they can make a difference in terms of their own lifestyle choices and in mobilising their communities. Whilst some individuals may be driven by short term financial savings through energy efficiency measures and the like, others may require different and less obvious stimuli. Therefore, there is a need

to identify specific groups of potential actors and target them with appropriate messages and measures in order to change behaviour across a broad front. There is also the need for a partnered approach in delivering community-wide change.

Whilst it will be necessary to address the full spectrum of potential actions in due course, our initial approach must be more focused. The mitigation agenda is something we know we have to do, it is measurable and it can be started today without the need for detailed regional and local climate impact and vulnerability assessments for which the science is not yet mature. This strategy will concentrate its communications effort on reducing greenhouse gas emissions from the domestic sector in the first instance. Details of proposed activity are further explained in Our Communications Plan at Appendix 3. The strategic objectives of the communication plan are in Box 1.

Box 1. Strategic Objectives (Communications)

1 – Attitude to Climate Change.

To create "agency" for action with the members and officers of Devon County Council, our partners and, most importantly, the people of Devon towards climate change by raising awareness of its causes and impacts, and outlining potential responses.

2 – Behavioural Change.

To promote behavioural change of specific target groups within the Council and community in support of the mitigation agenda.

The Mitigation Agenda

It is now well understood that the emission of greenhouse gases due to human activities continue to alter the atmosphere in ways that are expected to effect the climate. Over the course of the 21st century this anthropogenic interference in the global climate system will manifest itself in rising temperatures, changes in rainfall patterns, more extreme weather events, rising sea levels, melting ice sheets and glaciers, and changes in the strength of the oceanic circulation. As the century progresses these effects are likely to become progressively more significant making the requirement to stabilise the concentration greenhouse gases in the atmosphere increasingly more urgent. As a consequence of the long life that some greenhouse gases have in the atmosphere, stabilisation of their concentrations can only be achieved by making very significant cuts in emissions. It is well documented that global emissions need to fall below 1990 levels within a few decades and reduce to a fraction of that (60% or more) thereafter if we are to prevent the worst excesses of climate change occurring in the latter half of the 21st century and beyond. After the stabilisation of greenhouse gas concentrations is achieved, temperatures will continue to rise for a century or more whilst sea level is projected to rise for many centuries. The slow transport of heat into the oceans and the slow response of ice sheets mean that it may take a millennium or

more before a new climate system equilibrium is reached. Regardless of the final outcome, it is acknowledged that reducing emissions will delay and reduce damages caused by climate change. This in turn will lessen the costs associated with adaptation.

The key feature of the mitigation agenda is that it can be started immediately without any need to understand or identify local or regional climate change outcomes. Therefore not surprisingly, most climate change strategies have a strong mitigation component. This strategy follows that model.

The mitigation agenda has two components which represent the difference between capital and revenue budgets. Capital budgets are used for investment in assets whilst revenue budget accounts for day-to-day running costs. Therefore from a capital perspective, the mitigation agenda is concerned with minimising the carbon content of the build process (i.e. accounting for embodied energy) together with ensuring that the '*best available technology'* is used at the outset to minimise the carbon footprint of all future operations. The implication is that life-cycle carbon management needs to become a basic design consideration in all future investments. From a revenue budget perspective there is a requirement to identify the operational *'carbon footprint'* of an organisation through a detailed carbon audit. This process is a bottom-up approach to quantifying greenhouse gas emissions which must be capable of replication year-on-year in order to monitor progress. A carbon footprint facilitates the prioritisation of measures to reduce carbon output in line with agreed targets. It has eight key steps which are further explained in Our Mitigation Protocol at Appendix 4.

In signing the Nottingham Declaration on Climate Change on 14th July 2004, the Council has made a commitment to achieve a significant reduction in greenhouse gases from its own operations whilst also encouraging all sectors in the local community to take the opportunity to reduce their own emissions. In order to achieve this, carbon footprints for the Council's operations and for Devon County need to be identified. Initial estimates of these baseline carbon footprints suggest that it is very likely that Council's carbon output is in the region of 77,500 tonnes of CO_2 equivalent (tCO_2e) per annum not including the municipal waste stream and emissions from the County estate. As for Devon County, a carbon footprint of 4.6 million tCO_2e has been estimated on the basis of National Atmospheric Emissions Inventory analysis for 2002. More detailed work is now required to confirm the accuracy of these two assessments.

In addition, a process for life-cycle carbon management needs to be established to ensure that all future DCC projects are as sustainable as they can be given present technology. DCC should also exert appropriate influence on regional and local planning authorities to ensure that the same standards are applied to non-DCC programmes.

The strategic actions associated with the mitigation agenda are in Box 2.

Box 2. Strategic Objectives (Mitigation)

3 - DCC Approach to Carbon Management.

To scope, agree and implement a carbon management policy for application across both the capital programme and the operational items covered by the revenue budget.

4 - DCC Operational Carbon Footprint, Target and Measures.

To define a baseline carbon footprint, agree an emissions reduction target and identify, cost, prioritise measures to reduce the Council's emissions of greenhouse gases.

5 – DCC Capital Programme Carbon Assessment.

To identify, document, agree and implement an assessment process for identifying and minimising both the embodied energy/carbon content and the future operational carbon footprint of proposed programmes/plans, infrastructure upgrades and maintenance regimes.

6 – Implement DCC Mitigation Measures.

To implement, monitor and report progress on measures to reduce the Council's emissions of greenhouse gases.

7 – Management of Carbon in Devon *[As agent for the Devon Strategic Partnership]*

A. *To define a baseline carbon footprint for Devon, and recommend an emissions reduction target and measures to reduce community emissions of greenhouse gases.*

B. *To assist in implementing, monitoring and reporting progress on those measures.*

C. *To influence regional and local planning authorities to ensure that both the embodied energy/carbon content and the future operational carbon footprint of proposed programmes and plans are minimised.*

The Adaptation Agenda

The development of an adaptation agenda is a more difficult proposition because of the degree of uncertainty inherent in the assessment of likely climate change impacts. The United Kingdom Climate Impacts Programme (UKCIP) climate change scenarios (Hulme et al, 2002) provide the best regional information to date on the expected changes in climate in the UK over the coming century. The South West Climate Change Impacts Partnership has used this data in its regional climate impact assessment for the 2050s (SWCCIP, 2003) which is characterised by hotter drier summers, milder wetter winters, more intense winter rainfall and more frequent storms. However, not only are the projections over the first half of the century largely within the bounds of the existing natural variability of our present climate but there are considerable margins of uncertainty in the projections as a result of the findings from other climate models. Whilst the scenarios provide an excellent projection of four possible evolutions of UK climate over the century, there is a large gap between these

potential national and regional outcomes, and the data needed to identify local schemes, projects and services on which money should be spent in the present to adapt them to changed circumstances.

Given this view of uncertainty, there is a case that until better information becomes available with the next update of the UKCIP scenarios (possibly in 2007/8) no action on climate change adaptation should be taken. This *'wait and see'* approach is an acceptable adaptation strategy given that the research is underway and the rate of change in the short intervening period is probably not measurable given the natural variability of our climate. However, even allowing for the uncertainty, the potential risks are such that we should consider taking responsive action now on a sensible and measured *'no regrets'* basis. This should be based on evaluating how well we are adapted to today's climatic hazards by learning lessons from recent extreme events and weather related incidents that have caused destruction and disruption over and above that which could be normally anticipated. For example, there are clear parallels between the Lynmouth tragedy of 15th August 1952, the East Devon/Blackdown Hills flood of 10th July 1968 (Hawkins, 1988) and that at Boscastle on 16th August 2004. In all cases a high summer storm delivered in excess of 100mm of precipitation in a few hours resulting in devastating flash floods. Whilst none of these events can be attributed directly to climate change, the fact that global warming will increase the intensity of the hydrological cycle leading to more intense downpours means that another "Boscastle" in Devon is entirely possible. Adaptation is largely about recognising this potential, and identifying and implementing measures that will reduce community vulnerability to such occurrences.

The logical approach to developing an adaptation agenda requires a climate impact assessment to be carried out that cross matches impacts and responses across the complete range of range of responsibilities and services – effectively, a contingency plan for the entire operation for all conditions. This approach is neither practical nor necessary as service delivery is flexible enough in-year to be able to cope with normal variations in driving forces only one of which may be climate. A more appropriate way is to examine the impact of experienced daily weather conditions that have caused disruption at a local level and apply lessons learned from the responses made across relevant service areas. It must be remembered that most climate change adaptation will happen as a natural response by society to climate and weather stimuli. The role of local government is to identify key intervention strategies required to minimize losses or benefit from opportunities based on an awareness that conditions have or are about to change. The strategic actions associated with this aspect of the adaptation agenda are Box 3.

Box 3. Strategic Objectives (Adaptation)

8 – Climate Impact Assessment for Devon

To undertake a climate impact assessment for Devon for the short and medium term.

9 – Emergency & Contingency Planning

To review and update the Council's emergency/contingency plans for all vulnerable locations in the light of recently experienced weather-related hazards.

10 – Climate-proofing for Today's Weather Hazards

To ensure that when unexpected, unusual or extreme weather events cause problems the post hoc restoration is climate-proofed for the next 50 years against potentially more extreme events and the lessons learned are applied where practicable to similar locations countywide.

11 – Climate-proofing for Projected Weather Hazards

To climate-proof strategies, policies, programmes and plans that come up for review, infrastructure upgrades, maintenance regimes and new fixed infrastructure that has a life of 20 years or more against projected changes in climate over the next 50 years.

In order that the appropriate level of climate-proofing is applied some basic modelling on the probability of exceedance for daily maximum temperature and precipitation by season using local meteorological records will be necessary. For more detailed assessments of the impact of other weather variables we should maintain a *'watching brief'* on developments in the climate change arena in anticipation of the updated UKCIP scenarios. It is probable that at that stage a more complete climate impact assessment along the lines of that laid out in Our Adaptation Protocol at Appendix 5 or in the UKCIP publication on risk management for climate adaptation (Willows and Connell, 2003) should be undertaken.

Assumptions and Constraints

The implementation of the strategy assumes long-term corporate and partner commitment, and ongoing support to develop and implement a range of actions across the full panoply of DCC responsibilities. This will include a willingness to take decisions for the long term that may not have an economic payback in the short term.

Resources. A project management approach to climate change was endorsed by the DCC Executive on 8th June 2004 (DCC, 2004[a]). The DCC Climate Change Officer lodged within the Spatial Planning Group of the Environment Directorate will act as programme manager. Priorities for action will be determined by the DCC Officer's Group on Climate Change and once endorsed climate change projects will be managed and funded by the appropriate officer within the existing organisational framework as a mainstream activity. No additional manpower is proposed.

Budget. An initial funding stream has been allocated for climate change communications activity. It is expected that additional funding will be allocated to climate change projects that support the objectives of the DCC Strategic Plan on a case-by-case basis. Robust business cases will be required.

The Strategic Framework

The various components of the strategy described in this section and in supporting appendices can be brought together to form a strategic framework for the climate change programme. This framework is shown at Figure 1. It identifies the three core strands of work (i.e. communication, mitigation and adaptation) operating at two levels (i.e. internally within DCC and externally as part of the DSP Community Strategy). The framework also identifies the need for a set up process to create "agency" for action amongst stakeholders, a carbon footprint for DCC and Devon, and a climate impact assessment for Devon. Furthermore, it highlights the principal strategic outcomes (i.e. changed behaviours, reduced emissions and reduced vulnerability) of each work strand together with the channels and strategies needed to achieve those objectives. Finally, it recognises the contribution of existing initiatives which provide continuity of action on climate change whilst the core programme is initiated.

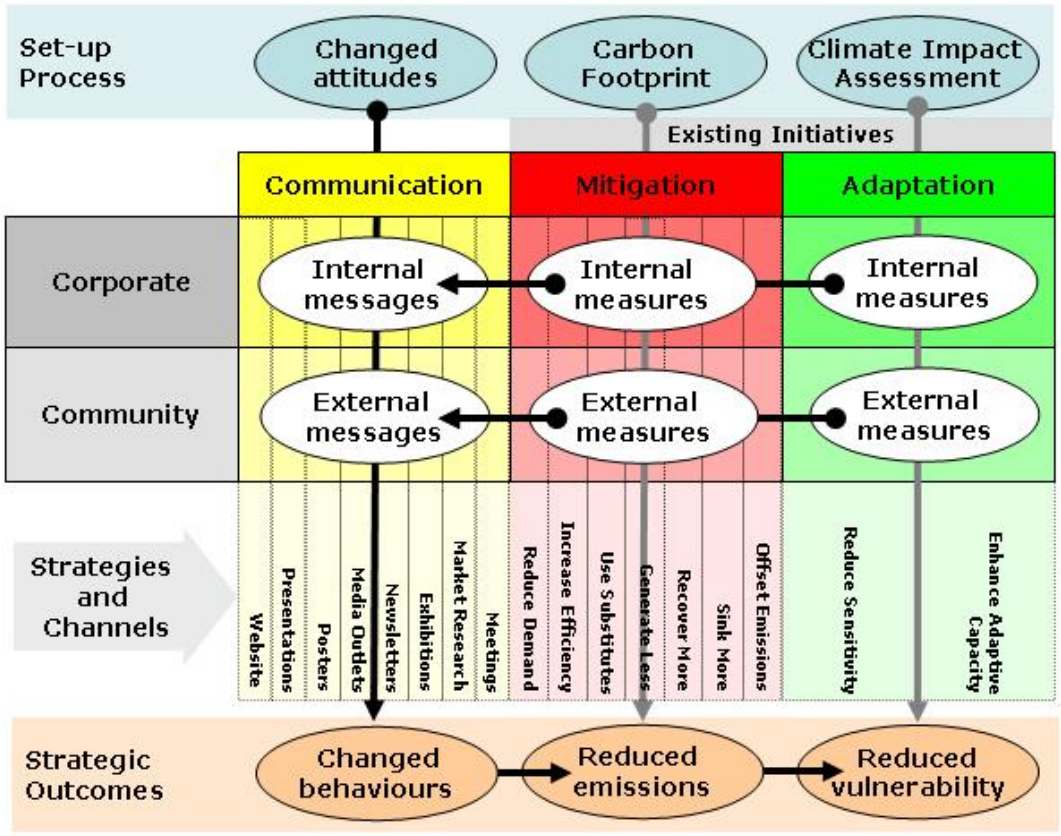

Figure 1. The strategic framework

Source: DCC

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Section 12

Climate Change Action Plan

What actions do we need to take?

Introduction

The strategic framework for the climate change programme identifies a two step process i.e. set-up followed by strategic action. Whilst it is possible to be prescriptive about the activities required to initiate and complete the set-up process in each of the three key areas (i.e. communications, mitigation and adaptation), the identification and prioritisation of strategic actions will depend on the findings of early work in these disciplines. Therefore, with the exception of the set-up process, this action plan intends to identify example actions only.

The Set-up Process

The strategy identifies six key objectives that are essential in order to define and prioritise further work. These objectives and associated actions are outlined in priority order below.

SO(C)1 – Attitude to Climate Change

To create "agency" for action with the members and officers of Devon County Council, our partners and, most importantly, the people of Devon towards climate change by raising awareness of its causes and impacts, and outlining potential responses.

A pilot climate change awareness raising project was launched at the Devon County Show in May 2005. This initial activity was based on a "local heroes" theme using the strapline "Make a climate change for the better". The project delivered an exhibition stand complete with advertising hoardings and flat screen for presenting an in house DVD on climate change. The campaign was supported by a newspaper double page insert and five days of editorial focussing on climate change action in the home. Fridge magnets highlighting the key messages were given away at the show.

The principal lesson learned from this initial activity is that the general public is aware of the climate change debate but that the connection with personal lifestyle and the home is not yet strong enough to promote behavioural change. Climate change is seen as a "future" rather than "now" issue and something that is caused by someone else in some other place with consequences that will impact elsewhere. Consequently, potential solutions are exported to future generations and to other cultures and countries.

With this experience the following actions are required;

Serial	Action	Output
1	To undertake climate change awareness survey to establish the baseline level of awareness throughout the community.	Survey
2	To cost, propose and seek approval for a targeted communications campaign for implementation in 2005/6 based on the outcome from the pilot programme and the survey results.	Approved communications plan
3	To create and issue a design brief to the communications/media industry with the purpose of identifying appropriate communications strategies and channels for creating "agency" with a variety of target audiences.	Design brief
4	To implement the agreed communications activity.	Communication project
5	To repeat the climate change awareness survey to establish the degree to which the baseline level of awareness throughout the community has been changed by the communications project.	Survey
6	To produce a summary version of the Climate Change Strategy for the general public.	Climate Change Strategy summary document
7	To develop a climate change website containing the Climate Change Strategy, summary document, survey results and advice and guidance on reducing emissions.	Website
8	To deliver climate change presentations to organisations, institutions and other groups as required.	Climate change presentations

SO(M)3 - DCC Approach to Carbon Management

To scope, agree and implement a carbon management policy for application across both the capital programme and the operational items covered by the revenue budget.

Serial	Action	Output
1	To draft a carbon management policy for endorsement by the Executive.	Policy Statement

SO(M)4 - DCC Operational Carbon Footprint, Target and Measures.

To define a baseline carbon footprint, agree an emissions reduction target and identify, cost, prioritise measures to reduce the Council's emissions of greenhouse gases.

It is expected that DCC will take part in the Carbon Trust's 2006 Local Authority Carbon Management Programme to deliver the following actions;

Serial	Action	Output
1	To identify an appropriate organisational boundary for the DCC Carbon Footprint by resolving the corporate ownership of greenhouse gas emissions based on financial responsibility.	Scoping document
2	To recalculate the initial estimate of the DCC Carbon	Carbon Footprint

	Footprint based on Scope 1 (Direct) and 2 (Electricity) emissions using the most up to date data.	
3	To seek endorsement of an appropriate emissions reduction target based on the recalculated baseline noting that a 2% year-on-year reduction could meet the UK emissions reduction target for 2050.	Approved Target
4	To identify the full scope of the Council's existing/planned mitigation measures including an annual estimate of the absolute size of their individual contribution to the mitigation effort.	Quantified listing
5	To cost, propose and seek approval for an initial mitigation agenda for implementation in 2006/7.	Approved mitigation measures
6	To gain organisational support from members and officers throughout the Council for a greenhouse gas emissions mitigation action plan (MAP).	MAP presented
7	To establish an effective greenhouse gas emissions monitoring system.	Implemented monitoring system
8	To investigate, identify and update a catalogue of potential mitigation measures for consideration in future years.	Catalogue of potential mitigation measures

SO(M)5 – DCC Capital Programme Carbon Management

To identify, document, agree and implement an assessment process for identifying and minimising both the embodied energy/carbon content and the future operational carbon footprint of proposed programmes/plans, infrastructure upgrades and maintenance regimes.

Serial	Action	Output
1	To draft a procedure for identifying the embodied energy/carbon content and future operational carbon footprint of proposed programmes/plans and incorporate this into existing environmental assessment mechanisms.	Procedure

SO(M) 7 – Management of Carbon in Devon *[As agent for the Devon Strategic Partnership]*

A. *To define a baseline carbon footprint for Devon, and recommend an emissions reduction target and measures to reduce community emissions of greenhouse gases.*

C. *To influence regional and local planning authorities to ensure that both the embodied energy/carbon content and the future operational carbon footprint of proposed programmes and plans are minimised.*

Serial	Action	Output
1	To identify an appropriate organisational boundary for the Devon Carbon Footprint by resolving issues surrounding the import and export of greenhouse gas emissions.	Scoping Document
2	To recalculate the initial estimate of the Devon Carbon Footprint.	Carbon Footprint
3	To propose an emissions reduction target based on national greenhouse gas reduction targets.	Target proposal
4	To identify the high emissions sectors of the Devon economy.	Prioritised listing
5	To assist the DSP in developing measures to mitigation greenhouse gas emissions.	Advice and guidance

6	To ensure that policies are included in the Regional Spatial Strategy and Local Development Frameworks to minimise the embodied energy/carbon content and future carbon of proposed development programmes	RSS and LDF Policies

SO(A)8 – Climate Impact Assessment for Devon

To undertake a climate impact assessment for Devon for the short and medium term.

Serial	Action	Output
1	To identify and document the baseline climate of Devon using the Met Office 5km x 5km gridded dataset.	Assessment of Baseline Climate
2	To identify and document the location and magnitude of recent significant extreme weather events in Devon using archived material as an indicator of potential impacts in the short term (i.e. to 2010).	Catalogue of extreme weather events
3	To identify and document potential climate impacts for the medium term (i.e. to 2050) using UKCIP scenarios and data.	Climate impact assessment
4	To identify vulnerable locations, populations and activities and potential opportunities arising from a changed climate.	SWOT analysis

The Strategic Actions

Strategic actions will emerge from the set-up process for each of the following six strategic objectives. Example actions are given in each case.

SO(C)2 – Behavioural Change

To promote behavioural change of Council staff and specific target groups within the community.

Example actions may include:

- To set up a series of training events for facilities managers around DCC properties and the schools. This would be an educational programme to improve the energy efficient operation of the DCC estate.
- To support and encourage the County Hall "environment promoters" project.

SO(M) 6 – Implement DCC Mitigation Measures.

To implement, monitor and report progress on measures to reduce the Council's emissions of greenhouse gases.

Example actions may include:

- To produce an annual progress report on emissions reduction performance.
- To cost and seek approval for an annual mitigation agenda for implementation based on the catalogue of potential mitigation measures.
- To introduce energy benchmarking and monitoring in all buildings.
- To conduct energy audits and make recommendations for improving energy efficiency.
- Implement waste management strategy across DCC to incorporate all premises - this would include a call-off collection contract to incorporate recycling.
- Implement a schools waste collection contract to include recycling.

SO(M)7 – Management of Carbon in Devon *[As agent for the Devon Strategic Partnership]*

B. *To assist in implementing, monitoring and reporting progress on those measures [to reduce community emissions of greenhouse gases].*

Example actions may include:

- To promote green electricity tariffs to domestic customers.
- To ensure a complementary relationship between climate change and other work of the DSP.

- Reduce demand for fossil fuels through such actions as car sharing schemes, Green Travel Plans for businesses, schools etc., promoting more sustainable travel options (walking, cycling, bus and train), homeworking and video conferencing.

- Promote and implement energy efficiency measures.

- Promote and implement sustainable and renewable energy solutions.

- "Sink" more greenhouse gases by promoting the conservation of existing woodland, the creation of new and the planting of trees in the urban environment.

- To reduce landfill by linking recycling with reduced landfill and climate change in waste management publicity.

- To use the carbon footprint concept to highlight a typical household's waste to landfill.

- Via the Devon Sustainable Energy Network;
  - Provide a strategic, co-ordinated and practical approach to promoting renewable energy.
  - Market the concept that emissions reduction is achievable at local community level.
  - Support community based energy conservation schemes.
  - Develop a partnership between Devon's construction professionals, building materials industry and academics to develop a credible system for true energy costing in the manufacture, supply and use of construction materials.

- Influence SWCCIP to give greater prominence to the effects of climate change on the transport infrastructure.

- To promote the sale of energy efficient appliances.

- To promote the use of sustainable building principles in all new developments.

- To meet the renewable energy targets for Devon.

- To meet recycling, composting and landfill waste management targets.

SO(A)9 – Emergency & Contingency Planning

To review and update the Council's emergency/contingency plans for all vulnerable locations in the light of recently experienced weather-related hazards.

Example actions may include:

- Review and update where necessary local emergency planning policies, procedures and plans.

- To include projections for changes in patterns of extreme weather as part of the local risk assessment to be undertaken as part of the Civil Contingencies Act.

- To promote resilience measures amongst communities and individuals.

- To identify the impact of climate change on the highways emergency planning process.

SO(A)10 – Climate-proofing for Today's Weather Hazards

To ensure that when unexpected, unusual or extreme weather events cause problems the post hoc restoration is climate-proofed for the next 50 years against potentially more extreme events and the lessons learned are applied where practicable to similar locations countywide.

Example actions may include:

- To develop a catalogue of lessons learned from other Councils following recent extreme weather events like Summer 2003, Boscastle (August 2004) and the October 2004 storm and coastal flooding.

SO(A)11 – Climate-proofing for Projected Weather Hazards

To climate-proof strategies, policies and plans that come up for review, infrastructure upgrades, maintenance regimes and new fixed infrastructure that has a life of 20 years or more against projected changes in climate over the next 50 years.

Example actions may include:

- To identify relevant strategies, policies and plans, prioritising those that have a statutory basis.
- To ensure climate change is identified as a cross cutting issue in the DCC Strategic Plan and reflected in Directorate Business Plans.
- To investigate the potential change in air quality in Devon under the regional climate change scenarios.
- To respond to consultation from external agencies to ensure climate change is considered in policy development.
- To produce a Climate Change report for Devon and take action on recommendations.
- To promote opportunities related to improved health benefits from reduced winter cold and extended summer warmth.
- Assess the likely impacts, both positive and negative, of climate change in the short, medium and long term, i.e., up to 50 years.
- Consider the action required for the maintenance or adaptation of strategic infrastructure such as the built environment, the transport network, utilities etc.
- Undertake climate impact and adaptation assessments for key "exposure units".
- Consider the implications for the coastal zone;
  - Review and implementation of Shoreline Management Plans.
  - Identify sites for 'managed retreat' and those needing maintenance and repair and integrate them into strategic planning processes.
  - "Managed retreat" initiatives.
  - Create new habitats as a part of managed retreat.
- Build benefits of climate change into promotion and publicity material.

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Appendix 1

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Appendix 2

Abbreviations and Glossary of Terms

Term	Definition
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Adaptive Capacity	The ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Anthropogenic	Resulting from or produced by human beings.
Atmosphere	The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1%) and oxygen (20.9%), together with a number of trace gases, such as argon (0.93%), helium, and radiatively active greenhouse gases such as carbon dioxide (0.035%) and ozone. In addition, the atmosphere contains water vapour.
Baseline	The baseline is any datum against which change is measured. In a climate change context 1990 is the baseline year for emissions reduction purposes. The baseline climate period is taken as 1961 – 1990.
Beaufort (Scale) Force	A numerical wind force scale ranging from 0 (calm) to 12 (hurricane) devised by Admiral Beaufort in 1805.
Biodegradable	Capable of being broken down by living organisms, principally bacteria and fungi. This process can have some disadvantageous side effects, such as the release of methane.
Biodiversity	The numbers and relative abundances of different genes, species and ecosystems in a particular area.
Biomass	The total mass of living organisms. However, the term is often used to describe a type of renewable energy and heat production using wood, forest and agricultural residues and wastes, and a wide range of organic wastes such as animal slurry and kitchen waste.
Carbon Dioxide	A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1.
Carbon Footprint	A calculation of the weight of carbon dioxide equivalent emitted into the atmosphere as a result of the activities of an individual or organisation.
Carbon Sink	See Sink.
Carshare Devon	A web-based scheme that enables commuters to find others travelling in the same direction and arrange to share a car thus reducing travels costs, congestion and air pollution.
Central England Temperature Record	A composite data series of seasonal and annual mean temperatures expressed in degrees Celsius for central England from 1659 to 1973 originally constructed by Professor Gordon Manley but now updated by the Hadley Centre.
CFCs	See Chlorofluorocarbons.
CH_4	See Methane.
Chlorofluorocarbons	A species of greenhouse gas covered under the 1987 Montreal Protocol and used for refrigeration, air conditioning, packaging, insulation, solvents and aerosol propellants. Since CFCs are not destroyed in the lower atmosphere, they drift into the upper atmosphere where they break down ozone. These gases are being replaced by other compounds, including hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), which are greenhouse gases covered under the Kyoto Protocol.
CIA	See Climate Impact Assessment.
Climate	Climate is usually defined as the "average weather" or more rigorously as the statistical description in terms of the mean and variability of relevant meteorological attributes

	(e.g. temperature, precipitation and wind) over a period of time. The classical period is 30 years, as defined by the World Meteorological Organization (WMO).
Climate Change	Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.
Climate Change Levy	The climate change levy is a tax on the use of energy in industry, commerce and the public sector, with offsetting cuts in employers' National Insurance Contributions and additional support for energy efficiency schemes and renewable sources of energy. The levy forms a key part of the Government's overall Climate Change Programme.
Climate Change Projection	See Climate Projection
Climate Change Scenario	See Climate Scenario
Climate Change Signal	Observed and simulated climate change are the sum of a forced “signal” and natural variability. The climate change signal is the forced element unobscured by the noise of natural variability.
Climate Impact Assessment	The practice of identifying and evaluating the detrimental and beneficial consequences of climate change on natural and human systems.
Climate Impacts	Consequences of climate change on natural and human systems.
Climate Model	A numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. Coupled atmosphere/ocean/sea-ice general circulation models (AOGCMs) provide a comprehensive representation of the climate system.
Climate Prediction	A climate forecast. The result of an attempt to produce a most likely description or estimate of the actual evolution of the climate in the future.
Climate Projection	A projection of the response of the climate system to greenhouse gas emission scenarios which are based on assumptions concerning future socio-economic and technological developments that may or may not be realized. Climate projections are therefore subject to substantial uncertainty.
Climate Proofing	Actions taken to protect infrastructure, systems and processes against projected climate impacts for a period into the future.
Climate Scenario	A plausible representation of the future climate that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change.
Climate System	The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcings such as volcanic eruptions, solar variations, and human-induced forcings such as the changing composition of the atmosphere and land-use change.
Climate Variability	Climate variability is the term used to describe natural climate change. The UNFCCC makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.
CO_2	See Carbon Dioxide.
CO_2 Equivalent	The concentration of carbon dioxide that would cause the same amount of radiative forcing as a given mixture of carbon dioxide and other greenhouse gases. See Global Warming Potential.
Community Leadership	A role of local government.
Coping Range	The variation in climatic stimuli that a system can absorb without producing significant impacts.
Corporate Management	The process of managing a business.

Deforestation	Conversion of forest to non-forest.
DEFRA	Department for Environment, Food and Rural Affairs.
Deglaciation	The process that terminates an Ice Age. Deglaciation of the last Ice Age commenced about 18,000 years BP and was largely complete by 10,000 years BP.
Devon Strategic Partnership	The Government believes that Local Strategic Partnerships (LSPs) are the most effective way of preparing a community strategy for an area. The DSP is Devon's LSP. Its purpose is to improve the quality of life of people living in Devon by ensuring the work of all agencies and groups has the needs of local people at its core.
Devon Sustainable Energy Network	A proposed network of individuals, organisations and companies to promote the development and deployment of renewable energy projects in Devon.
Devon TravelWise	TravelWise is a national campaign which encourages people to think before they travel and suggests that they do not always need to use a car.
DSP	See Devon Strategic Partnership.
Emissions	The release of greenhouse gases and aerosols into the atmosphere over a specified area and period of time.
Emissions Scenario	A plausible representation of the future development of greenhouse gas emissions based on a coherent and internally consistent set of assumptions about population growth, socio-economic development and technological change.
Emissions Trading	A market-based approach to achieving environmental objectives that allows those that reduce greenhouse gas emissions below a target level to trade the excess reductions to offset emissions at another source inside or outside the country.
Energy Balance	Averaged over the globe and over longer time periods, the energy budget of the Earth's climate system must be in balance. A perturbation of this global radiation balance, be it anthropogenic or natural, is called radiative forcing.
Energy Efficiency	The ratio of energy output to input of a conversion process/system.
Energy Recovery	The use of technologies to recover energy from waste e.g. burning methane produced in landfill sites to produce electricity.
England And Wales Precipitation Series	A composite data series of seasonal and annual precipitation totals expressed in mm for England and Wales from 1766 to 1995 constructed by Professor Phil Jones and updated by the Climatic Research Unit of the University of East Anglia.
Eustatic Sea-Level Change	A change in global average sea level brought about by an alteration to the volume of the world's oceans. In an anthropogenic climate change context this means the response of the oceans to thermal expansion and glacial melt water as a consequence of global warming.
Extreme Weather Event	An extreme weather event is an event that is rare within its statistical distribution at a particular place. Definitions of rare vary but an extreme weather event would normally be rarer than the 90th percentile i.e. a 1 in 10 year event for an annual series.
Fossil Fuels	Carbon-based fuels from fossil carbon deposits, including coal, oil, and natural gas.
GCM	General Circulation Model. See Climate Model.
General Circulation Model	See Climate Model.
Global (Average) Surface Temperature	The global (average) surface temperature is the area-weighted global average of the sea surface temperature over the oceans and the surface air temperature over land at 1.5 m above the ground.
Global Energy Balance	See Energy Balance.
Global Warming	The progressive and gradual rise of the earth's surface temperature caused by the greenhouse effect and responsible for changes in the climate. Global warming has occurred throughout the history of the Earth as the result of natural influences, but the term is most often used to refer to the warming that is taking place now as a result of the increased emissions of greenhouse gases as a consequence of human activity.
Global Warming Potential	An index describing the radiative characteristics of greenhouse gases that represents their relative effectiveness in absorbing outgoing infrared radiation. This index is expressed relative to carbon dioxide which has a global warming potential of 1. Methane has a GWP of 23 and nitrous oxide 296.

GOSW	Government Office of the South West.
Green Electricity	A term used to describe electricity generated from renewable sources.
Greenhouse Effect	A popular term used to describe the role of water vapour, carbon dioxide, and other trace gases in keeping the Earth's surface warmer than it would be otherwise. These "radiatively active" gases are relatively transparent to incoming shortwave radiation, but are relatively opaque to outgoing longwave radiation. The latter radiation, which would otherwise escape to space, is trapped by these gases within the lower levels of the atmosphere. The subsequent reradiation of some of the energy back to the surface maintains surface temperatures higher than they would be if the gases were absent.
Greenhouse Gas	Greenhouse gases absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. In addition to CO_2, N_2O, and CH_4, the Kyoto Protocol deals with sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
Greenhouse Gas Concentrations	The volume of specific well-mixed greenhouse gases in the atmosphere. For example the pre-Industrial level of carbon dioxide in the atmosphere was 280 parts per million (ppm). This has now risen to 380 ppm and continues to increase by up to 2 ppm per year.
Gulf Stream	The oceanic system of currents that dominate the western and northern Atlantic Ocean consisting of the Florida current, which flows through the Florida Straits northwards; the Gulf Stream, which begins around Cape Hatteras and flows northeast off the continental slope into the North Atlantic; and the North Atlantic Drift, which begins around the Grand Banks off Newfoundland and continues across the Atlantic towards the British Isles.
gw	Gigawatt – a billion (10^9) watts.
GWP	See Global Warming Potential.
Hadley Centre	A vital component of the Met Office, the Hadley Centre for Climate Prediction and Research was opened in 1990, when the Met Office was still in residence at its previous headquarters in Bracknell. Now working out of the new state-of-the-art headquarters at Exeter, the centre continues to produce world-class guidance on the science of climate change and to provide a focus in the UK for the scientific issues associated with climate change.
HFCs	See Hydrofluorocarbons.
Hydrofluorocarbons	Among the six greenhouse gases addressed by the Kyoto Protocol. HFCs are produced commercially as a substitute for chlorofluorocarbons. HFCs largely are used in refrigeration and semiconductor manufacturing. Their Global Warming Potentials range from 1,300 to 11,700.
Hydrological Cycle	The movement of water from ocean by evaporation, to atmosphere, to land by precipitation and back, via river flow, to ocean.
Ice Age	Any period in the Earth's history during which high latitude ice sheets expand considerably and surface temperatures in the temperate latitudes are lowered. The last Ice Age concluded about 10,000 years BP.
Infrared Radiation	Radiation emitted by the Earth. It is also known as terrestrial or long-wave radiation. Infrared radiation has a distinctive range of wavelengths ("spectrum") longer than the wavelength of the red colour in the visible part of the spectrum. The spectrum of infrared radiation is distinct from that of solar or short-wave radiation because of the difference in temperature between the Sun and the Earth system.
Intergovernmental Panel on Climate Change	A panel set up by the World Meteorological Organization and the United Nations Environment Programme in 1988, in recognition of potential global climate change. The panel's role is to assess the scientific, technical and socioeconomic information needed to understand the risk of human-induced climate change. IPCC does not carry out research or monitor climate related data, but bases its assessments mainly on peer reviewed and published scientific/technical literature.
IPCC	See Intergovernmental Panel on Climate Change.
Isostatic Adjustment	Isostasy refers to the way in which the Earth's crust responds to changes in surface loads such as land ice, ocean mass, sedimentation, erosion or mountain building. Vertical isostatic adjustment results in order to balance the new load. This is happening in the South West of England which is subsiding at a rate of up to 1mm per year following the removal of the ice sheets from Scotland.

Kyoto Protocol	The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1997 in Kyoto, Japan. It contains legally binding commitments for the reduction of greenhouse gas emissions. Countries included in Annex B of the Protocol (most countries in the OECD, and countries with economies in transition) agreed to reduce their anthropogenic greenhouse gas emissions (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force following agreement by the Russian Duma in September 2004.
Landfill	A private or municipal site where non-hazardous solid or municipal waste is buried.
Landfill Gas	A by-product from the digestion of anaerobic bacteria of decaying matter in waste deposited in landfill sites. The gas is predominantly methane (65%) together with carbon dioxide (35%) and trace concentrations of a range of vapours and gases.
Low Carbon Economy	The aspirational goal for the UK economy of the 2003 Energy White Paper.
LTP	Local Transport Plan.
Mean Annual Temperature	The average temperature of a location over a year. It is calculated by averaging all the daily maximum and minimum temperatures throughout a calendar year.
Melt Water	The water resulting from the melting of a glacier or ice sheet.
Met Office	Founded in 1854 the Met Office is now located in Exeter. It is an Executive Agency of the Ministry of Defence and is responsible for the provision of a wide range of meteorological services both nationally and internationally.
Methane	A greenhouse gas produced through anaerobic decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and oil, coal production, and incomplete fossil-fuel combustion. Methane is one of the six greenhouse gases to be mitigated under the Kyoto Protocol.
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.
mw	Megawatt – a million (10^6) watts.
N_2O	See Nitrous Oxide.
NAO	See North Atlantic Oscillation.
Natural Variability	Climate varies naturally because in a system of components with very different response times and non-linear interactions, the components are never in equilibrium and are constantly varying. An example of such internal climate variation is the El Niño-Southern Oscillation (ENSO), resulting from the interaction between atmosphere and ocean in the tropical Pacific.
Nitrous Oxide	A powerful greenhouse gas emitted through soil cultivation practices, especially the use of commercial and organic fertilizers, fossil-fuel combustion, nitric acid production and biomass burning. One of the six greenhouse gases to be mitigated under the Kyoto Protocol.
No Regrets Measure	See No-regrets Policy.
No-Regrets Policy	One that would generate net social benefits whether or not there is climate change. No-regrets opportunities for greenhouse gas emissions reduction are defined as those options whose benefits such as reduced energy costs and reduced emissions of local/regional pollutants equal or exceed their costs to society, excluding the benefits of avoided climate change.
North Atlantic Oscillation	On average, a westerly current, between the Azores high pressure and the Icelandic low pressure carries cyclones and associated frontal systems towards Europe. The North Atlantic Oscillation is a measure of the gradient of sea level pressure between these two pressure centres. The pressure difference fluctuates on time scales of days to decades, and can be reversed at times. However, when it has a high value (i.e. in its positive phase) there is strong zonal flow and strengthened mid latitude westerly winds in the North Atlantic. It is the dominant mode of winter climate variability in the region.
Nottingham Declaration on Climate Change	The Nottingham Declaration on Climate Change was launched on 25th October 2000. It was signed by Devon County Council on 14th July 2004. In becoming a signatory to the declaration Local Authorities commit themselves to reduce their own greenhouse gas emissions and to develop an action plan with local communities to address the causes and impacts of climate change.
Ocean Conveyor Belt	The theoretical route by which water circulates around the globe driven by wind and the thermohaline circulation.

Perfluorocarbons	Among the six greenhouse gases to be abated under the Kyoto Protocol. These are by-products of aluminium smelting and uranium enrichment. They also replace chlorofluorocarbons in manufacturing semiconductors. The Global Warming Potential of PFCs is 6,500–9,200 times that of carbon dioxide.
PFCs	See Perfluorocarbons.
Precautionary Approach/Principle	A principle which states that where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. This approach is promoted by the Framework Convention on Climate Change to help "achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous man–made interference with the climate system."
Proxy	A proxy climate indicator is a local record that is interpreted, using physical and biophysical principles, to represent climate-related variations back in time. Climate data derived in this way are referred to as proxy data. Examples of proxies are tree ring records, characteristics of corals, stalactites and various data derived from ice cores.
Proxy Data	See Proxy.
PSA	Public Service Agreement. A contract between Local Authorities and Government.
RCM	Regional Climate Model. See Climate Model.
RegenSW	RegenSW is the renewable energy agency for the South West of England. It acts as a catalyst for the development of renewable energy in the South West, aiming to increase the amount of high quality renewable energy projects on the ground and to maximise the social, economic and environmental benefits to the South West from the growth of the sustainable energy industry.
Renewable Energy	Energy sources that are sustainable, and include non-carbon technologies such as solar energy, hydropower, wind, wave and tidal as well as carbon-neutral technologies such as biomass.
Renewables	See Renewable Energy.
Renewables Obligation	The obligation placed on licensed electricity suppliers by Government to deliver a specified amount of their electricity from eligible renewable sources.
Renewables Obligation Certificates	Eligible renewable generators receive Renewable Obligation Certificate (ROC) for each MWh of electricity generated. These certificates can then be sold to suppliers.
REvision 2010	REvision 2010 was a project funded by the Government Office for the South West in partnership with the SW Regional Assembly to identify and adopt sub-regional renewable electricity targets for 2010.
ROCs	See Renewables Obligation Certificates.
Sea Level Rise	An increase in the mean level of the ocean. Eustatic sea-level rise is a change in global average sea level brought about by an alteration to the volume of the world ocean. Relative sea-level rise occurs where there is a net increase in the level of the ocean relative to local land movements.
Seasonality Ratio	The seasonality of rainfall as measured by the changing ratio of winter to summer rainfall.
Sensitivity	Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).
Sequestration	The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through land-use change, afforestation, reforestation and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases and long-term storage underground.
Service Provision	A role of local government.
SF_6	See Sulphur Hexafluoride.
Sink	Any process, activity or mechanism that removes a greenhouse gas from the atmosphere.

Social Cost	The social cost of an activity includes the value of all the resources used in its provision. Some of these are priced and others are not. Non-priced resources are referred to as externalities. It is the sum of the costs of these externalities and the priced resources that makes up the social cost.
Socio-Economic Factors	Those factors concerning demography and economic development that are likely to impact on the production of greenhouse gases.
Solar Radiation	Radiation emitted by the Sun. It is also referred to as short-wave radiation.
South West Forest	South West Forest is an independent, non-commercial partnership responsible for the management and development of 300,000 hectares of woodland broadly bounded by Bodmin Moor, Dartmoor and Exmoor.
Stabilization	The achievement of stabilization of atmospheric concentrations of one or more greenhouse gases (e.g., carbon dioxide or a CO_2-equivalent basket of greenhouse gases).
Storm Surge	The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place.
Storm Track	The track which Atlantic cyclones take across the North Atlantic towards the British Isles. See North Atlantic Oscillation.
Storyline	A short narrative description of the factors that describe the socio-economic factors that produce greenhouse gas emissions scenarios used in modelling anthropogenic climate change.
Subsidence	The sudden sinking or gradual downward settling of the Earth's surface with little or no horizontal motion.
Sulphur Hexafluoride	One of the six greenhouse gases to be curbed under the Kyoto Protocol. It is largely used in heavy industry to insulate high-voltage equipment and to assist in the manufacturing of cable-cooling systems. Its Global Warming Potential is 23,900.
Sustainability	The ability to meet the objectives of sustainable development.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
SWCCIP	South West Climate Change Impacts Partnership.
SWRA	South West Regional Assembly.
SWRDA	South West Regional Development Agency.
Techno-centric	An economic development path that is based on the widespread deployment and application of technology to resolve issues such as climate change. The opposite of eco-centric.
Terrestrial Radiation	See Infrared Radiation.
Thermal Expansion	In connection with sea level, this refers to the increase in volume that results from warming water. A warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.
Thermal Growing Season	The length of the thermal growing season is defined as the longest period within a year that satisfies the twin requirements of (i) beginning at the start of a period when daily-average temperature is greater than 5.5°C for five consecutive days, and (ii) ending on the day prior to the first subsequent period when daily-average temperature is less then 5.5°C for five consecutive days.
Thermohaline Circulation	Large-scale density-driven circulation in the ocean caused by differences in temperature and salinity. In the North Atlantic the thermohaline circulation consists of warm surface water flowing northward and cold deepwater flowing southward, resulting in a net poleward transport of heat.
Troposphere	The lowest part of the atmosphere from the surface to about 10 km in altitude in mid-latitudes (ranging from 9 km in high latitudes to 16 km in the tropics on average) where clouds and "weather" phenomena occur.
UKCIP	UK Climate Impacts Programme.
Uncertainty	An expression of the degree to which the future state of the climate system is unknown. Uncertainty results from lack of information or from disagreement about

	what is known or even knowable. It has many different sources from quantifiable errors in data to uncertain projections of human behaviour.
UNFCCC	See United Nations Framework Convention on Climate Change.
United Nations Framework Convention On Climate Change	The Convention was adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Its aim was to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered into force in March 1994.
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of its sensitivity, and its adaptive capacity.
Weather	The state of the atmosphere at a specific time and with respect to its effect on life and human activities. It is the short term variations of the atmosphere, as opposed to the long term, or climatic, changes.

Appendix 3

Our Communications Plan

What are our key messages and how will we communicate them?

Background

National public attitude surveys[1] indicate that most people are aware of and, indeed, worried about climate change. Unfortunately most respondents identify the destruction of rain forests (a bone fide cause) and the hole in the ozone layer (definitely not a cause) as the responsible agents thus distancing the problem from their personal sphere of influence. Given that in the UK emissions from the domestic sector are second only to those from the electricity, gas and water supply industries[2], it is of concern to note that only 20% of respondents identified the use of energy in the home as a major contributory factor. These national findings are mirrored in the results of the Devon Voice citizen's survey conducted in Devon in September 2004. If the Council is to meet its declared commitment to tackle climate change, there is a need to increase the awareness of members, officers, partners and the public of their individual contribution to global warming and climate change, and to transfer ownership for action from Government to citizen.

Scope and Strategic Objective

Action on climate change consists of two complementary activities. The mitigation agenda is concerned with the causes of global warming and promotes the reduction of greenhouse gas emissions. The adaptation agenda is concerned with the impacts of a changing climate on society, the economy and the environment, and promotes activities to reduce vulnerability to extreme weather events and other longer term changes in our climate. The focus of this communications plan is the mitigation agenda as it is something we know we have to do, it is measurable and it can be started today without the need for detailed regional and local climate impact and vulnerability assessments for which the science is not yet mature.

The strategic objective of this communications plan is:

"to make climate change relevant to the members and officers of Devon County Council, to our partners and, most importantly, to the people of Devon so that we can all understand why making a personal commitment TODAY to reduce

[1] DEFRA's Survey of Public Attitudes to Quality of Life and to the Environment: 2001.
[2] Page 30 of The Office of National Statistics Environmental Accounts, Spring 2004.

greenhouse gas emissions both in the home and at work is of enormous importance."

The challenge is to engage people in the climate change debate in order to break down some of the barriers that prevent personal action and to connect people to the role that their lifestyle and their professional working activity plays in the problem. Thereafter, there is a need to persuade them that they can make a difference in terms of their own lifestyle choices and in mobilising communities for political, social and economic change. Whilst some individuals may achieve short term financial savings through energy efficiency measures and the like, individual and collective action taken today is almost entirely for the benefit of future generations and communities. Climate change action is therefore an ethical/moral issue requiring cultural change at both the personal level and across communities.

Key Messages

Part I - Explaining the Science and *"myth busting"* - *"What is likely to happen and over what time scale?"*

There is a considerable volume of ill-informed and emotive rhetoric surrounding the climate change debate which is not helpful in promoting individual and collective action. Such rhetoric, regardless of whether it is based on fact or fiction, promotes the broadest possible spectrum of climate change outcomes from an impending shut down of the oceanic thermohaline circulation – the Gulf Stream and North Atlantic Drift - producing Arctic conditions in Britain within 20 years, through the full-on sceptics view of *"it's not happening"* to the apocalypse associated with a runaway greenhouse effect threatening the very survival of life on Earth. The issue is further confused by debate centred on the hole in the ozone layer and, more recently, by the spurious connection with tsunami events.

Within this maelstrom of conflicting information it is difficult to see how an individual can identify what constitutes a meaningful personal contribution i.e. the very thing that is needed if we are to be successful in stabilising the atmospheric concentration of greenhouse gases by significantly reducing emissions over the next 30 years or so. Somewhere on this continuum is the considered and moderate view of the majority of the world's climate scientists which must be used to inform personal, community and corporate decision-making.

The first step must be to provide an uncomplicated picture of this considered view. The statement at Box 9 is the basis for such a message.

Box 9 – Make a Climate Change for the Better

As a result of observations taken throughout the 20th century there is clear evidence that global warming is happening. Over the past 50 years most of this warming has been caused by the emission of greenhouse gases such as carbon dioxide and methane as a result of human activity. Rising temperatures have changed weather patterns across the globe. In the UK over the past 30 years we have experienced an unusual sequence of very warm dry summers. Winters have also been getting wetter and sea level has risen.

Our climate will continue to change gradually over the next 30 to 40 years as a result of past and present emissions. We can expect to experience more extreme weather events as a result of higher summer temperatures and increased winter storminess. Beyond 2050 our climate will be increasingly influenced by the volume of greenhouse gases we emit over the next few decades. Indeed, business-as-usual may precipitate unexpected and irreversible changes to our climate.

Whilst time scales are long, the climate of the second half of the 21st century is being decided TODAY by our life-style choices. Should we fail to reduce emissions by 60% or more over the next few decades, global warming will continue unchecked. As a consequence climate will continue to change for many centuries to come and sea level will rise for the rest of the 3rd millennium.

Climate change is happening NOW, here in the UK.

You have an important part to play in reducing greenhouse gas emissions.

TOGETHER we can make a difference.

Make a Climate Change for the Better

Part II - Making the Connection with Lifestyle – *"You are the cause…."*

As we need to start the process of promoting far reaching cultural change, the best place to start is at home where individuals have ownership of the decisions they make and the things they do and buy. Moreover, given the relative contribution of the domestic sector to the UK's emissions profile, there should be considerable scope for making a measurable impact on emissions (not climate) at the regional level. By focussing on producing a carbon footprint for the home environment, households could be challenged to make small cuts to help meet UK targets.

The Government is looking for a 60% reduction in emissions below 1990 levels by 2050. Starting in 2005 that target could be met by making a 2% year-on-year saving for the foreseeable future. On the face of it such a target would not appear too onerous for most households at least initially. A carbon footprint calculator could provide households with the most likely (no cost/low cost) ways on how to reduce emissions and the likely benefits both in emissions and financial terms. Such an approach could also be used in schools and the workplace to produce more formal carbon audits and annual carbon balance sheets.

Part III - Promoting a Response – *"….and the solution."*

The final key message concerns the contribution that each individual can make. The Energy Saving Trust has produced a number of killer facts that demonstrate the concept of *"together we can make a difference"*. For example, if everyone boiled only the water they needed to make a cup of tea instead of filling the kettle every time, we could save enough electricity in a year to run more than 75% of the street lighting in the country! The aim must be to get everyone doing something along these lines or, at the very least, thinking about doing something.

The problem is that many people do not identify activities like home composting, lagging the loft or hot water tank, cycling, recycling and leaving the TV/VCR on stand-by with climate change. A reasonable approach might be to produce a list of everyday activities that contribute something to reducing emissions or adapting to the likely impacts. Most people will find something on that *"caring for the climate"* list that they are already doing. By default they will join the climate change action club, begin to feel positive about their contribution and start to look for other ways to contribute.

Linkage with the National Climate Change Communications Campaign

Whilst the UK Climate Change programme was initiated in 2000, there has been a growing realisation by Government of the need for a co-ordinated climate change communications campaign to change public attitude. A national Climate Change Communications Strategy [3] was commissioned by DEFRA in 2004 and was made public in Feb 2005. Amongst its many recommendations is the establishment of a new fund, starting in financial year 2005/06, to support climate change communications at a regional and local level. In addition, the strategy recommends the publication of a toolkit to help local communicators. Whilst the details of this activity stream have yet to be agreed, the DCC climate change communications plan must organise its communications programme along the lines proposed in order to attract funding when it becomes available.

The three key areas in which the national approach should influence our local campaign are as follows;

- **Principles of climate change communications**. These principles are known colloquially as the "rules of the game" and are reproduced at Annex A to this plan.

[3] At http://www.defra.gov.uk/environment/climatechange/pdf/ccc-fund.pdf

- **Selection of target audiences**. The strategy recommends public target goups should be divided into three major groups - youth, homeowners and the disadvantaged. The DCC strategy has selected homeowners as its first target with the following objectives:
    - To identify climate change as a current and UK issue.
    - To increase confidence that climate change can be acted upon.
    - To draw mental links between climate change and other key issues such as health and employment.

- **Branding**. Whilst DCC has adopted the strap line ***"Make a Climate Change for the Better",*** this will need to be supplemented by the proposed national branding once it has been agreed.

Annex A to Appendix 3

The Rules of the Game

Principles of Climate Change Communication

Section 1: Blowing Away Myths

1. **Challenging habits of climate change communication.**

   - **Don't rely on concern about children's future or human survival instincts.**

   Recent surveys show that people without children may care more about climate change than those with children. "Fight or flight" human survival instincts have a time limit measured in minutes – they are little use for a change in climate measured in years.

   - **Don't create fear without agency.**

   Fear can create apathy if individuals have no 'agency' to act upon the threat. Use fear with great caution.

   - **Don't attack or criticise home or family.**

   It is unproductive to attack that which people hold dear.

2. **Forget the climate change detractors.**

   - Those who deny climate change science are irritating, but unimportant. The argument is not about *if* we should deal with climate change, but *how* we should deal with climate change.

3. **There is no 'rational man'.**

   - The evidence discredits the 'rational man' theory – we rarely weigh objectively the value of different decisions and then take the clear self-interested choice.

4. **Information can't work alone.**

   - Providing information is not wrong; relying on information alone to change attitudes *is* wrong. Remember also that money messages are important, but not *that* important.

Section 2: A New Way of Thinking

5. **Climate change must be 'front of mind' before persuasion works.**

   - Telling the public to take notice of climate change will only be successful when people realise (or remember) that climate change relates to them.

6. **Use both peripheral and central processing.**

   - Attracting attention to an issue can change attitudes, but peripheral messages can be just as effective.

7. Link climate change mitigation to positive desires/aspirations.

- Traditional marketing links products to the aspirations of their target audience. Linking climate change mitigation to home improvement, self-improvement, green spaces or national pride are all worth investigating.

8. Use transmitters and social learning.

- People learn through social interaction, and some people are better teachers and trendsetters than others. Targeting these people will ensure that messages are transmitted effectively.

9. Beware the impacts of cognitive dissonance.

- Confronting someone with the difference between their attitude and their actions on climate change will make them more likely to change their *attitude* than their *actions*.

Section 3: Linking Policy and Communications

10. Everyone must use a clear and consistent explanation of climate change.

- The public knows that climate change is important, but is less clear on exactly what it is and how it works.

11. Government policy and communications on climate change must be consistent.

- Don't 'build in' inconsistency and failure from the start.

Section Four: Audience Principles

12. Create 'agency' for combating climate change.

- Agency is created when people know what to do, decide for themselves to do it, have access to the infrastructure in which to act, and understand that their contribution is important.

13. Make climate change a 'home' not 'away' issue.

- Climate change is global issue, but we will feel its impact at home – and we can act on it at home.

14. Raise the status of climate change mitigation behaviours.

- Research shows that energy efficiency behaviours can make you seem poor and unattractive. We must work to overcome these emotional assumptions.

15. Target specific groups.

- A classic marketing rule, and one not always followed by climate change communications from government and other sources.

Section Five: Style Principles

16. Create a trusted, credible, recognised voice on climate change.

- We need trusted organisations and individuals that the media call upon to explain the implications of climate change to the average citizen.

17. Use emotions and visuals.

- Another classic marketing rule: changing behaviour by disseminating information doesn't always work, but emotions and visuals usually do.

Section Six: Effective Management

18. The context affects everything.

- The prioritisation of these principles must be subject to ongoing assessments of the UK situation on climate change.

19. The communications must be sustained over time.

- All the most successful public awareness campaigns have been sustained consistently over many years.

20. Partnered delivery of messages will be more successful.

- Experience shows that partnered delivery is often a key component for projects that are large, complex and have many stakeholders.

Appendix 4

Our Mitigation Protocol

How will we reduce our greenhouse gas emissions?

A Mitigation Agenda

The agenda for a policy response to mitigate climate change through greenhouse gas (GHG) emissions reduction and the enhancement of sinks is well rehearsed in the climate change literature. Driven by a variety of Government-agreed, short-term GHG emissions reduction targets, the UK Climate Change Programme recognises that local authorities are uniquely placed to provide the vision and leadership necessary for the delivery of the programme. Devon County Council has action in place on a number of initiatives that will contribute to climate change mitigation but these measures, together with additional activities, need to be brought together into a coherent mitigation agenda. Such an agenda is likely to have the following characteristics:

- Action taken is independent of the uncertainty over climate change outcomes and can be started immediately.
- It is a long-term activity that will require routine examination of ways of working as well as the deployment of new technology, new regulatory frameworks and challenging cultural change.
- It is unlikely that individual/community voluntary action alone can deliver the deep cuts in emissions required to prevent dangerous climate change.
- It will always attract investment costs in the short-term.
- It may deliver short-term savings but is principally aimed at realising long-term benefits for future generations.

The following 8-point mitigation protocol is based on three widely acknowledged mitigation frameworks from Defra [1] and the World Resources Institute [2] [3].

Step 1. Secure Organisational Support

The case for action has been made through the work of the Climate Change Task Group of the Environment and Economy Overview/Scrutiny Committee and endorsed by the Executive in December 2002[4]. With the appointment of the Climate Change Officer in December 2003,

[1] Defra Environmental Reporting Guidelines for Company Reporting on Greenhouse Gas Emissions @ www.defra.gov.uk/environment/envrp/gas/04.htm .
[2] Working 9 to 5 on Climate Change: An Office Guide @ www.wri.org .
[3] The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard @ www.ghgprotocol.org
[4] ED/02/294/HQ, Climate Change: Priorities dated 16 December 2002.

the process of building organisational support for a corporate response to climate change has begun. As *"greenhouse gas champion"*, the Climate Change Officer has the authority to collect data and draw up a strategy for managing and reporting on greenhouse gas (GHG) emissions as well as addressing the adaptation response. A public declaration of the Council's commitment to reduce emissions from its own operations and to promote mitigation and adaptation action throughout the local community was made on 14th July 2004 by becoming a signatory to the Nottingham Declaration on Climate Change. There is now a requirement to gain organisational support from members and officers throughout the Council.

Step 2. Plan the Emissions Inventory.

Set the organisational boundary. It is normal to align the organisational boundary for GHG reporting along the lines of corporate financial responsibility using the concepts of control and influence. This is necessary because GHG emissions may in due course become a formal liability attracting a value perhaps based on the social cost of carbon (currently £74 per tonne of carbon or £20 per tonne of CO_2)[5]. The present value of this liability may be in excess of £1.5 million based on a carbon footprint of 75,000 tonnes of CO_2 equivalent. Recognition of legal responsibility and ownership will allow the Council to better assess its GHG risks and opportunities leading to well-informed management decisions. Early resolution of the ownership of emissions from, for example, Exeter and Devon Airport Ltd., locally-managed schools, contracted out services like highway maintenance, school/community transport and DevonBus, and the county's municipal waste and landfill sites is essential.

Set the operational boundary. The process of identifying the scope of the emissions inventory requires a distinction between direct and indirect emissions. Direct emissions are those from sources owned or controlled by the Council. They are also known as Scope 1 emissions and include those from gas, coal or oil-fired boilers owned by the Council, from its vehicle fleet and from unintentional (fugitive) releases from refrigeration and air conditioning systems. Emissions from Council-owned landfill sites may also fall in this category. Indirect emissions are those resulting from the consequence of Council activity but occur from sources owned or controlled by other organisations. Indirect emissions are further divided into Scope 2 and 3 emissions where Scope 2 accounts for those resulting from the import of electricity and Scope 3 all other activities. This latter grouping will include emissions from employee business travel and commuting, outsourced activities, waste and the supply chain. The distinction between direct and indirect emissions is important as any future regulation covering emissions is likely to make such a distinction in order to prevent double counting. Under the GHG protocol reporting of Scope 1 and 2 emissions is mandatory. The reporting of

[5] The Government Economic Service Working Paper 140 entitled "Estimating the Social Cost of Carbon Emissions".

Scope 3 emissions is encouraged as it provides the opportunity to be innovative with GHG management.

Identify a Baseline Year. The baseline year against which emission reductions are measured throughout the climate change community is 1990. This year is used as it has been calculated that global emissions will need to drop below 1990 levels within a few decades in order to stabilise the atmospheric concentration of CO_2 during the 21st century and avoid dangerous climate change. However, as the data for constructing the Council's carbon footprint for 1990 is no longer available, the use of 2004/5 as the baseline year is unavoidable.

Step 3. Gather the data and calculate emissions.

Data Capture Mechanism. This is a new, extensive and ongoing data collection requirement that is essential if annual progress is to be monitored and reported. Initially, emission estimates will have to suffice in many areas using performance benchmarks, national or regional averages and other explicit assumptions. Over time local key performance indicators (KPIs) for selected mitigation measures will be identified and timely data capture at source will be necessary. The development, implementation and maintenance of such a system will require staff resources. Moreover, it is likely to take several annual iterations to become properly established and integrated into the core business.

Initial Data Capture Requirements. The following areas are identified as the principal sources of Scope 1 and 2 emissions:

- Total annual fuel consumption for the DCC-owned fleet by fuel type.
- Total annual fuel consumption of oil, gas and solid fuel consumed in boilers owned and operated by the Council.
- Total annual output of methane and CO_2 from Council-owned landfill sites.
- Total annual kilowatt-hours of electricity purchased by facilities owned and operated by the Council including properties, road signs and streetlights.

In order to increase the scope for GHG reduction measures, arrangements for collecting the following Scope 3 data should be developed;

- Total annual number of business miles by transport type.
- Total annual number of commuting miles by transport type.
- Total volume/tonnage of waste generated by Council operations.
- Total volume of water consumed.

- An assessment of emissions associated with key outsourced activities.

Step 4. Establish an emissions reduction target.

International and Domestic Targets. As a result of the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) the UK agreed to reduce its greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012 [6]. In addition to this international commitment, the Government has set a domestic goal to reduce CO_2 emissions by 20% below 1990 levels by 2010 [7]. This 1% per annum reduction target has been restated in the UK Government's Public Sector targets from April 2000 and in the 2003 Energy White Paper [8] where the aspiration is to cut greenhouse gases to 60% below 1990 levels by 2050.

Setting the Council's Target. As the data for constructing the Council's carbon footprint for 1990 is no longer available, a mechanism is required for setting an appropriate emissions target based on the baseline year of 2003/4. It is inappropriate to adopt outright either the Kyoto or domestic reduction targets i.e. a 12.5% reduction within 4 years or 20% within 6 years. Such large reductions in the order of 3.3% to 3.7% per annum may be too costly to achieve on an ongoing basis and would represent significant over-achievement in the present target regime. Based on the aspirational target outlined in the 2003 Energy White Paper a target of 2% per annum would deliver a 60% reduction in emissions by 2050 for a 2003/4 baseline. This is likely to represent a reduction of 1500 tonnes of CO_2 per annum, which is equivalent to 3.5 million kWh of electricity or 4.5 million commuting or business miles. For mitigation action to be successful savings of this magnitude will have to be made year-on-year and thus alternatives to a simple reduction in electricity consumption or mileage count will be required.

Step 5. Decide on measures to achieve target.

From a systems perspective there are three mitigation strategies to be considered as follows;

Input (or Energy) Strategies

- ***Option 1. "Do less" - DEMAND REDUCTION -*** reduce the demand for fossil fuels.
- ***Option 2. "Use less" - ENERGY EFFICIENCY -*** make more efficient use of fossil fuels.
- ***Option 3. "Use different" - SUBSTITUTION -*** substitute existing fossil fuels with sustainable fuels or fuels with low or no carbon output.

[6] UK 3rd National Communication under UNFCCC, 2001.
[7] UK Climate Change Programme, 2000.
[8] Energy White Paper entitled *"Our energy future - creating a low carbon economy"*

Output (or Waste) Strategies

- ***Option 4***. ***"Generate less" - WASTE MANAGEMENT -*** reduce the potential for emissions especially methane from agriculture and waste.
- ***Option 5***. ***"Recover more" - RECOVERY*** - collection and use of landfill gas as a substitute energy source.
- ***Option 6. "Sink more"- SEQUESTRATION -*** conserve existing biological carbon pools and enhance sequestration potential through afforestation.

Market Strategy

- ***Option 7. "Offset"- EMISSIONS TRADING/TECHNOLOGY TRANSFER*** - purchase carbon credits or pay others to reduce their emissions as offsets against the Council's emissions.

The Council has action in place on a number of mitigation initiatives within this strategic framework. For example, the Green Travel Plan has both a demand reduction and energy efficiency focus, the Renewable Energy Strategy has a clear substitution goal and the Municipal Waste Management Strategy with its emphasis on recycling is an important waste management strategy. However, neither the full scope of the Council's existing/planned mitigation measures nor an estimate of the absolute size of their individual contribution is known at present. This scoping exercise is essential before the initial mitigation agenda can be confirmed. There is also a need to identify and cost additional mitigation measures that may be required to meet the initial and/or future targets.

Step 6. Implement measures.

Once the initial package of measures has been costed and funded, implementation is likely to take place as a corporate (horizontal) rather than directorate (vertical) initiative.

Step 7. Establish and operate a monitoring system.

The lead officer will need to establish and operate a system for monitoring the effectiveness of the mitigation measure. This process may use extant local/regional monitoring initiatives (e.g. BVPIs) and should be identified at the initial data capture stage for the carbon footprint.

Step 8. Report progress/make a public declaration.

It is recommended that an annual progress report is produced.

Appendix 5

Our Adaptation Protocol

How will we adapt to the impacts of climate change?

Introduction

As a consequence of the significant time lag in the climate system between cause and effect, climate change over the next 30 to 40 years has already been determined by historic greenhouse gas emissions. Moreover, even if humanity is successful in making the significant reduction in emissions required to stabilise the atmospheric concentration of CO_2 at an acceptable level, global temperatures will continue to increase and sea level will rise for many centuries. For the South West, the UK Climate Impacts Programme (UKCIP) Scientific Report 2002 projects an average annual temperature increase of up to 4°C by the 2080s together with hotter drier summers, milder wetter and stormier winters, more extreme weather events and a rising sea level. Therefore, as a complement to the mitigation agenda, there is a need to develop strategies to address such risks and take advantage of any resultant opportunities.

What is Adaptation?

Climate change adaptation is the adjustment in natural or human systems in response to experienced or future climatic conditions or their effects or impacts, which may be beneficial or adverse. It embraces a number of key concepts. System *"sensitivity"* is the degree to which a particular ecological, social or economic system is affected either adversely or beneficially by all aspects of climate including variability and extremes. Sensitivity reflects a system's exposure to climate impacts hence the use of the term *"exposure unit"* to indicate the system of interest. *"Adaptive capacity"* is the ability of an exposure unit to adjust to climate change, moderate potential damages, take advantage of opportunities or cope with the consequences. The *"coping range"* is an expression of the present adaptive capacity of that system to current climatic variability. As such, it is a zone of minimal hazard and defines *"vulnerability"* or damage *"thresholds"* as benchmark levels of climate risk. For most communities, changes in average climatic conditions commonly fall within the existing coping range and therefore, it is more important to identify potential changes in climate variability, and in the frequency and magnitude of extreme events outside the present coping range. That said, a coping range is not static as it can be shifted by actions to reduce the exposure unit's sensitivity and/or enhance its adaptive capacity. Such actions are climate change adaptations.

In unmanaged natural systems adaptation is the means by which species respond to changed conditions. Such adaptations are reactive and spontaneous as natural selection takes its course. In human systems adaptation has the added dimension of anticipation motivated by both private and public interest. A distinction is drawn between *"autonomous adjustment"* and *"planned adaptation*" reflecting private and public drivers. Autonomous adjustments are initiatives taken by private decision-makers (i.e. individuals, households, businesses, and corporations) usually triggered by market or welfare changes induced by actual or anticipated climate change. Planned adaptations are the result of deliberate policy decisions on the part of a public agency (e.g. local government) based on an awareness that conditions are about to or have changed and that action is required to minimise losses or maximise benefits from new opportunities. As such, planned adaptations represent *"intervention strategies"* that are developed in the light of known or anticipated autonomous adjustments.

Adaptation Frameworks

Under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC) much work has been done to identify frameworks, methods and tools to evaluate climate change impacts, vulnerabilities and adaptations. Whilst initial development work was driven by the urgency to understand the magnitude of climate change impacts for the mitigation agenda, more recently the focus has been on adaptation linked to current climate variability and vulnerability. This change in emphasis has led to the development of a second generation of studies that begin with current climate variability and adaptation (or the lack of adaptation or maladaptation) in order to provide a grounding in reality on which to base projections of future impacts, vulnerabilities and adaptations. Such an approach addresses issues regarding climate change relevance, timeliness and uncertainty to some degree.

An Adaptation Agenda

The question is *"What does all this mean for Devon?"* By taking account of the above guidance, it is clear that the DCC adaptation protocol should lead to the creation and implementation of appropriate intervention strategies whilst also promoting autonomous adjustment at a community level. Moreover, it should be based on an assessment of current as well as future climate variability and make recommendations to continually improve the community's coping range. The choice of exposure units to be examined should reflect a prioritisation of both present and future climate risk and may be either service-related (e.g. highway maintenance) or non-sectoral reflecting specifically identified risks e.g. the Slapton Line, the Dawlish - Teignmouth rail link, the ecology of Dartmoor etc. It will consist of a suite of measures aimed at reducing vulnerable communities' sensitivity to climate impacts and/or enhancing their adaptive capacity. It will require clear-cut climate-driven decisions as well as

less obvious decisions in which climate change may be just one of many driving factors. Indeed, as much of the existing Social Services' programme is aimed at reducing social vulnerability, such work should be considered as adaptive capacity enhancement even though there may be no immediate or direct climate change driver. Consequently, the adaptation agenda will be a portfolio of hard protection measures and soft adaptive capacity enhancement measures that promote the welfare of the most vulnerable members of our community. It is likely that this decision-making process will involve a *"precautionary approach"* with an initial preference for *"no/low regrets"* measures. However as a consequence of the considerable uncertainty, it is most important that all decisions are reviewable and reversible in the light of new knowledge.

Framework for the Protocol

Given the UK's economic performance and our well-developed political, institutional and technological support systems, our adaptation potential is considered to be very high. As a consequence we are likely to be able to adapt readily to changes in average conditions, particularly if they are gradual. However, our communities are more vulnerable and less adaptable to changes in the frequency and/or magnitude of extreme weather events. In Devon, our principal sensitivities are to:

- Extreme seasons such as exceptionally hot dry summers and mild winters.
- Short-duration hazards such as tidal surges associated with storms, and heavy rainfall resulting in river valley flooding and flash floods.
- Long term coastal squeeze as a result of sea level rise acting on fixed coastal infrastructure.

Figure 17 shows the relationship between natural variability and mean climate in a climate change context. It also demonstrates the concept of a coping range – a zone of minimal hazard - within which we can deal with most climatic variability other than extreme weather events. As climate change occurs the mean climate is changed by the increasing frequency and magnitude of extreme events.

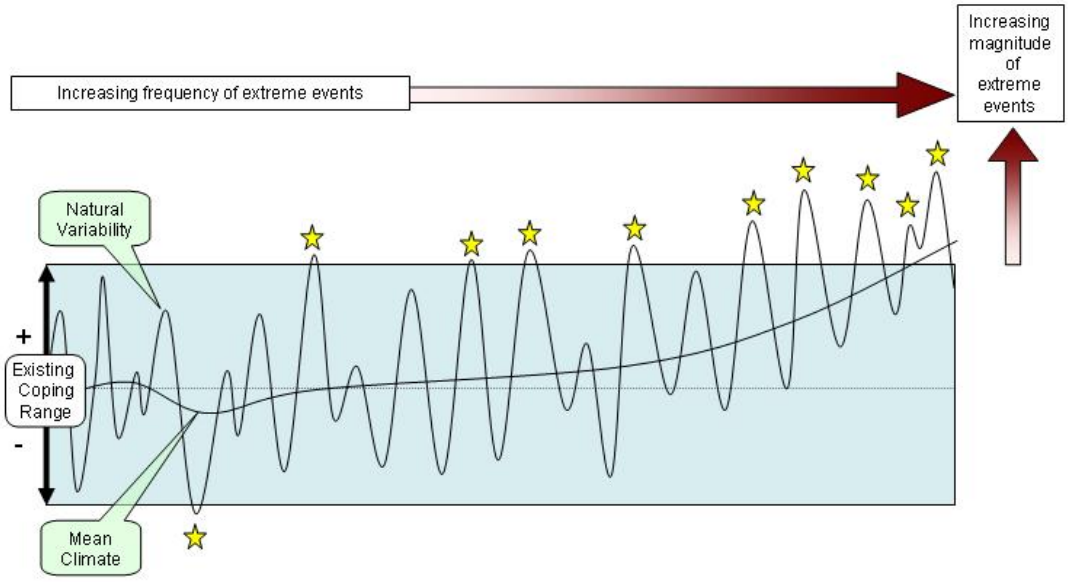

Figure 17. Natural variability, mean climate and coping range.

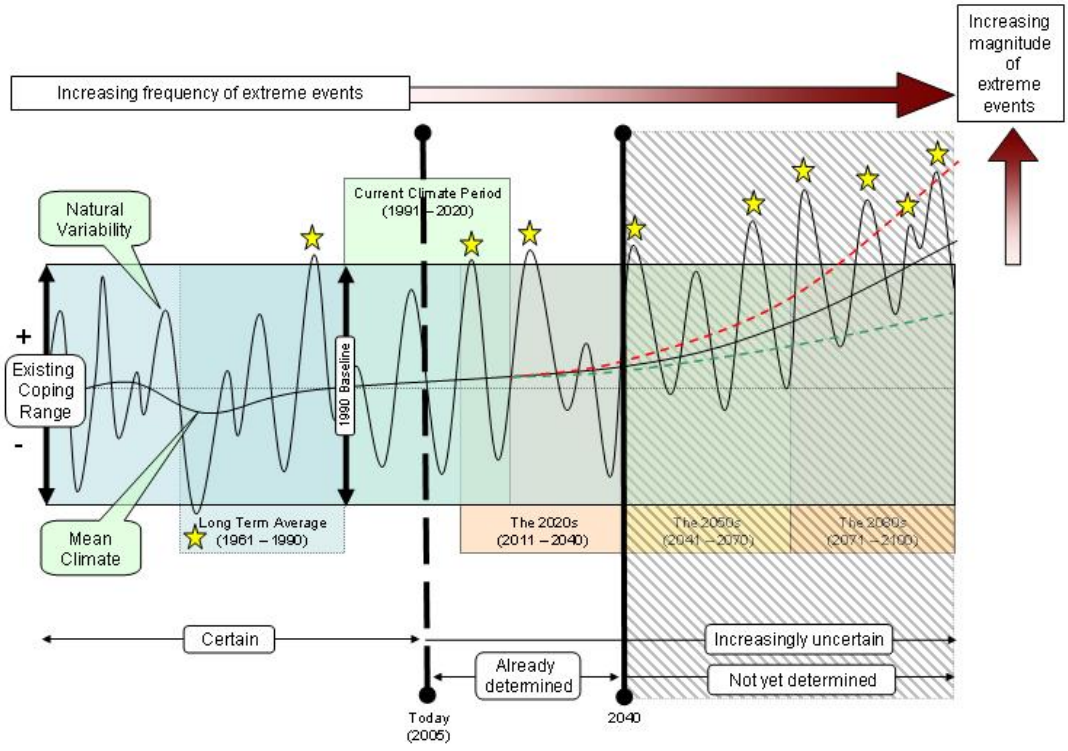

Figure 18. Climate change schematic in a temporal context.

Figure 18 puts the schematic diagram of climate change and extremes into a temporal context which runs from the early/mid 20th century to the end of the 21st century. We can be

certain about past weather and climate as reliable records of most weather variables have been collected at many stations across Devon and the UK for up to 140 years. However as we look forward, our future weather and climate becomes increasingly uncertain as we do not know future levels of greenhouse gas emissions which have yet to be determined by global population growth, economic development and technological innovation. Given the 30 to 40 year time lag in the response of the climate system to increased emissions, we know that the climate out to about 2040 is already determined and there is nothing we can do about it. That said, we can use models of past climate and the expected greenhouse gas forcing to project the changes we are likely to experience during this period. However, beyond mid-century the climate is not yet determined. Future climate projections for this period are based on four storylines of global development. It is during this period that the oft quoted headline global temperature change of 5.8°C may occur. From this view of climate change we can derive three periods in which we need to situate our adaptation response:

- Period 1. Climate certainty – the recent past.
- Period 2. Climate determined but uncertain – the next 30 or 40 years.
- Period 3. Climate not yet determined and increasingly uncertain – beyond mid century.

Given that our adaptation potential in response to gradual changes in the mean climate is good and that climate change projections over *"the 2020s"* (i.e. 2011 to 2040) show a marginal increase in average annual temperature for Devon of about 0.9°C and a marginal decrease in rainfall across the county of about 2%, adaptation should focus on seasonal extremes and short duration hazards. Using the periodic approach identified above, the first step is to examine the frequency of occurrence and impact of such events in the recent past (Period 1) as a "certain" indicator of future events over the next 20 years or so. By identifying lessons learned from these past events and applying them across the county with an additional 50 years worth of climate-proofing embodied, we will be able to create anticipatory adaptations out of reactive adaptations in which we have a degree of confidence. This concept is shown at Figure 19.

However, because of the nature of climate change there will be extreme events that we have not experienced but must prepare for. As we move forward through time our knowledge, wealth and technology will improve which will allow us to put in place more effective adaptations than we could today. It is for this reason that we should not consider at this stage those adaptations against extremes required in Period 3. The climate impact assessment needed for this forward look at anticipatory adaptations must concentrate on Periods 1 and 2 only. Clearly, this process will roll forward with time and begin to address the early years of the "not yet determined" and "very uncertain" future of Period 3 in due course.

Figure 19 also identifies the business-based Forward Planning/Investment Horizon. It can be seen that decision-making and investment cycles operating over short time scales (e.g. 5 years) are only affected by climate variability (i.e. extreme events) and not changes in mean climate. However, business decisions for the long term (e.g. 50 years) must also take into account changes in mean climate. Any business case for long term adaptation would have to use the precautionary principle as the basis for action because of the uncertainty involved.

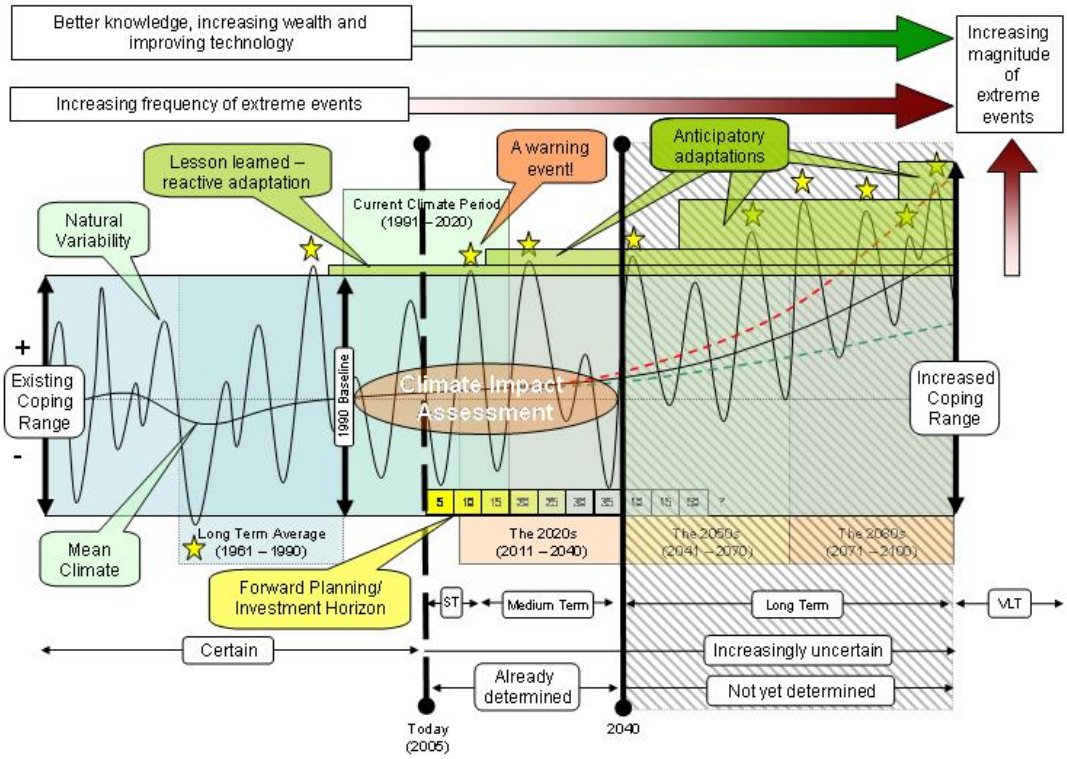

Figure 19. Climate Impact Assessment, reactive and anticipatory adaptation, and the forward planning/investment horizon.

Adaptation Principles

- Principle 1. Adaptation should focus on seasonal extremes and short duration hazards for the period to 2040.
- Principle 2. Climate events of the recent past should be used to identify potential adaptations required over the next 20 years.
- Principle 3. All adaptation measures should be climate-proofed for a minimum of 50 years.
- Principle 4. Long-term business/investment decisions (i.e. + 30 years) must take into account changes in mean climate.
- Principle 5. The business case for long term adaptations must use the precautionary principle as the basis for action.