Climate Change

Climate Science is not new. In fact the idea that the Earth might have a 'warming blanket' surrounding it within the atmosphere was first suggested over 180 years ago in 1827 with Joseph Fourier using the phrase 'greenhouse effect'. The role that Carbon Dioxide (CO_2) (and other climate-forcing gases such as Methane and especially water vapour) play in the formation of this 'blanket' gas mixture has been at the forefront of research amongst climate scientists in the last 30 years. We should also remember that it is the 'greenhouse effect' that makes the planet habitable for without it, the mean temperature would be too cold to sustain life. The simplified explanation of the mechanism involved is illustrated in Diagram 1.

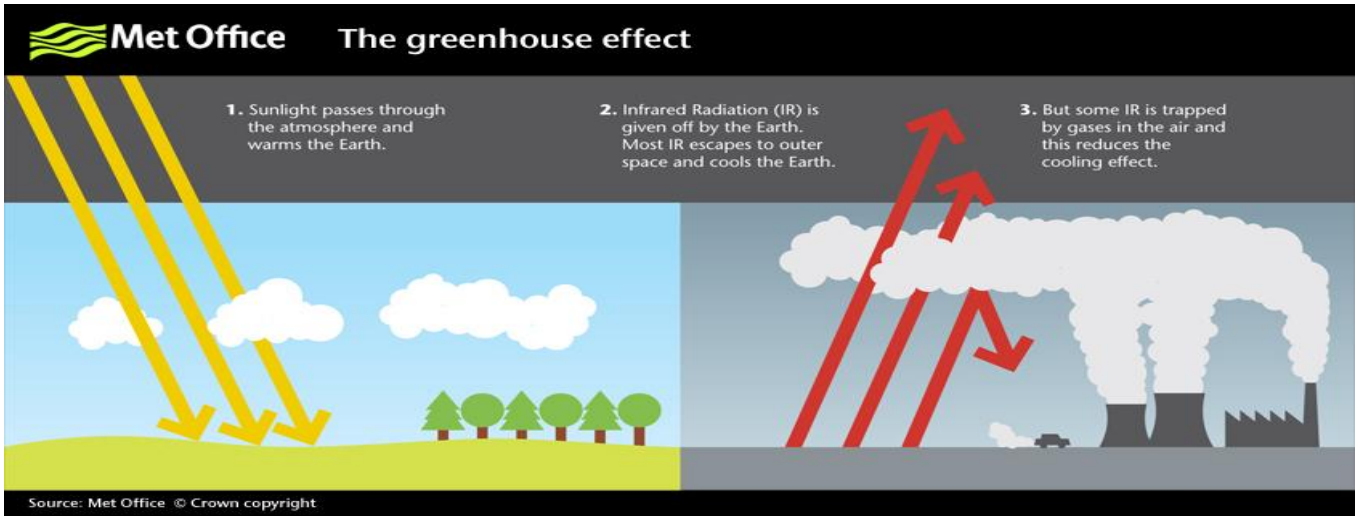

Diagram 1 illustrating the 'Greenhouse effect'
Reproduced by courtesy of the Met Office

What is Climate Change?

Our climate changes as part of a complex set of interlinked natural process. The earth's orbit around the sun changes over cycles lasting tens to hundreds of thousands of years. These changes in orbit, known as Milankovitch cycles, can increase or decrease the strength of solar radiation received on earth influencing our climate leading to warming and cooling and the start and end of periods of glaciation.

Other factors can influence our climate such as volcanic eruptions. These release millions of tonnes of gases, such as sulphur dioxide and carbon dioxide (CO_2), and particulate matter into the atmosphere. The sulphur dioxide forms acid droplets which reflect solar radiation back out to space, cooling the planet for several months or even two or three years after the event until these droplets fall from the atmosphere. The CO_2 released by the volcano has the opposite effect trapping solar radiation leading to future warming. This CO_2 lasts in the atmosphere for up to 100 years and so the effects will be felt for a much longer timescale.

The surface of the Earth itself can influence the way in which heat is absorbed. White surfaces such as snow and ice reflect light and heat back into space whereas darker surfaces such as soil will absorb heat and less is radiated back into the atmosphere. This phenomenon is known as the 'Albedo Effect'. So changes in terrestrial lice cover can demonstrably alter the climate.

All these variations in solar output, volcanic activity and surface reflectivity are responsible for the relatively small changes in the climate that have been identified over the recent past up to the time of the industrial revolution. These natural processes, however, cannot be responsible for the relatively dramatic changes in our climate observed since the middle of the 19th century up to the present day.

These much more rapid changes in climate are thought to have been driven by additional greenhouse gases emitted through human activity such as the use of fossil fuels in generation of electricity and for transportation, changes in

agricultural processes, soil management and deforestation rather than natural processes alone.

Weather and climate definitions

There are two terms that are often used interchangeably but have different definitions which should not be confused:

Weather = the present condition of measurable variables such as temperature, humidity, atmospheric pressure, wind, rainfall which change hour by hour , day by day or week by week.

Climate = the range of these measurable variables (temperature, humidity, atmospheric pressure, wind, rainfall) over extended periods of time. It is the average weather experienced over time (usually exceeding 30 years).

Both 'climate' and 'weather' can refer to small geographical locations as well as large.It is also important to draw a distinction between **gradual change** (such as sea level rise and increased temperatures) and **sudden or catastrophic change** (such as a coastal landslide, major flood event or a large storm event).

Predictions of our Future Climate

Despite attempts to mitigate our emissions, both in the UK and around the world, the impacts from current and previous emissions will be experienced long into the future. This is due to the inertia of the global climatic system. Greenhouse gases, such as CO_2, can stay in the atmosphere for up to 100 years. Even if all man-made greenhouse gas emissions ceased immediately, the influence of historical gas emissions already in our atmosphere will result in increasing temperatures, changing rainfall patterns, rising sea levels and more extreme weather events for the next 40 or so years up to the middle of the 21st century.
The decisions made now in regulating global emissions and the speed in which any reductions are implemented will influence the degree of climate change experienced from 2050 until the beginning of the next century.

United Kingdom Climate Projections 2009 (UKCP09)

In order to prepare for the future and adapt our infrastructure, communities and services, we have to know by how much the climate is likely to change and what temperatures and rainfall patterns we can expect. Making timely and proportionate changes to how we do things, to make sure that our investments, such as buildings and transport infrastructure, last for as long as they possibly can make good sense. Effective decisions now can save money in the long term.

To further this understanding, the United Kingdom Climate Projections (UKCP09) was released in 2009. UKCP09 is the latest cutting edge climate modelling tool to help us plan and prepare for a future with climate change. It builds upon earlier modelling work (UKCIP02), and has been developed by the Hadley Centre, based at the Met Office in Exeter, in conjunction with the United Kingdom Climate Impacts Partnership (UKCIP) which is funded by Defra.

Climate models are computer simulations of the way the Earth's climate works. They represent the characteristics of air, ocean water, ice, and crucially, heat around the Earth. They model chemical, biological and physical processes in the atmosphere, oceans and on land. Ever more sophisticated models and increasing computer power enable climate scientists to understand our climate better and study a range of possible future climates.

The UKCP09 projections produce outputs for three varying future greenhouse gases emission scenarios, categorised as 'low', 'medium' and 'high'. These 'scenario's reflect the various paths we may follow depending on how quickly we can mitigate our future greenhouse gas emissions.

Unlike previous models which gave a single estimate of future change for a given set of climate variables (such as Temperature, Precipitation or Sea Level Rise etc), UKCP09 provides probabilistic projections which shows a range of possible changes as well as giving a clear indication of what is most likely within that range and over several timescales. Varying levels of certainty can be attached to the predictions made, such as 10%, 50% and 90% probabilities. This gives us a greater confidence in the local temperatures, precipitation patterns or sea levels we are likely to experience in the future.

Climate Change

SW England	2020 →			2050→			2080→		
Probability level	10%	50%	90%	10%	50%	90%	10%	50%	90%
Summer mean air temperatures (°C)	0.5	1.6	2.7	1.3	2.7	4.6	2.1	6.9	3.4
Summer mean rainfall (%)	-27	-8	+14	-42	-20	+7	-50	-24	+6
Winter mean rainfall (%)	-2	+7	+20	+4	+17	+38	+ 6	+23	+54
Mean sea level rise (m) (relative to 1990) in Poole Bay	<0.1	<0.1	<0.1	0.1	0.2	0.3	0.2	0.4	0.5

The UKCP09 projections provide future climate information for 25km^2 grid cells. Due to the complex technique used to average the projections over a geographical area, it is not possible to produce a single set of data for the whole of the county of Dorset; a range exists dependent on local geography. Six 25 km grid squares make up the coverage for the county; these should not be averaged. Several of the coastal areas of Dorset fall within predominantly 'marine' grid squares, (Portland, Weymouth and Purbeck). Because there is more sea than land in these grid squares, the climate model cannot give accurate data for those areas of land in these cells and therefore the nearest land grid is to be used as an approximation.

The predicted changes for the South West (relative to 1961 -1990 values)
(Data taken from the Met Office report for Dorset County Council, March 2010)

A note on probability levels: *'10%' means it is very unlikely that the actual figure will be* ***less than*** *that shown in the table. '50%' means the figure shown has a 50:50 chance of being exactly right or is as likely as not to occur. '90%' means it is very unlikely that the actual figure will be* ***more than*** *that shown in the table. It can also be interpreted as saying that 80% of all measurable observations will fall within the range given. For example, in the cell shaded blue, it means that it is very unlikely that the winter rainfall in the 2020's will be more that 20% greater than levels in the period 1961 – 1990.*

Climate predictions relating to Dorset
a) Air Temperature (2050's)
According to the UKCP09 projections, by 2050 Dorset will experience hotter summers with an increase in average summer temperature of 1.3 - 4.6 °C on the current average summer temperature. The hottest summer days could rise by as much as 7°C although it is more likely to be around 4°C. Average

Winter temperatures are also set to rise with an expected increase of 1.1 - 3.6 °C above the average winter temperature experienced today.

b) Precipitation (2050's)
In terms of precipitation in the 2050's, the total annual rainfall is unlikely to change. The patterns of rainfall however could shift with total summer rainfall likely to decrease by around 20% but could be as much as a 42% reduction and winter rainfall is predicted to rise by between 4% - 38% but is likely to increase by around 20%.

c) Sea levels
Sea levels in the English Channel have risen by some 10cm since 1900. They are rising at an accelerating rate today and on average sea surface temperatures locally have risen by 0.7°C since 1980. Sea levels are expected to rise around the South West coast by 18 - 26cm by 2050, rising to 30 - 44cm by the 2080's.

The central estimates (medium emissions) for the relative changes in sea level (compared to 1990) are given for four locations along the Dorset Coast; Lyme Regis, Portland, Swanage and Poole Bay. In all four cases the (50:50) relative increase suggests approximately 48cm (0.54cm/year averaged over 90 years) increase in still water levels by 2100. There are also a number of locations that have been identified as being particularly vulnerable to storms (over the next 100 years) and subsequent flooding and / or accelerated erosion. Lyme Regis, the Portland causeway, Weymouth (lower town centre and the Park District) and Poole Town are the most notable. The Environment Agency also gives data for Christchurch.

d) Sea surface temperatures (SST) and salinity
UKCP09 projections for the period 2070 -2098 suggest that the summer seasonal mean English Channel waters will be up to 4°C warmer than today. Winter temperatures will be 2 °C higher. These waters are likely to have a slightly lower salinity than today.

e) Storms and storm surges
A meteorological principle states that when more energy enters the sea /air system, then the frequency and intensity of storms increases. However it is not yet possible to produce robust models that project changes in storm patterns. Existing models give contradictory results but they do suggest that the proportion of rainfall falling as heavy rain will continue to increase. This in turn will increase the frequency of coastal flooding events. Even if the pattern of coastal storms does not change drastically, the extreme high-water levels they generate coupled with the increase in absolute sea levels means that the overall risk of increased damage and erosional loss on the Dorset coast will increase.

Ecological Effects

Physical changes could have important consequences, both positive and negative, for the distribution of plankton, fish larvae and fisheries stocks which in turn will affect fishing activity. With rising sea levels and increased coastal erosion intertidal areas, which are often rich in invertebrate sediment communities, may be squeezed with consequences for over-wintering wildfowl and waders.

The 2009-2010 Marine Climate Change Impacts Partnership report states with medium confidence that biodiversity is already increasing in southern areas as warm water species extend their distributions faster than cold water species are retreating.

Changes in crustacean abundance in some locations and the occurrence of previously undocumented species in others suggest some degree of climate-influence in Shallow and Shelf Subtidal Habitats whilst increased seawater temperatures have been linked with disease outbreaks in seafans, changes in algae distribution and abundance, and the appearance and increased occurrence of a previously unrecorded warm-water barnacle in southern and south-western areas (all low confidence).

Shifting species range boundaries will have implications for Marine Protected Areas as designated boundaries in the past have been static. The Marine Conservation Zone (MCZ) Project Ecological Network Guidance states “Where features protected by MCZs have altered due to natural processes or climate change, it will be possible to revise the features listed for a site, de-designate MCZs, amend the MCZ conservation objectives, or modify the boundaries if such actions are deemed appropriate...”

Charmouth Heritage Centre in Storm. Copyright: Richard Edmonds

Climate Change

The main policies & strategies that relate to climate change at the coast

International

The Kyoto Protocol (1997) is a UN-sponsored agreement to reduce (and to stabilise levels of) greenhouse gas emissions. The Protocol set binding targets for reductions in emissions but the absence of the USA from the co-signatories highlighted a serious weakness in the scheme. The protocol became International law in February 2005. The Industrialised nations have agreed to cut their yearly emissions of carbon by an average of 5.2% (from 1990 levels) by 2012. It is unlikely that any of the world's large economies will reach their targets by 2012. It's important to note that aeroplane and shipping emissions are not included in the Kyoto Protocol.

The Copenhagen Conference (November 2009) intended to have a workable system of reducing carbon emissions globally. This did not happen despite two weeks of talks between experts, Ministers and Heads of State. At the end a draft resolution (the Copenhagen Accord) was drawn up. The Alliance of Small Island States (AOSIS) explained the urgency regarding the survival of small island developing states. Many recognised the historical significance of the Copenhagen Conference, highlighting its unprecedented success in bringing together the majority of the world's leaders to consider climate change but many now see the Accord as a "weak agreement," and question its practical implications because the Accord was not formally adopted as the outcome of the negotiations.

European Strategies - Since the 1970s the EU has been dealing with coastal zone issues through international conventions covering its regional seas. More recently, the EU has begun to specifically address problems related to the state of coasts and the coast as an entity in its own right. In 2006, the Commission appointed an ICZM Evaluation Team to carry out an independent evaluation of ICZM in Europe. One of their main recommendations was to begin to address long-term risks, vulnerabilities to climate change at the coast as well as the direct consequences of sea level rise (on a regional seas basis).

EU coastal polices and recommendations

Explanatory Note: "Regulations" of the Council of the Commission of the European Communities (e.g. fisheries regulations) are automatically binding on all member States. "Directives" (e.g. water quality directive) require States to legislate in order to achieve agreed objectives. "Decisions" are binding only on the States to whom they are addressed.

EU principal directives that relate to the coast and inshore waters and directly or indirectly impact upon the long term management of the coast (in the face of a changing climate) include the:

- Environmental Impact Assessment Directive (EIA 1997) Environmental Impact Home
- European Spatial Development Perspective (ESDP 1999)
- The Water Framework Directive (WFD 2000) Environment Agency Water Framework Directive
- Strategic Environmental Assessment Directive (SEA 2001)
- Recommendation (2002/413/EC) - the implementation of an integrated approach to Coastal Zone Management (ICZM) in Europe. In it there is a requirement to address major long-term risks such as vulnerability to sudden catastrophic coastal losses, sea level rise and water pollution on a Regional Sea level and to adopt a long-term perspective. The European Parliament and the Council (May 2002)
- A Marine Strategy *(for the protection & conservation of the marine environment throughout Europe)* 2005. Integrated Coastal Zone Management
- The INSPIRE Directive 2007 *(to co-ordinate spatial information)*

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 concerns the promotion of the use of energy from renewable sources. In December 2008 EU leaders approved a new Renewable Energy Directive which requires 20% of total energy consumption in EU to come from renewable sources in 2020.

There is also an integrated Maritime Policy for the European Union: The Blue Book *(an analysis of how each European country relates to the sea)* 2007

National

UK governments now have an obligation to put in place measures to ensure that the negative effects of climate change are minimised. There are a number of legislative instruments that are concerned with climate change and therefore have an impact on the coast and how it will be managed in the future.

The Climate Change Act (Nov 2008) - makes the UK the first country in the world to have a legally binding long-term framework to cut carbon emissions and sets a framework for adapting to climate change. The main mitigation ambition is to reduce the net UK carbon account for the year 2050 by at least 80% in comparison with the 1990 baseline. For the period up to December 2020 it must be at least 26% lower than the 1990 baseline figure. Although the Climate Change Act's main focus is on mitigating emissions, it also provides a statutory framework for planning and implementing adaptation measures and includes the establishment of the Adaptation Sub-Committee. The Act also contains a number of provisions that relate to waste recycling, reductions in energy consumption and the use of renewable energy.

The Marine and Coastal Access Act (November 2009) - provides a legal mechanism to "help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new streamlined system for the management and protection of the marine and coastal environment." The Act sets up a new Marine Management Organisation that will be responsible for delivering marine activity licensing arrangements. It will also enable the designation of Marine Conservation Zones (MCZs).

The Energy Act 2010 (April 2010) - includes a strategy for carbon capture and storage (CCS) and brings forward four commercial scale demonstration projects on coal-fired power stations. The Act falls under the remit of the Department of Energy and Climate Change (DECC).

Planning Policy Statement 25 (PPS25): Development and Flood Risk (2010) - In 1992, PPG 20 (Coastal Planning) was published and one of the core provisions was that planning authorities should exercise great caution when considering planning applications that related to vulnerable coastal sites. This approach has been challenged on the basis that many sites *do* have the capacity to support modest (and possibly short-term) developments. Consequently, a new supplementary planning statement entitled 'Development and Coastal Change' has been released (9th March 2010) and is now annexed to PPS25. This PPS is under the authority of the Department for Communities and Local Government. PPS20 is now cancelled. The PPS25 supplement sets out a planning framework for the continuing economic and social viability of coastal communities. The policy aims to strike a more pragmatic balance between economic prosperity and reducing the consequences of 'change' on coastal communities. This indicates a more common sense approach to development in areas at risk from coastal erosion: preventing development in areas assessed as 'high risk', but possibly allowing some temporary development in lower risk situations.

Coastal Planning authorities are required to ensure that decisions are based on an understanding of coastal change over time and prevent new development from being put at risk from coastal change by:

- disallowing development in areas that are highly vulnerable to coastal change or any development that accelerates physical changes to the coast
- directing development away from areas highly vulnerable to coastal change

Local Planning Authorities are also charged with identifying 'Coastal Change Management Areas (CCMA's). Once designated, special attention has to be paid to the likely longevity of any proposed development but these areas are not automatically blighted as far as new developments are concerned. View the PPS25 supplement

Regional
Regional Strategies/reports

***"Warming to the Idea"* report** - Climate SW formally the South West Climate Change Impacts Partnership (SWCCIP) (founded in 2001) considers how the SW

might adapt to the potential impacts of climate change with special reference to the coast and the businesses that trade along the coast. The 2003 *"Warming to the Idea"* report outlines the long term impacts of climate change for the region.

The study formed part of a series of regional Scoping Studies undertaken across the United Kingdom under the auspices of the UK Climate Impacts Programme (UKCIP).

The South West Climate Change Action Plan was launched in September 2008. The Plan was developed by the South West Regional Assembly, the South West Regional Development Agency, the Environment Agency, the Government Office of the South West and Natural England. The emphasis within the plan is to encourage the adoption of a low carbon lifestyle and thus reduce our emissions. The coast is acknowledged in both documents, but specific climate change impacts and subsequent solutions at the coast are not addressed.

Local Climate Impact Profiles (National Indicator 188) - In 2008 the Government introduced an 'adapting to climate change indicator' (NI 188) within the new Local Government Performance Framework. The indicator, measured over five levels from Level 0 to Level 4, encourages Local Authorities to take action from making a high level public commitment to take action on climate change through to having undertaken a comprehensive assessment of risk from future climate impacts and developing an adaptation action plan. Whilst coastal impacts are covered, the reports are not specific in that respect. Dorset County Council and the Dorset's 6 Districts and Boroughs a have currently reached Level 2 and are working towards identifying key actions to better prepare Dorset for climate change. Further details are available at the UK Climate Impact Programme website.

Shoreline Management Plans (SMP_2, 2010)
In 1994, the coastal groups and local authorities of England & Wales were encouraged by Government to adopt the concept of Shoreline Management Plans (SMPs), with a view to providing a more strategic and sustainable approach to coastal defence. An SMP sets out high level policies for managing each section of coastline and the most beneficial responses to the threats from coastal flooding and erosion. The SMP is a detailed non-statutory policy document that aims to balance human interventions with natural processes and the consequences of climate change. The first round was produced in 1999 and the 2009 - 2010 reviews have to be completed by autumn 2010.

- In the east of the County the Two Bays SMP
- West of Durlston Head, the Lyme Bay SMP runs to Plymouth

There is now a growing presumption that for the open coast, 'No Active Intervention' will be the preferred policy so that natural erosional processes are allowed to progress unhindered; unless there is an overriding social or economic reason to intervene.

Coastal erosion at Timber Hill. Copyright: Tony Flux

County
County-wide strategies, management plans and programmes

Dorset County Council

- **Emissions reduction strategy 2001**
- **A Renewable Energy Strategy** + Action Plan currently being written 2010
- **Local Climate Impacts Profile' report 2009** - This report details the key findings of the Local Climate Impacts Profile, compiled on Dorset's county and district/borough council's services and assets. The study sought to develop an understanding of the current vulnerability of local authorities in Dorset to the weather, particularly severe weather events.

Carbon Trust's '*Carbon Management Programme for Local Authorities*'. A scheme requiring LA's continues to develop an emissions 'baseline' (for the services it provides) and set reduction targets and carbon usage reduction programmes

Coastal Change Pathfinder Projects:

- **Defra Rural Pathfinder project 2008 - Challenge 4: coastal and marine issues** - A DCF project to produce six case study scenarios through stakeholder engagement on how climate change could affect six coastal areas on the Dorset coast. Tackling coastal challenges report produced.

- **Managing Change on the Jurassic Coast 2010 - 2011**
  Dorset County Council, in partnership with Devon County Council received a grant from DEFRA to work with communities along the Jurassic Coast to explore how they can adapt to the impact of coastal change. The overall purpose of this project was to engage with coastal communities about planning to adapt to coastal change, and ensure these communities were well-equipped to understand, debate and take part in the decision-making processes involved in managing coastal change.

  The communities were also encouraged to devise their own adaptation plans to help them become more resilient to coastal change. This was primarily in relation to erosion but also for more complex coastal change issues including catastrophic events such as flooding. For example, most of the locations decided that an emergency action plan (village action plan) was something they would now work towards.

Exploring future implications of climate change – 2008 - A collaborative project between DCF and The National Trust to develop three potential scenarios of coastal change at three National Trust locations over varying time periods. The scenarios attempt to identify outcomes and issues for the National Trust.

West Dorset Climate Change Strategy - a local framework for action 2009 - the strategy aims to help residents, businesses and other organisations reduce their carbon emissions by 30% by 2020 from 2005 levels. Sea level rise is mentioned but there are no policies specifically dedicated to the coast.

Purbeck District Council - has been investigating way to reduce the effects of climate change. The Council has a coastline of approximately 100km, which extends from Poole Harbour in the east to White Nothe in the west. The coastline includes the southern boundary of Poole Harbour and the islands within it. Most of the coastline within the district is undeveloped.

Weymouth and Portland Borough Council - The local plan policies (Dec 2008) that relate to the natural environment and coast can be viewed here.

Policies N2 4 specifically discuss protection from sea level rise, storm flooding and over-topping.

Dorset Coast Forum Strategy
The Dorset Coast Strategy (1999) set out a series of guiding principles for the way the coast should be cared for up to the year 2050. View the Dorset Coast Strategy. The 1999 Strategy is under review (2010) and will include references to management approaches that include reference to climate change impacts.

National Trust 'Shifting Shores' strategy
This set of documents details the full set of guiding principles adopted by the Trust and used to determine the coastal management strategies used throughout the organisation. Coastal change and sea level rise are core considerations throughout. Biodiversity South West: Coastal Adaptation Strategies and 'Shifting Shores'.

The Regulators (relating to climate change issues at the coast)

In England, the central government departments with coastal functions include:

- Department for Communities and Local Government (DCLG) (local and regional government, planning)
- Department for Environment, Food and Rural Affairs (DEFRA) (nature conservation, fisheries, water quality, deposits in the sea, flood and coastal defence)

- Department for Transport (DfT) (shipping, harbours, pollution from ships)
- Department for Energy and Climate Change (DECC) (oil and gas, energy) - A new Government Department created in Oct 2008 with strategic objectives to:
  - reduce greenhouse gas emissions in the UK
  - ensure secure energy supplies for the future
  - ensure the UK benefits from the business and employment opportunities of a low carbon future
  - oversee the development of the renewable energy sector both on land and at sea
- Department for Culture, Media and Sport (DCMS) (historic wrecks)
- Department of Health (DH) (port health)
- Department for Work and Pensions (DWP) (offshore safety)
- Ministry of Defence (MOD) (dockyard ports, military ranges)

Other Statutory bodies with coastal responsibilities include:

- Crown Estate Commissioners (foreshore and sea bed ownership)
- Environment Agency (water quality, flood defence, salmon fishing)
- Natural England (nature conservation, landscape protection, access to the countryside)
- English Heritage (the historic environment)
- Commissioners for Revenue and Customs (administration of customs ports)
- Health and Safety Executive (offshore safety)

National Trust owns 715 miles of coastline in England and Wales and NI and whilst a Registered Charity, they are non-statutory.

Mitigation and Adaptation

There are two accepted routes to explore in terms of addressing climate change: **mitigation and adaptation.** Adaptation is complementary to Mitigation.

Mitigation – addresses the Causes

- Reduce greenhouse gas emissions

Adaptation – addresses the Consequences

- Minimise adverse effects of climate change
- Take advantage of any opportunities that arise

Mitigation = reducing the potential effects of climatic change **-** mitigation identifies steps taken (as individuals and as a society) to slow down and limit further changes to our atmosphere e.g. reducing greenhouse gas emissions (carbon dioxide, methane, nitrous oxide) through more efficient use of energy, reducing overall demand and adopting non-carbon-based renewable energy supply sources.

Mitigation (as applied to coastal activities in Dorset)

- Energy generation that reduces reliance on fossil fuels and / or removes greenhouse gases from the atmosphere:
- Solar Power (solar cells and thermal collectors on roofs etc)
- Geothermal power
- Biofuel (Ethanol and biodiesel)
- Nuclear power (Nuclear Power Stations are invariably constructed on or near the coast)
- Offshore and coastal windfarm installations
- Tidal, wave and hydroelectric power generation
- Carbon capture and storage (CCS / geo-sequestration)

Renewable Energy and offshore generation - Onshore and offshore wind power generation offers the potential for considerable expansion of renewable energy in the UK, with wave and tidal power expected to have a lesser role in supplying the nation's future energy needs and in meeting ambitious targets. Currently there are nine designated development zones around the UK coast. The target (by 2020) is to construct 6400 turbines at a cost of £75 billion and generating 25 gigawatts of electricity. The Crown Estate (who own and manage the seabed) is contributing £100M to the development costs.

Onshore and offshore wind farms will be the cornerstone the Government's commitment to raise the proportion of energy consumed in the UK (from a range of renewable sources) from 2.4 per cent to 15 per cent by 2020. The plan is that many of these

new farms will be online by 2014 although the construction industry estimates that this date is too optimistic and that 2017 is more realistic.

The legally-binding EU target is even more specific and requires 35% of all the electricity used in the UK in 2020 to be derived from renewable sources. This target is even more ambitious than the '20-20-20' EU Renewable Energy Directive that requires 20% renewable energy provision and 20% greenhouse gas reductions by 2020.

Offshore wind – Dorset - under the Crown Estate Round 3 proposals, Development Zone 7 relates to the Dorset waters between the Isle of Wight and Ringstead Bay and the development contract was awarded (December 2009) to a Dutch consortium, Eneco. The plans will consider an offshore windfarm of 180-300 large (3-5MW each) turbines with a combined output of 900MW. The visual impact (from the land) will be minimal as the nearest distance to shore is some 12km off Durlston Head. If the necessary permissions are granted, construction could commence in 2015 and be commissioned by 2018.

Possible landfall sites (for cabling) could be Weymouth Bay for the Chickerell National Grid sub-station or Poole/Bournemouth/Hengistbury Head for the Mannington sub-station and the western Solent for the power station at Fawley.

Wave and Tidal stream power

The large tidal range along the western coasts of England provide some of the most favourable conditions for the utilisation of wave and tidal power. Prominent headlands provide accelerated currents on the ebb and flow of the tide and the Portland race has been suggested as a possible location for the installation of small scale sub-sea turbines. Flow rates (Spring tides) can reach 1.7m/sec which is at the current limit of economic feasibility.

Nuclear power - There are no plans currently to re-instate the nuclear facility at Winfrith in S.Dorset. However, the licences allowing for radioactive discharges (Tritium and Caesium 137) through the pipeline to sea at Arish Mell are still current and the site is fully compliant regarding the quantities of radioactive discharge.

Portland underground natural gas storage facility. - This project will provide the largest onshore gas storage facility in the UK with a capacity of 1,000 million cubic metres and is designed to help to secure the UK energy supply in a volatile international market. The plan will involve laying two large pipes across Weymouth Bay and with a landfall near Osmington Beach. Planning permission was granted by Dorset County Council in May 2008 and Pipeline Construction Authorisation was granted by the Department of Energy and Climate Change in July 2008. The current estimate of total development cost for the project is £456m.

Carbon storage - When the oil-bearing strata under the sea at Kimmeridge are exhausted, it is possible that they might be used for geo-sequestration. Geo-sequestration involves injecting carbon dioxide directly into underground geological formations. CO_2 has been injected into declining oil fields for more than 40 years, to increase oil recovery. This option is attractive because the storage costs are offset by the sale of additional oil that is recovered. Another benefit of injecting CO_2 into oil fields is that CO_2 is soluble in oil. Dissolving CO_2 in oil lowers the viscosity

Adaptation

Adaptation = adjusting our lifestyles and behaviour (within our environment) to cope better with climate change and take advantage of any opportunities which may arise as a result of any changes.

Coastal Adaptation Strategies (CAS)
These are long-term plans that first identify the likely impacts of sea level rise and storm damage at vulnerable locations. The technique involves a detailed study and inventory of the site (including an ecological inventory). This is followed by a risk analysis and costings of the damage likely to be incurred over the 100 year time period. The final stage is the production of a set of realistic adaptation proposals (and their costings) to minimise any loss and to maximise any benefits. CAS work is therefore an extension of recognised cost / benefit analysis methodology and attempts to tease out the positive opportunities that coastal change

may offer. A CAS is usually specific to a given coastal location.

Adaptation on the Dorset Coast

The Dorset coast is particularly susceptible to the projected increase in storm events because it is exposed to both South Westerly storms and to Easterly storms. Dorset coastal urban locations most at risk from flooding and erosion over the next 50 - 100 years includes Christchurch Harbour, Poole and Poole Harbour, Weymouth town centre, Seatown, Charmouth and Lyme Regis

Other Useful Websites

General climate change science:
http://www.parliament.uk/documents/post/postpn295.pdf
http://www.climate.org/topics/sealevel/index.html
http://www.epa.gov/climatechange/effects/coastal/index.html
http://www.mccip.org.uk/
Connecting biodiversity with climate change:
http://www.cbd.int/climate/copenhagen/
Climate Change and the coast:
http://www.coastalwight.gov.uk/responseimages/final/pdfs_final/Summary%20Leaflet.pdf
http://www.dorsetforyou.com/330927

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