PLANET GUERNSEY

Towards a Sustainable Future!

THIS BOOK IS DEDICATED TO THE PEOPLE OF GUERNSEY AND, IN PARTICULAR, TO BRIDGET OZANNE, OUR MUCH LOVED GUERNSEY BOTANIST WHO SADLY DIED DURING ITS PREPARATION.

"No man is an island, entire of itself; every man is a piece of the continent, a part of the main... Any man's death diminishes me, because I am involved in mankind; and therefore never send to know for whom the bell tolls; it tolls for thee..."

John Donne

Meditation 17
Devotions upon Emergent Occasions

PLEASE PASS THE WORD!

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PREFACE

Small island communities are among the most vulnerable to the effects of climate change. Some, particularly in the South Pacific, are already losing valuable land to the ocean, whilst their populations make arrangements to move to higher ground or, where that is not available, to other countries. History shows that our islands of the Bailiwick of Guernsey will not be immune from these changes. Indeed, the impact that climate change has already had on our natural environment provides a powerful argument of the need for local action. Guernsey has its part to play as the response of the world community to global warming begins to develop momentum.

Guernsey has an impressive history of recording its local ecology and natural history, stretching back to the 19th century. Together with its extraordinarily rich coastal and marine environment and its geographical location on the northwest fringe of the Bay of St Malo, this makes the island a uniquely informative sentinel of change.

The editor and the authors are to be congratulated for putting together a highly informative body of data on the climatic changes that have already occurred, and the impact these have had on the species distribution of plant, bird and insect life, on flowering dates, on the migration of birds and on marine life. This has been put in the context of change over past millennia, and predictions of where current change may lead us. The final section on opportunities for action should be of importance for everyone in Guernsey.

Last year we celebrated the second centenary of the reclamation of the Braye du Valle, which has made such a contribution to Guernsey's development. It would be a tragedy if by the third centenary, we had started to surrender back to the sea, land that had been so successfully reclaimed from it.

G R Rowland
Bailiff
The Royal Court House
St Peter Port
Guernsey.

PLANET GUERNSEY

Towards a Sustainable Future

A Handbook detailing the Evidence and Impacts of Climate Change in Guernsey, the Consequences and Opportunities for Action.

Compiled and edited by Andrew Casebow
Designed and produced by Chris Regan

ACKNOWLEDGEMENTS

The editor wishes to express his gratitude to Tim Sparks whose initial enthusiasm and editorial assistance made this project possible, and to Donna Le Tissier for managing the administration and assisting in the production of the book.

Particular thanks are due to all the contributing authors and to the editorial team of the Guernsey Climate Change Partnership (Tim Lillington, Nick Day, Muir Ashworth and Charles David), and to our private and business sponsors whose financial support has enabled the publishing of this book.

Tim Sparks has been responsible for statistical analysis (except that carried out on Met office information by Tim Lillington). We are grateful to the Guernsey Biological Records Centre, Digimap and to many private individuals and organisations who have contributed photographs and illustrations.

Finally, Andrew would like to record his thanks to his wife and family who have supported him in the production of 'Planet Guernsey' from conception to birth, and beyond!

GUERNSEY CLIMATE CHANGE PARTNERSHIP
2007

FOREWORD

Human associated climate change is real. There are, as always, questions about particular details, but a clear scientific consensus on the main facts has emerged, that the increase in temperatures seen over the past fifty years is due to the accelerating emissions of carbon dioxide and other greenhouse gases. If unchecked, the increasing levels of these emissions in the atmosphere will lead to massive, irreversible damage to the global environment. If atmospheric levels of these gases are to be stabilised at a level, which avoids the worst effects of climate change, the industrialised countries need to make cuts of 60% by the middle of this century. This is a huge challenge. Identifying the problems associated with climate change is one thing, doing something effective about it is another. In recent years, the Royal Society has been extremely energetic in the analysis of these problems, calling for increased investment in renewable energy sources, working with developing countries, notably China and India, in developing their capabilities in appropriate science and technology, and arguing vociferously for greater political commitment.

It is therefore a real pleasure to have been asked to write a foreword to this publication. Each community must play its part in reducing the threat of global warming, particularly those from the rich, industrialised part of the world. The greater the awareness of the changes that have already taken place, and to where these changes are leading us, the more likely it is that individuals will see the need to participate in what must become a global effort. What better way to boost awareness in a community than to publish local data on sensitive indicators of change. Furthermore, if, as is intended, this publication becomes the first in a series, then an extraordinarily interesting picture should emerge of the effects on an island's environment of a warming world. I congratulate Andrew Casebow and his colleagues in producing this publication. It is in the spirit of the oldest traditions of the Royal Society.

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(Past President of the Royal Society)
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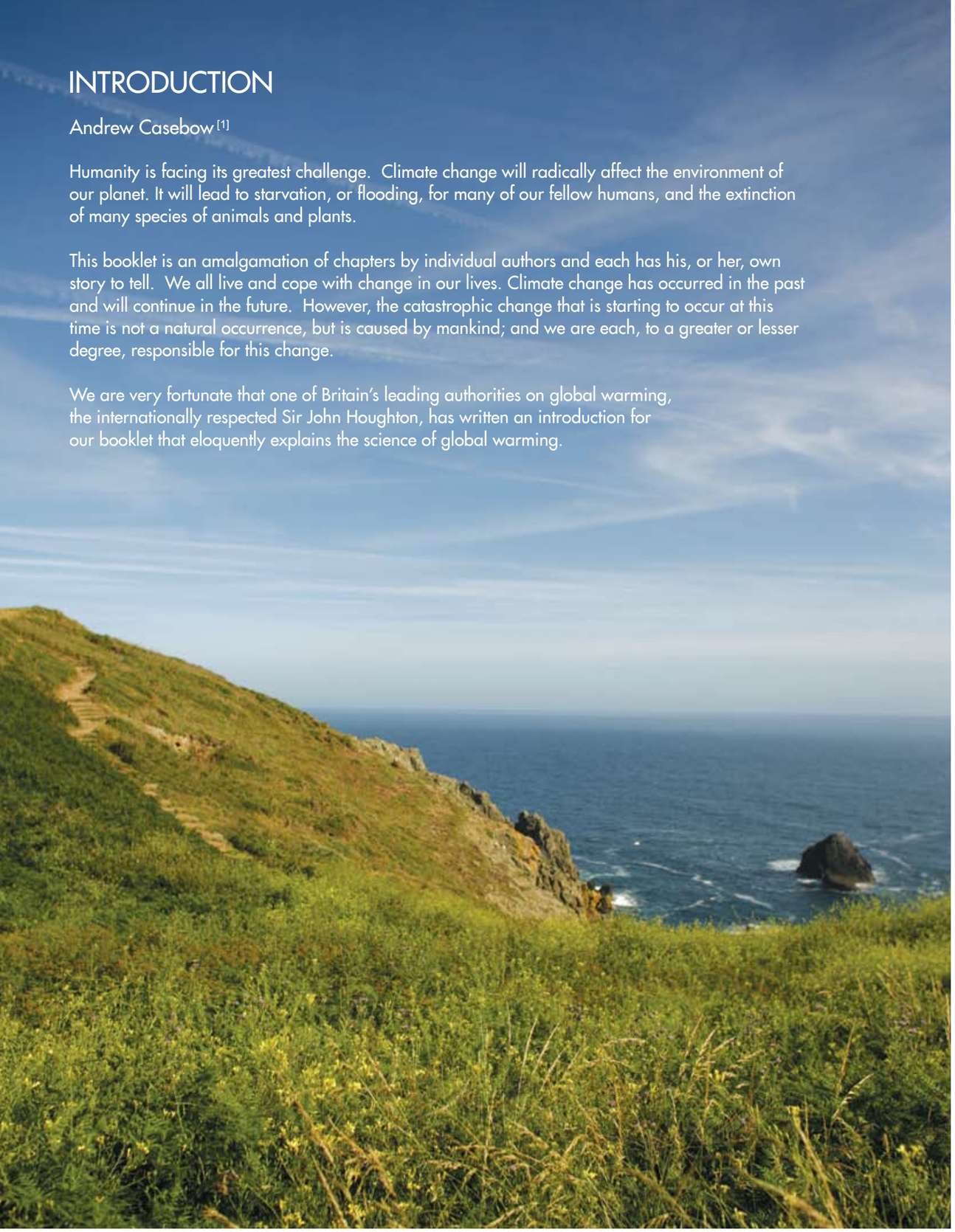
INTRODUCTION

Andrew Casebow [1]

Humanity is facing its greatest challenge. Climate change will radically affect the environment of our planet. It will lead to starvation, or flooding, for many of our fellow humans, and the extinction of many species of animals and plants.

This booklet is an amalgamation of chapters by individual authors and each has his, or her, own story to tell. We all live and cope with change in our lives. Climate change has occurred in the past and will continue in the future. However, the catastrophic change that is starting to occur at this time is not a natural occurrence, but is caused by mankind; and we are each, to a greater or lesser degree, responsible for this change.

We are very fortunate that one of Britain's leading authorities on global warming, the internationally respected Sir John Houghton, has written an introduction for our booklet that eloquently explains the science of global warming.



Guernsey's undulating cliff paths. One of the many beautiful landscapes the island has to offer. *Image courtesy of VisitGuernsey.*

The booklet is divided into six sections, concentrating specifically on Guernsey, under the following general headings:

- Historical Evidence of Past Climate Change
- Evidence of Climate Change in Guernsey
- Impacts of Climate Change in Guernsey
- Predictions of Future Climate Change
- Consequences of Future Climate Change in Guernsey
- Responding to Climate Change in Guernsey - Opportunities for Action

Each section contains a number of short chapters by a wide range of authors, who all have a connection with Guernsey. Some authors were born and educated in the island, some have spent happy holidays in Guernsey, others have undertaken research here, whilst many of us are fortunate to live and work here. We are all united in our desire to tell you about the climatic changes that are occurring and the dangers that lie ahead if action to curb 'global warming' is not taken quickly. The positive action that we can take to reduce our contribution to what could be a disaster for mankind, and for the many species of plants and animals that share this beautiful planet with us.

This booklet gives you clear evidence that climate change is, indeed, occurring in Guernsey. It shows the impact that it has already had in the island and how it is already affecting our lives. Predictions of the future show that climate change will have huge consequences throughout the world. There is a moral responsibility for us to try to alleviate these changes but to do so we need to take positive action. Everyone should take responsibility, not just individually, but also collectively through government and business.

Taking appropriate action now could benefit us in innumerable ways. For example, oil is already a scarce resource that is becoming more difficult and expensive to obtain, and will run out in the foreseeable future. Developing new technologies and using known methods to save fuel will be beneficial to mankind as well as saving money.

The aim of this booklet is not only to inform and inspire us to take action, but also to motivate us to take responsibility for our own contribution to the future of our planet. What will we do to save Guernsey for our children, and for our children's children?

"We do not inherit the earth from our ancestors, we borrow it from our children."

(Native American proverb)

Colour coding - *Each of the sections in this booklet are coded with a quick reference coloured strip along the right-hand side of each article.*

References

1. Dr Andrew Casebow is States Agriculture and Environment Adviser. Andrew is a member of Magdalene College, Cambridge, and of the University's Geography Department where he undertakes research on climate change and sustainable island development. He and his family have loved living and working in Guernsey for over 20 years.

AN INTRODUCTION TO THE SCIENCE OF GLOBAL WARMING

Sir John Houghton [1]

Figure 1. *Sunrise over Herm Island.* *Image courtesy of VisitGuernsey.*

Climate change due to human activities represents the biggest challenge facing the world in the 21st century.

Summary of the basic Science

'Greenhouse' gases, such as water vapour and carbon dioxide, act as blankets over the earth's surface, keeping it warmer than it would otherwise be. They do this by absorbing infra-red or 'heat' radiation from the earth's surface. The existence of this natural 'greenhouse effect' has been known for nearly 2000 years. It is essential to the maintenance of our current climate to which eco-systems and humans have adapted.

Since the beginning of the Industrial Revolution around 1750, one of these greenhouse gases, carbon dioxide has increased by nearly 40% and is now at a higher concentration in the atmosphere than it has been for many thousands of years. Chemical analysis demonstrates that this increase is due largely to burning fossil fuels – coal, oil and gas. If no action is taken to curb these emissions, the carbon dioxide concentration will rise during the 21st century to two or three times its pre-industrial level.

The climate record over the last 1,000 years shows a lot of natural variability – including, for instance, the 'medieval warm period' and the 'little ice age'. However, the rise in global average temperature (and its rate of rise) during the 20th century is well outside the range of this known natural variability.

Over the 21st century the global average temperature is projected to rise by between 2 and 6°C from its pre-industrial level (see Figure 2); the range represents different assumptions about mankind's future emissions of greenhouse gases. A rise of this amount is large. The difference between the middle of an ice age and the warm periods in-between is only about 5 or 6°C.

The Impact of Global Warming on Human Activity

Some of the most obvious impacts of global warming on human activity will be due to the rise of sea level that occurs because ocean water expands as it is heated. The projected rise, of about half a metre per century, will continue for many centuries, because it takes a long time to warm the deep oceans as well as surface waters. This will cause many problems for human communities living in low-lying regions.

There will also be impact from extreme events. The unusually high temperatures in central Europe during the summer of 2003 led to the deaths of over 20,000 people. Such summers are likely to be commonplace by the middle of the 21st century, and cool by the year 2100.

Water is becoming an increasingly important resource. A warmer world will lead to more evaporation of water from the surface, more water vapour in the atmosphere and more rainfall. Of greater importance is the fact that the increased condensation of water vapour in cloud formations leads to increased latent heat of condensation being released. Since this latent heat release is the largest source of energy driving the atmosphere's circulation, the hydrological cycle will become more intense. This means a tendency to more intense rainfall in some parts of the world, but also less rainfall in some semi-arid areas.

Floods and droughts are the most damaging of the world's disasters. Between 1975 and 2002 over 200,000 lives were lost and 2.2 billion people were affected by flooding caused by rainfall. Over the same period over half a million lives were lost and 1.3 billion

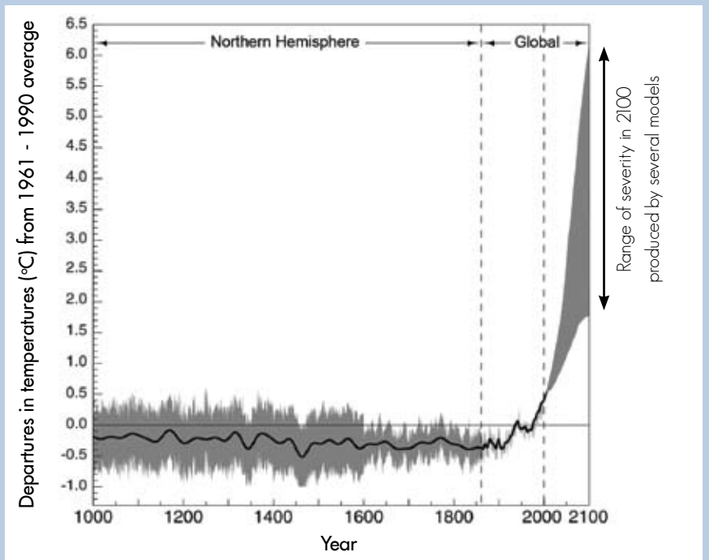


Figure 2. *Variations of the Earth's surface temperature: 1000 to 2100.*
1000 to 1861, N. Hemisphere, proxy data; 1861 to 2000 Global, instrumental; 2000 to 2100, SRES projections.

people were affected by drought. The greater frequency and intensity of flooding and droughts is bad news for most human communities, and especially for those regions such as South East Asia and sub-Saharan Africa where such events occur only too frequently.

Sea level rise, changes in water availability and extreme events will lead to increasing pressure from environmental refugees. A careful estimate has suggested that, due to climate change, there could be more than 150 million extra refugees by 2050. There are also potential changes that, if they occurred, would be highly damaging and possibly irreversible. For instance, large changes are being observed in Polar Regions.

With the rising temperatures over Greenland it is estimated that meltdown of the icecap could begin during the next few decades. Complete meltdown is likely to take many centuries but would add 7 metres (23 feet) to the sea level.

Of further concern is the 'Thermo-Haline Circulation', (often known as the 'gulf stream') which brings a warmer climate to northern Europe. This is a circulation of heat in the deep oceans.

Figure 3. *An iceberg in the Jacobshavn fjord. Greenland continues to lose ice mass, and the rate of loss is accelerating.* *Photo courtesy Konrad Steffen, University of Colorado at Boulder.*

Because of evaporation, the water in the Gulf Stream becomes more salty, and hence of higher density than the surrounding water.

It therefore tends to sink and provides the source of a slow circulation of water that connects all the oceans together. This sinking assists in maintaining the Gulf Stream itself. In a globally warmed world, increased rainfall together with fresh water from melting ice will decrease the water's salinity making it less likely to sink. The circulation will therefore weaken, leading to large regional changes of climate.

Emissions of Carbon into the Atmosphere

Global emissions of carbon dioxide to the atmosphere from fossil fuel burning are currently approaching 7 billion tonnes of carbon per annum and rising rapidly. Unless strong measures are taken they will reach two or three times this level during the 21st century. Therefore, to stabilise carbon dioxide concentrations, emissions must reduce to a fraction of their present levels before the end of the century.

The reductions in emissions must be made globally; all nations must take part but there are very large differences between greenhouse gas emissions in different countries. Expressed in tonnes of carbon dioxide per person per year, they vary from about 5.5 tonnes per person in the USA, 2.5 tonnes per person in Europe, 0.7 tonnes in China, and 0.2 tonnes in India (see Figure 4). Ways need to be found to achieve reductions that are both realistic and equable.

We, in the developed countries have already benefited over many generations from abundant fossil fuel energy. The demands on our stewardship take on a special poignancy as we realise that the adverse impacts of climate change will fall disproportionately on poorer nations and will tend to exacerbate the increasingly large divide between rich and poor.

The Kyoto Protocol represents a beginning for the process of reduction. It is an important start demonstrating the achievement of a useful measure of international agreement on such a complex issue. It also introduces, for the first time, international trading of greenhouse gas emissions so that reductions can be achieved in the most cost effective ways.

The aim must be to stabilise emissions of carbon dioxide. In order to stop dangerous climate change the level needs to be as low as possible. In 1996 the European Commission proposed a 2°C limit on the rise in global average temperature from its pre-industrial level. This implies a stabilisation level for carbon dioxide of about 430 ppm (allowing for the effect of other greenhouse gases at their 1990 levels). Others have proposed "stabilisation in the range 500-550 ppm" that "with care could be achieved without disrupting economic growth", but without firm action atmospheric concentrations of carbon dioxide could go much higher (see Figure 5).

If carbon dioxide is stabilised at 500ppm and the effect of other greenhouse gases at their 1990 levels is added, it is about equivalent to double the carbon dioxide at its pre-industrial level, and will therefore produce a rise in global average temperature of about 2.5°C. Eventually, although human induced climate change may be halted, the impacts at such a level would be large. A steady rise in sea level will continue for many centuries, heat waves such as in Europe in 2003 would be commonplace, devastating floods and droughts would be much more common in many places and Greenland would most likely start to melt down. The aim should be to stabilise at a lower level. But is this possible?

The UK government has taken a lead on this issue and has agreed a target for the reduction of greenhouse gas emissions of 60% by 2050.

The cost of this will not be great if action is taken quickly. Economists in the UK Government Treasury Department have estimated the cost to the UK economy of achieving this target. On the assumption of an average growth in the UK economy of 2.25% per annum, they estimated a cost of no more than the equivalent of 6 months growth over the 50-year period.

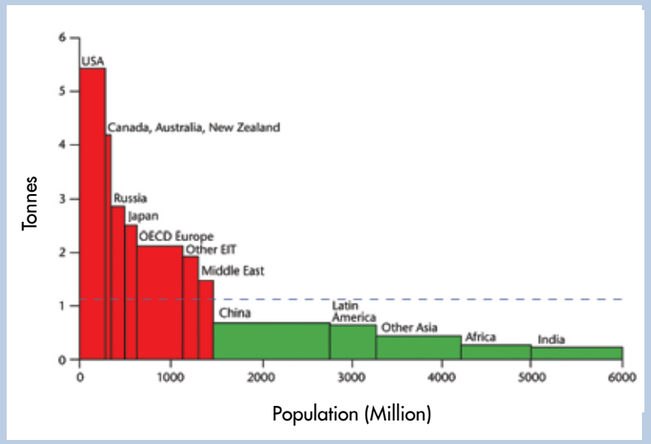


Figure 4. *Carbon dioxide emissions in 2000, per capita versus population.* (after M Grubb 2003).

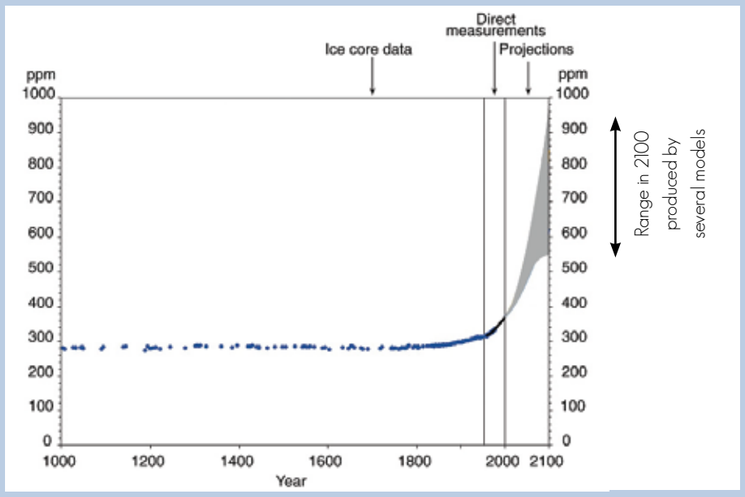


Figure 5. *Past and future CO2 atmospheric concentrations.* (from IPCC 2001 Synthesis Report).

Urgent Actions Needed to Achieve Reduced Carbon Emissions

Three sorts of actions are required:

1. Energy efficiency. About one-third of energy is employed in buildings (domestic and commercial), one-third in transport and one-third in industry. Large savings can be made in all three sectors, many with significant savings in cost. But to achieve these savings will require encouragement and incentives from government and a great deal of determination from all of us.

2. Exploitation of non-fossil fuel energy resources. This includes biomass (including waste), solar power (both photovoltaic and thermal), hydro, wind, wave, tidal, geothermal energy and nuclear.

3. Sequestration. There are possibilities for sequestering carbon that would otherwise enter the atmosphere, either by planting forests or by pumping it underground, for instance into spent oil and gas wells. The opportunities for innovation, development and investment in all these areas is great.

The need for action is urgent for three reasons:

1. Scientific. Because the oceans take time to warm, there is a lag in the response of climate to increasing greenhouse gases. The greenhouse gas emissions that have already occurred will continue to change the climate for 30-50 years.

2. Economic. Energy infrastructure (e.g. in power stations) also typically lasts for 30-50 years. It is much more cost effective to begin to phase in the required infrastructure changes now rather than having to make them much more rapidly later.

3. Political. Countries like China and India are industrialising very rapidly. If we want to provide an example of effective leadership we need to start now.

Both the challenge and the opportunity for all of us are unmistakable.

"No one made a greater mistake than he who did nothing because he could do so little."

Edmund Burke

References

1. Sir John Houghton's career includes posts as Professor of Atmospheric Physics, Oxford University, and Director General, UK Meteorological Office, where he took a particular interest in research into human induced climate change. He chaired the Scientific Assessment Panel on the Intergovernmental Panel on Climate Change (1998-2002). After retiring from the Met Office, he became Chairman of the Royal Commission on Environmental Pollution (1992-8). His many awards include the Japan Prize (2006), the International Meteorological Organisation Prize (1998), and Gold Medals from the Royal Astronomical Society and the Royal Meteorological Society.