Global Climate Change

Purpose

Climate describes the long-term pattern of weather, its averages, variability and extremes. The scientific consensus is that human activity is changing the climate[1], as evidenced in the recent temperature record, though the extent and timing of the change is much debated. Though the Earth has undergone climate changes—distinct and long-term alterations in its climate—throughout its lifetime, the term "climate change" is now typically used to describe specifically the recent changes which have been measured or are foreseen as a result of human activity. The issue of contemporary, global climate change has been described by some scientists and policymakers as the most significant environment issue of our time.

This Policy Position Statement reviews the importance of contemporary, global climate change and its resultant impacts on humans and the physical environment. CIWEM supports action to reduce human induced climate change and its impacts, and identifies 15 key actions for individuals, industry and policy-makers.

CIWEM calls for:

The Strengthening of International Agreements on Climate Change

1. Strengthening of international agreements on climate change, including the Kyoto Protocol, to ensure greenhouse emissions are capped and reduced in a meaningful and timely manner

2. Development of an equitable means of reducing greenhouse gas emissions, through contraction and convergence, supplemented by technology transfers to provide alternative development pathways for industrialising countries

3. Greater links between international environmental policy, in particular protection of important sinks such as rainforests and peat bogs, to ensure international agreements on measures such as biofuel use in the EU do not accelerate sink destruction either directly from land uses transferred to biofuel production or indirectly through relocation of activities displaced by biofuel production into rainforests and former peat bogs. Import and use of only appropriately certified, sustainable biofuels and timbers should be allowed

Consistent and Unambiguous UK Policy

4. A thorough examination of the impact on climate change in all government policy decisions, with a statement of the outcomes of the examination provided for all key policy decisions in terms of the estimated net change in greenhouse gas emissions

5. A strong focus on energy efficiency measures set by the Government as the main means of reducing greenhouse gas emissions. This should be based upon the Energy Hierarchy, which prioritises energy saving first, then the use of less polluting sources of energy

6. Transport and housing policies should deliver reductions in greenhouse gas emissions and be revised accordingly, with clear targets for delivery of more sustainable housing stock and fuel use

7. Clear policy regarding the respective roles of various low-carbon energy sources, including solar, wind, tidal, biofuels, nuclear and energy from waste

8. Further integration of climate change considerations in the Government's sustainability agenda. Transparent targets to be set, monitored and reported upon for UK Government departments, businesses, industry and the transport sector

Further Targeted Measures to Reduce Emissions

9. Removal of unfair tax benefits on some emission sources (e.g. aviation fuel) and full use of instruments such as air passenger duty to disincentivise the most polluting forms of transport.

10. Increased penalties for comparatively high emission power generation (e.g. inefficient boilers, polluting vehicles).

11. Development of innovative incentives for reducing greenhouse gas emissions, e.g. lower taxes, exclusive vehicle access.

12. Development of mechanisms that will provide a clear and guaranteed value for avoided carbon emissions, to give investors in low carbon technologies the certainty they require to proceed.

Improved Knowledge and Education

13. Continued research into the causes and effects of climate change, including the sensitivity and adaptability of natural and human systems, and more detailed forecasts of future climate, with a view to quantifying and reducing uncertainties. A commitment to protect and expand climate observation stations is also required

14. More effort to educate people about the importance of climate change, its risks and opportunities

15. More efforts to link the global effects of climate change to individual actions (e.g. sourcing local food, products and services), including the development of individual carbon budgets (carbon rationing) and (conceptual) carbon contracts

The Chartered Institution of Water and Environmental Management (CIWEM) is an independent professional body and a registered charity, advancing the science and practice of water and environmental management for a clean, green and sustainable world. Thousands of members in 98 countries include managers, consultants, contractors and academics, working within local authorities, water companies, regulatory bodies, governments, universities and the private sector.

Context

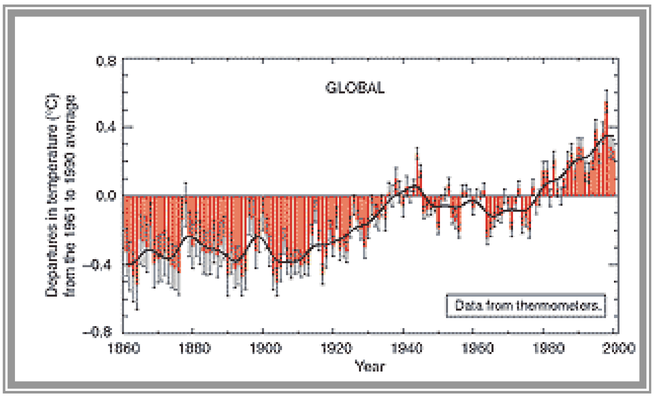
Introduction

Climate describes the long-term pattern of weather (e.g. temperature, rainfall, etc), its averages, variability and extremes. The climate system includes the atmosphere, oceans, land surface, ice cover and living things. These components shape our climate, interacting with each other, influencing the use of energy from the sun, and the transfer of heat and gases throughout the climate system. There is a consensus amongst peer-reviewed scientists that human activity is changing the climate[2], as evidenced in the recent temperature record

The recent temperature record

The trend in the Earth's average temperature over the past 140 years is presented in Figure 1, it is based on actual measurements of near-surface air temperatures over land and sea, and sea surface temperature[3]. The graph shows the year on year variations and an overall warming trend since about 1970. The 1990s were the warmest recorded decade, with 1998 the warmest year, and 2005 the second warmest year.

Figure 1. Trend in global average air temperature[4]



The average surface temperature of the Earth has increased by about 0.6°C ±0.2°C over the past century[5], though considerable regional variation and complexity underlies this overall warming. Globally, the greatest increases have been in night-time temperatures, in land temperatures and during northern winter and spring-times.

As well as direct measurements, scientists also use indirect (proxy) means of measuring temperature. The use of over 400 different proxies[6], including tree rings, corals, ice cores and historical records, also indicates that the 1990s was the warmest decade and the twentieth century was the warmest century of the past millennium, suggesting the Earth is warming faster now than at any time in the past millennium.

Information from satellites for the lowest 10km of the atmosphere, available since 1979, shows about half as much warming as the ground based measurements. These differences may be due to differing effects of stratospheric ozone depletion, aerosols and El Nino, but remain unresolved at present.

In addition to the increases observed in the recent temperature record, other changes have been observed in the climate over the past century[7]:

- Decreased extent of snow and ice cover
- Raised global average sea level
- Increased ocean heat content

Factors driving global climate change

Scientists have conducted a number of attribution studies that compare observed changes in the global climate with those factors that are known to influence climate. These studies indicate that the climate change observed over the past century is due to a combination of changes in solar radiation, volcanic activity, land-use change, and human-influenced increases in levels of atmospheric greenhouse gases. Of these, greenhouse gases appear to be the dominant drivers of climate change over the past few decades. Recent studies include:

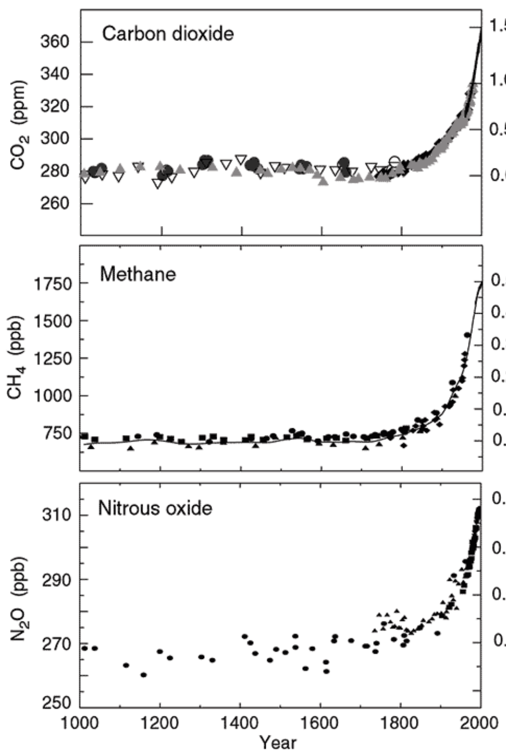
1. **Physical simulation of twentieth century surface warming.** Scientists at the US National Center for Atmospheric Research examined the contributions of a variety of natural (solar, volcanoes) and human-influenced (greenhouse gas, ozone, sulfate aerosols) driving factors in changing global surface temperature[8]. They compared model results, with and without the various potential driving factors, with observed changes over the twentieth century. The objective of the study was to determine which drivers, or combinations of them, allowed the model results to match the fingerprint of actual surface warming. The best fit of the model output to the observed data was produced when all of the driving factors were included, indicating that both natural and human-influenced factors were involved. Moreover, the model results indicated that different factors contributed differently over time. Human-influenced factors were relatively unimportant during the first few decades of the twentieth century, whereas changes in solar energy and volcanic activity were. During the last half of the twentieth century, the dominant contribution to the observed warming fingerprint was from human-influenced greenhouse gases.

Main greenhouse gases

- Water (H_2O)
- Carbon dioxide (CO_2)
- Ozone
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

2. **Physical simulation of heat penetration into the ocean.** Scientists at the UK Hadley Center and the US Scripps Institution of Oceanography, Lawrence Livermore National Lab, and National Center for Atmospheric Research studied the effects of internal and external factors on the warming of six oceans (N. Atlantic, S. Atlantic, N. Indian, S. Indian, N. Pacific, S. Pacific)[9]. Modeling was undertaken to simulate the simultaneous warming of the oceans observed over the past 40 years, occurring from the surface downward, and the variation from ocean to ocean in heat penetration with depth. Modeling of internal variability alone did not produce temperature profiles that matched this fingerprint, whereas combining internal variability with the effects of greenhouse gases did. This indicated that observed patterns of climate change required an external driver and were only mimicked by including the effects of human-influenced greenhouse gases.

Figure 2. Carbon dioxide, methane and nitrous oxide levels over the past 1,000 years



Proxy data from several sites in Antarctica and Greenland (shown by different symbols) are supplemented with the data from direct atmospheric samples over the past few decades (shown by the line for CO_2 and incorporated in the curve representing the global average of CH_4). Source: IPCC, Third Assessment Report, 2001

3. **Physical simulation of the increasing height of the tropopause.** Scientists in the UK, Germany and the US studied the effects of natural (solar, volcanoes) and human-influenced (tropospheric greenhouse gas, stratospheric ozone reduction) drivers on the height of the tropopause[10]. This is a region of the atmosphere that separates the lower atmosphere (troposphere) from the upper atmosphere (stratosphere) – it has increased in height by 189m between 1979 and 2001, as measured by weather balloons. Factors that either warm the troposphere or cool the stratosphere increase the tropopause height. Modeling of the tropopause height mimicked the observed increase in height when both

human-influenced greenhouse gases and human-influenced stratospheric ozone reduction were included, with about 40% of the effect due to greenhouse gases and the remainder due to ozone reduction. The natural drivers had little effect on the model results.

The long-term climate record and greenhouse gases

Climate varies naturally over both short and long time-scales. Over the longest geological timescales the Earth has been subject to cycles of warming and cooling, and wet and dry periods, influenced by changes in the amount of energy received from the sun and resultant changes in climate system components. We are currently in an interglacial (warmer) period, following the last glacial (cooler) period, which lasted from about 110,000 to 18,000 years ago.

Ice-core samples can be used to construct a highly detailed picture of temperatures as far back as about 420,000 years[11]. Analysis of gas bubbles in Greenland ice cores indicate that greenhouse gas concentrations have broadly correlated with surface temperatures over this entire period[12], with higher levels of gases present at higher temperatures.

Greenhouse gases trap heat in the Earth's atmosphere. Without the presence of naturally occurring greenhouse gases (such as water, carbon dioxide, methane and nitrous oxide) in the atmosphere, the Earth's average surface temperature would be some 33°C colder.

The ice core records suggest that the present-day atmospheric levels of carbon dioxide and methane have been unprecedented during the past 420,000 years, and that levels of nitrous oxide have been unprecedented during the past millennium. Figure 2 shows changes in levels of these gases over the past millennium. Human influence has greatly increased the emissions of these gases since the start of the Industrial Revolution. Since 1750, atmospheric levels of carbon dioxide, methane and nitrous oxide have increased by 31%, 151% and 17% respectively (to 365 parts per million, 1745 parts per billion and 270 parts per billion in 1998 respectively) and levels continue to increase.

Current atmospheric levels of the main greenhouse gases cannot be accounted for without considering human activities, particularly the combustion of fossil fuels. Industrial processes, and changes in land use, such as deforestation and intensive agriculture are also significant emissions sources. Some greenhouse gases, such as industrial halocarbons (HFCs and PFCs), have no natural sources, and thus their presence in the atmosphere can only be explained by human influence.

10 tonnes CO_2 equivalent emissions[A]:

- Powering 86 computers for a year or using 23,000 kWh of electricity
- Running an average petrol car for 38,000 miles (48,000 km)
- Flying 14 international long haul trips or 110 short haul trips
- Travelling 165,000 km on a train
- Flying a fully loaded freight A727 (capacity 19 tonnes) just over 300 km (e.g. roughly Midlands to Brussels)
- Running an articulated lorry over 5,000 miles (9,000 km)
- Refrigerant leakage over 2 years from an air conditioning plant in a medium sized office block
- Emitting half a tonne of methane from a landfill site or from waste water

Source: Guidelines for company reporting on greenhouse gas emissions, DEFRA, 2001
Note:
Each greenhouse gas has a different capacity to cause global warming, depending on its radiative properties, its molecular weight and its lifetime in the atmosphere. Its so-called global warming potential (GWP) encapsulates these. The GWP is defined as the warming influence over a set time period of a gas relative to that of carbon dioxide. A 100-year time horizon is used in the Kyoto Protocol.

According to the attribution studies comparing detected climate change with model simulations, most of the observed warming over the last 50 years is likely to have been due to the human-influenced increase in greenhouse gas concentrations. Furthermore, it is very likely that this warming has contributed significantly to the observed sea level rise, through thermal expansion of seawater and widespread loss of land ice.

Carbon dioxide accounts for two-thirds of the human-influenced global warming[13]. Natural stores of carbon include the oceans, fossil fuels (coal, oil and gas), and plants. Natural systems can only remove carbon dioxide from the air very slowly; so most of it stays in the atmosphere for a century or more and leads to accumulation.

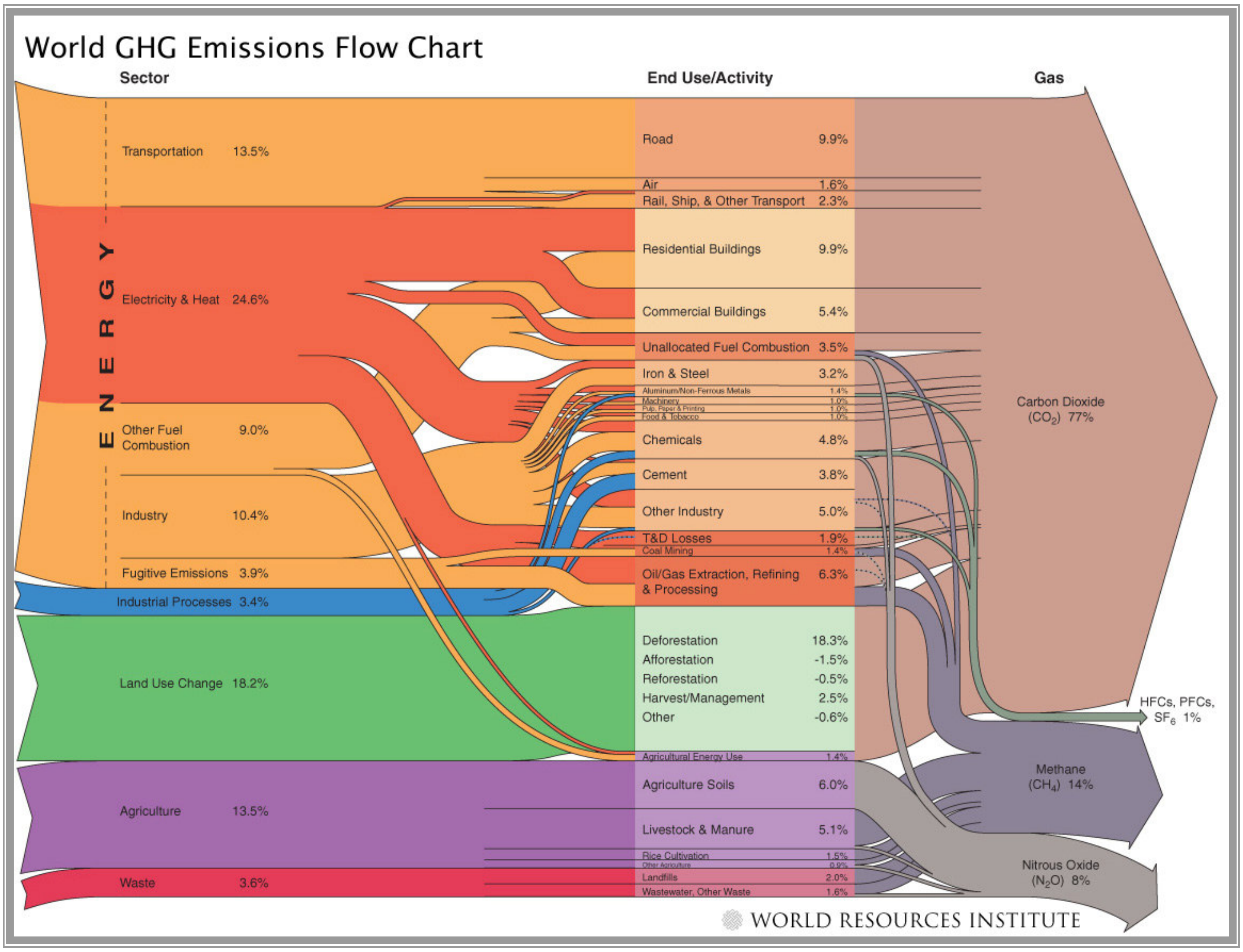


Figure 3. Global emissions of greenhouse gases in 2000[14]

<u>Climate change modelling and future climate change projections</u>

Scientists have developed global climate models incorporating components of the climate system to model how the climate behaves and to make projections of future climate change. The models are used to project changes in climate factors such as surface air temperature, rainfall and snowfall, soil moisture content, sea level and sea-ice area and volume.

Our understanding of the climate system is constantly evolving and many climate variables are difficult to quantify. The model input data and iterative calculations of future climate require vast computing resources, yet simplify the complexities of the climate system. Since the 1960s, global climate modelling science has developed rapidly, with weather models evolving into combined atmosphere-ocean system models and incorporating historic and projected greenhouse gas levels, plus additional factors such as sulphate and non-sulphate aerosols.

A number of different models exist and each represents the climate in a different way. Though past, long-term climate behaviour (decades to centuries) is well predicted by the models, they generally perform less well at modelling short-term climate variability (days to years) and regional climate variability. The models are highly dependent on assumptions on future emissions and resultant atmospheric levels of greenhouse gases (and aerosols), resulting in large differences among models in projections of future climate change. Nonetheless they can be useful tools for testing the potential effects of different emissions scenarios, and confidence in the ability of climate models to provide useful projections of future climate has improved due to their demonstrated performance on a range of spatial and time-scales.

Projections of future climate indicate that[15]:

- Emissions of carbon dioxide due to fossil fuel burning will be the dominant influence on atmospheric carbon dioxide levels and overall global warming in the twenty first century;
- As atmospheric carbon dioxide levels increase, the ocean and land stores will take up a decreasing proportion of the human-influenced emissions;
- Atmospheric levels of carbon dioxide by the end of the century are projected to be in the range of 490 to 1260 parts per million, i.e. 75 to 350% above the pre-industrial levels in 1750;
- Reductions in emissions of greenhouse gases and the gases that control their concentrations would be necessary to stabilise global warming;
- Stabilisation of atmospheric carbon dioxide levels at 450, 650 or 1,000 ppm would require global, human-influenced emissions to drop below 1990 levels, within a few decades, about a century, or about two centuries, respectively, and continue to decrease steadily thereafter. Eventually levels would need to drop to a very small fraction of current emissions.

Projections of future warming suggest a global increase of 1.4°C to 5.8°C by 2100 with regional warming in some areas expected to be even higher - a rate of warming very likely to be without precedent for the past 10,000 years. In addition to overall warming, changed water budgets, and an altered frequency and intensity of extreme weather events is expected. Increases in sea level and changes in precipitation, including more frequent floods and droughts, are likely. These changes are referred to collectively as (contemporary) global climate change.

Projected climate changes during the next century may also lead to the onset of large-scale and irreversible impacts which are not yet fully understood but probably of low likelihood[16]. These include:

- *Significant slowing of the ocean circulation carrying warm water to the North Atlantic* – a significant slowing of the oceanic thermohaline circulation would affect deep-water oxygen levels, carbon uptake by oceans and marine ecosystems, and would reduce warming over parts of Europe
- *Large reductions in the Greenland and West Antartic Ice Sheets* – either of these events could raise global sea level by up to 3 m over the next millennium, greatly exceeding the adaptive capacity of human and natural systems if the rate of ice loss was great
- *Accelerated warming due to carbon cycle feedbacks* – land use changes and the drying effects of warmer temperatures on forest cover may put this store at risk, with a consequential rapid release of the stored carbon into the atmosphere
- *Accelerated warming due to releases of carbon from permafrost regions* – this would further increase carbon dioxide levels in the atmosphere and accelerate warming
- *Accelerated warming due to releases of methane from hydrates in coastal sediments* - methane hydrate is a major, ocean-based store of methane, equivalent to the combined amount of coal, oil and gas storage of carbon. The solid hydrate is formed from rotting organic matter, typically found in shallow ocean sediments but only solid under a narrow range of temperatures and pressures. Warming of the oceans could destabilise the store of this very potent greenhouse gas, with the potential to prevent global cooling for many hundreds of millennia. The geological record suggests that a catastrophic carbon release (perhaps

involving methane hydrates) occurred around 55 million years ago, when global temperatures increased by 5 to 10°C, and took at least 20,000 years to return to their normal levels[17]

Living things thrive within a small range of temperatures. The regional warming observed in the recent temperature record is already affecting physical and biological systems. Observed changes likely to be associated with recent warming include glacier shrinkage, permafrost thawing, shorter river and lake ice durations, lengthening of mid- to high-latitude growing seasons, polewards and altitudinal shifts of plant and animal ranges, decline of some plant and animal populations, and earlier flowering of trees, emergence of insects, and egg-laying in birds[18].

Future global climate change is likely to have a profound effect on humans, both directly and indirectly, with impacts on human health, natural ecosystems, agriculture, water resources and coastal areas. Kofi Annan, Secretary-General of the UN, has called global warming a 'truly global threat'.

Responding to global climate change

Both adaptation and mitigation strategies are required to limit the adverse effects of global climate change, and to enhance the beneficial impacts. Awareness-raising is necessary amongst decision-makers to overcome the present inertia to responding to the problem of global climate change. Current greenhouse gas emissions will continue to impact on global climate for the next few decades and therefore adaptation is necessary. The capacity to adapt is closely related to technological ability, income levels and form of governance in a country. Adaptation to current climate variability and extremes provide a basis for future strategies, though decisions based on short-term considerations, lack of information and over-reliance on insurance measures may hinder appropriate adaptation.

Future global climate change is likely to exacerbate present inequities since those with the least resources have the least adaptive capacity and are the most vulnerable. Accordingly, adaptation, mitigation, sustainable development and increasing equity are mutually supportive processes.

Mitigation comprises limiting or reducing greenhouse gas emissions sources and enhancing sinks, to stabilise concentrations of greenhouse gases in the atmosphere and consequently stabilise projected average surface temperatures. Based on an increase in CO_2 emissions of 63% relative to 2002 predicted by 2030, an International Scientific Steering Committee meeting in 2005 concluded that "the world will, in the absence of urgent and strenuous mitigation actions in the next 20 years, almost certainly be committed to a temperature rise of between about 0.5 °C and 2°C relative to today by 2050"[19], i.e. between about 1°C and 2.5°C above pre-industrial levels. Some studies suggest increases of twice these levels or more if specific positive feedbacks occur.

At the 1992 Earth Summit in Rio de Janeiro, national governments signed a pledge to mitigate 'dangerous climate change'. This is generally taken to be a rise of 2°C above pre-industrial levels. The risk of this temperature being exceeded is low or unlikely if greenhouse gas concentrations are stabilised at 400 ppm CO_2 equivalent and likely if concentrations are stabilised at 550 ppm CO_2 equivalent. To reach a given target temperature, models suggest that delaying action would require greater emission reductions to be made to reach the same target and that even a delay of five years could be significant[20]. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be three to seven times greater to meet the same temperature target.

There are many challenges to adopting mitigation measures, particularly in the development of a consensus approach that is both equitable and effective, in light of the long-term, global and highly complex nature of the problem and the socio-economic and political frameworks involved. The type, magnitude, timing and costs of mitigation will vary according to different paths to socio-economic and technological development that may be taken in the future and the target stabilisation levels for greenhouse gases in the atmosphere. Decision makers will need to tackle issues of uncertainty and risk and the intergenerational effects of current activities, allowing for a progressive evolution in their responses to mitigating climate change. A portfolio of policy instruments will be required at international, national and regional levels, and improved education, innovation and changes in institutional structures could play a role in mitigation.

The Kyoto Protocol is the main approach to mitigation being pursued at present. Though the target emissions reductions set within the Protocol for participating countries are small, and unlikely to prevent 'dangerous climate change', it offers a co-ordinated approach to the problem. The Protocol incorporates the following market-based mitigation instruments, enabling countries to avoid directly reducing emissions:

- *Emissions trading* - the buying and selling of emissions credits among countries with binding emission targets (Annex I countries)
- *Joint implementation* - allowing one country with a target to receive emissions credit for a specific project undertaken in another country with a target
- *Clean development mechanism* - allowing industrialised countries to receive emissions credit for financing projects that reduce emissions in developing countries

Emissions trading was adopted in the European Union in 2005. European governments issued major industrial polluters such as steel firms, power generators and chemical companies with carbon dioxide emissions permits. These allow those companies adopting emission cuts to sell their spare emissions allocations. This is considered as an economic incentive to encourage the development and adoption of cleaner technology. Other possible instruments include: taxes; technology and product standards; voluntary agreements with industries; direct transfers of financial resources and technology; reduction of fossil fuel subsidies.

The "cap & trade" approach of the Kyoto Protocol towards emission reductions is intended to raise the cost of fossil fuels. Some countries, most notably the USA and China, have been unwilling to adopt such an approach due to the reductions in economic growth envisaged to occur as a result. The Asian Pacific Partnership for Clean Development and Climate (APCDC) has been established as an alternative approach to reducing emissions. It focuses on collaborative research into technologies which produce greater efficiencies in the combustion of fossil fuels, expand the capacities of existing technologies, undertake basic research in new energy technologies and support the capture and sequestration of carbon dioxide.

Carbon sequestration and storage offers a potential mitigation tool, particularly in terms of capturing and storing the carbon dioxide from power stations. Storage options include industrial uses, geological and ocean storage, and mineral carbonation, though the last two are very much at the research stage. It may become more feasible economically as carbon dioxide emissions costs rise, though the associated risks and regulatory and legal barriers will have to be overcome[21].

Though the political action so far has been weak, it is now widely accepted that emissions cuts are urgently required (indeed the UK's 2006 Stern Review[22] presses this point strongly, arguing that the economic costs of not responding to climate change far outweight those of acting to reduce the impacts by attempting to stabilise greenhouse gas concentrations at 500-550ppm CO_2 equivalent). We clearly urgently need a strong international framework that ensures meaningful and timely reductions in greenhouse gas emissions are made, and in a sustainable manner. In particular, agreements need to ensure there is no consequential destruction of important habitats and carbon stores such as rainforests and peat bogs. Emissions credits such as those set within Kyoto's clean development mechanism, for example, are one way to help ensure the protection of rainforests and the restoration of degraded ecosystems such as the drained peat swamps of Borneo.

In future, both companies and countries are likely to need a licence to emit carbon dioxide. In order to prevent dangerous climate change, there will only be a fixed number of licences worldwide and a means of allocating them will need to be agreed on. The present system under the Kyoto Protocol is ad hoc. Another solution is called 'contraction and convergence', developed by the Global Commons Institute and is attracting support from around the world. The contraction aspect requires annual ceilings to be set for global emissions, which would progressively decease with time, to a fraction of present levels. The convergence aspect requires governments to accept that every person on the planet has a similar right to pollute e.g. one tonne of carbon dioxide per person now, falling to half a tonne by 2050. Pollution entitlements would then be handed out to governments on this basis.

It is likely that approaches to mitigation will vary from country to country, with different energy mixes chosen on the path to a low carbon future in as cost-effective a way as possible. A long transition time will be required, allowing for the renewal and replacement of current systems. It is imperative that these changes are sustainable. We cannot simply swap an unsustainable high carbon present for an unsustainable low carbon future.

Key issues

Our understanding of the global climate change problem is based on information from models, with differing projections of future climate

As well as observed changes in the recent climate, models are used to detect human influence on climate change and make projections of future climate change. A number of different models exist, representing the climate in a different way.

- Our understanding of the climate system is constantly evolving and many climate variables are difficult to quantify
- The models are highly dependent on assumptions in future emissions and resultant atmospheric levels of greenhouse gases (and aerosols), resulting in large differences among models in projections of future climate change
- Some outlier model scenarios show very little future change in global temperature whilst others show extremely large changes. When the full set of model results from many studies are taken together, the overwhelming balance of probability is that there will be further increases in temperature
- The central (i.e. most probable) projections of future warming suggest a global increase of 1.4°C to 5.8°C by 2100 with regional warming in some areas expected to be even higher
- Projected climate changes during the next century may also lead to the onset of large-scale and irreversible impacts which are not yet fully understood but probably of low likelihood

Nonetheless, future global climate change is likely to have a profound effect on humans, both directly and indirectly, with impacts on human health, natural ecosystems, agriculture, water resources and coastal areas. Therefore our incomplete understanding of the problem should not be used as a reason for not responding to climate change.

There are many challenges in responding to global climate change

Both adaptation and mitigation strategies are required to limit the adverse effects of global climate change, and to enhance the beneficial impacts. However there are many challenges and barriers to overcome.

- Awareness-raising is necessary amongst decision-makers to overcome the present inertia to responding to the problem of global climate change
- Past and current greenhouse gas emissions will continue to impact on global climate for the next few decades and therefore adaptation is necessary. Adaptation to current climate variability and extremes provides a basis for future strategies, though decisions based on short-term considerations, lack of information and over-reliance on insurance measures may hinder appropriate adaptation
- Future global climate change is likely to exacerbate present inequities since those with the least resources have the least adaptive capacity and are the most vulnerable. Accordingly, adaptation, mitigation, sustainable development and increasing equity are mutually supportive processes

- Mitigation comprises limiting or reducing greenhouse gas emissions sources and enhancing sinks. Avoiding dangerous climate change will probably require the world to reduce emissions by about 60% from today's levels by 2050, and by 80 or 90% by the end of the century. We are not presently on the path to achieving reductions approaching these levels
- There are many challenges to adopting mitigation measures, particularly in the development of a consensus approach that is both equitable and effective. Decision makers will need to tackle issues of uncertainty and risk and the intergenerational effects of current activities, allowing for a progressive evolution in their responses to mitigating climate change
- The present system to allocating emissions allowances, under the Kyoto Protocol, is ad hoc. Another solution is called 'contraction and convergence', developed by the Global Commons Institute. It offers a more equitable basis for response
- Some legislative measures may counteract their intended purposes e.g. unless only appropriately evaluated, sustainably certified biofuels are able to be used in the EU then the EU Biofuel Directive is likely to be counterproductive. Without adequate controls, increased biofuel production will lead to deforestation and intensive agriculture with no net reduction in greenhouse gases or even perhaps lead to a net increase due to release of stored carbon from deforestation, increased nitrous oxide releases from heavily fertilised soils and the fossil fuel emissions associated with fuel processing
- Delaying action will result in greater action needed at a later stage to reach the same temperature level. Even a five year delay could be significant. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be three to seven times greater to meet the same temperature target

Major investment is needed now in both mitigation and adaptation.

National action needs to be more focussed, unequivocal and immediate

National policy is at best confused in terms of reducing greenhouse gas emissions. Government policy decisions need to transparently set out the impacts in terms of greenhouse emissions, compared with do-nothing and alternative policy options, and work towards clear, measurable targets. Since efficient use of energy is the most cost-effective and immediate means of delivering reductions in greenhouse gas emissions, it needs to be a strong focus of the Government's approach to climate change mitigation.

The Engineering Forum for Energy (EFE) proposes the adoption of an "Energy Hierarchy", based on the well-established Waste Hierarchy. This offers an integrated approach to the management of energy demand and supply, especially recognising that effective use of energy is the most powerful, indigenous tool to meet all the Government's policy objectives. The EFE defines the Energy Hierarchy as:

1. Energy conservation
2. Energy efficiency
3. Use of renewable, sustainable resources
4. Use of non-sustainable resources using best available technologies consistent with cost
5. Legacy resources and technologies

Energy conservation is the most fundamental element in this hierarchy.

The transport and housing sectors are key greenhouse gas emissions sectors, and accordingly the Government's transport and housing policies should be revised to ensure delivery of emissions reductions, with clear targets set. In addition, there is a range of financial instruments and mechanisms that the Government can adopt to incentivise low carbon emissions sources and to disincentivise others.

Continued research into the causes and effects of climate change is needed, in particular climate observation stations need to be protected and expanded. Improved, more detailed forecasts of future climate and its effects will aid the timely and appropriate implementation of adaptation and mitigation strategies. Key to this will be increased effort to educate people on the importance of climate change, its risks and opportunities. Many mechanisms exist to engage individuals and other stakeholders in responding to climate change, including carbon contracts and individual carbon budgets. There is much scope for the development of these measures to raise awareness on low carbon lifestyles and to help deliver emissions reductions.

Summary

This CIWEM Policy Position Statement reviews the importance of global climate change and its resultant impacts on humans and the physical environment. The key issues raised in this document are:

- Our understanding of the global climate change problem is incomplete and largely based on information from models with differing projections of future climate. Nonetheless, future global climate change is likely to have a profound effect on humans, both directly and indirectly, therefore our incomplete understanding of the problem should not delay responding to climate change
- Both adaptation and mitigation strategies are required to limit the adverse effects of global climate change and to enhance the beneficial impacts. However there are many challenges and barriers to overcome, including major investment requirements. Delaying action, though, will result in greater action needed at a later stage
- All adaptation and mitigation strategies must be viewed within the concept of sustainable development
- National action needs to be more focussed, unequivocal and immediate

CIWEM supports action to reduce human induced climate change and its impacts, and identifies 15 key actions for individuals, industry and policy-makers.

December 2006

Note: CIWEM Policy Position Statements (PPS) represents the Institution's views on issues at a particular point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPS's are under constant review and that previously held views may alter and lead to revised PPSs.

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