Abstracts

Day 1, Plenary Session 1

The second great climate shift in the last 65 million years?

Peter Barrett, Victoria University of Wellington

By the end of this century, if greenhouse gas emissions continue at their present rate, scientists estimate that global temperature will be around 3 degrees warmer, with a significant risk of even warmer temperatures. In this talk I'll explain how our knowledge of past climate suggests this could lead us to the "the second great climate shift" in the last 65 million years.

The first great climate shift in recent geological times, from "greenhouse" to the present "icehouse" earth, took place between 35 and 30 million years ago in association with falling carbon dioxide levels. This is widely believed to have led to the first big ice sheet on Antarctica, and fundamental changes in ocean circulation. Since then the earth has cooled further, but over the last century human-induced greenhouse gas pollution has begun to drive us back towards the "greenhouse earth" of earlier times. The implications are considerable.

The changing composition of the Earth's atmosphere: linkages to increasing agricultural and industrial activity

David Lowe, National Institute for Water and Atmospheric Research

Over the last 250 years the concentrations of many trace gases have increased in the atmosphere. Several of these gases play a significant role in the radiative properties of the atmosphere as well as its chemistry. In this talk I will discuss the behaviour of the most important of these gases, carbon dioxide and methane, linking their "trajectories" to fossil fuel combustion and changes in known sources. The Baring Head New Zealand station has played a crucial role with the longest time series of continuous carbon dioxide measurements in the Southern Hemisphere dating back to the early 1970s. These data show that more than half of the growth of carbon dioxide in the atmosphere since the industrial revolution has occurred since the establishment of the New Zealand station. Current growth rates of carbon dioxide are exceeding 2ppm/yr and are closely linked to record global fossil fuel combustion (more than 7 Gt/yr in 2004).

Antarctic deglaciation and future sea level rise

David G. Vaughan, British Antarctic Survey, UK

Rising sea level from warming of the ocean and melting ice on land will have a dramatic impact globally in decades that will continue to multiply many centuries after the stabilization of greenhouse gas concentrations. Today, around ten million people each year suffer from coastal flooding, and even assuming only modest sea level rise (~50 cm), this will rise to 100 million by 2080s. If our present estimates prove to be on the low side, this number together with the implied financial costs would rise dramatically. The most poorly understood component in sea level rise predictions is the contribution from a melting Antarctic ice sheet. In this talk I will discuss the evidence for recent climate change across the southern continent, the impact that this is having on the ice sheet and our predictions of sea-level rise, the probable impact that climate change will have on Antarctica in coming decades and centuries and how those distant impacts might affect our lives and those of our children.

Plenary Session 2

Observed changes to the climate and their causes

Kevin E Trenberth,Head of the Climate Analysis Section, US National Centre for Atmospheric Research, Boulder, Colorado.

Since 1970 the Earth has been warming from effects of human activities. Claims to the contrary are not credible. Atmospheric composition is changing and carbon dioxide is one third higher than pre-industrial levels. Global surface temperatures today are 0.75ºC warmer than at the beginning of the 20th Century and over 0.5ºC above values in the mid-1970s, as land has warmed at double the sea surface rate. Ten of the last 11 years are the warmest on record. Global ocean temperatures are rising and ocean expansion accounts for over half the rise in global sea level of 37 mm in the past 13 years. Melting glaciers and land ice account for 1 mm/year of sea level rise, and snow cover and Arctic sea ice extent are decreasing. Water vapour has risen about 4% over the oceans since the 1970s and is a key reason for widespread observed increases in intensity of precipitation and risk of floods. Hurricanes are more intense and lasting longer, and droughts have increased in intensity and extent, especially in the subtropics. All these vital signs are consistent with a warming climate.

Integration of the science and economics of climate change

Ronald G Prinn, Massachusetts Institute of Technology, Dept. of Earth, Atmospheric and Planetary Science, Cambridge, MA 02139, USA

Global climate change is in the news and is the subject of policy debate within most nations. It is also the subject of ongoing international negotiations in the Framework Convention on Climate Change and its Kyoto Protocol. To inform processes of policy development and implementation there is urgent need for better integration of the diverse components of the problem. Climate research needs to focus on predictions that relate to economic, social, and environmental effects. Forecasts of greenhouse gases and atmospheric aerosols, should take account of the economic, technological, and political forces that drive emissions. Assessments of possible societal and ecosystem impacts, and the analysis of alternative strategies for mitigation or adaptation, need to be based on realistic evaluations of the uncertainties of climate science and the likely paths to their reduction. Motivated by the challenge of bringing together these diverse elements, the MIT Joint Program on the Science and Policy of Global Change has developed an Integrated Global System Model (IGSM) comprising coupled submodels of economic development, atmospheric chemistry, climate dynamics and ecosystems. One important goal of the Program is to carefully analyze the scientific and economic implications of proposed policies. Another important goal of the Program is to provide objective estimates of the uncertainty in projections of climate change and its impacts. Such estimates are crucial information for decision makers as they evaluate policies to reduce the risk of climate impacts. The results of an uncertainty analysis involving hundreds of runs of the IGSM imply that, without specific mitigation policies, the global average surface temperature may rise between 1.0 and 4.9°C from 1990 to 2100 (95% confidence limits). Polar temperatures, absent policy, are projected to rise from about 2 to 12°C (95% limits) with obvious great risks for high latitude ecosystems and ice sheets at the high end of this range. Analysis of the Kyoto Protocol, and more stringent climate mitigation policies, shows the disparities among countries in economic costs and the difficulties in accounting simply for the effects of other greenhouse gases relative to carbon dioxide. Also, the greatest effect of these policies is to lower the probability of extreme changes as opposed to lowering the medians. There is 1 chance in 10 of warming exceeding 3.8°C in the above no policy case, but less than 1 chance in 250 if a policy aimed at keeping carbon dioxide levels below twice their preindustrial values is adopted. Faced with these estimated odds, the long lifetimes of most greenhouse gases in the atmosphere, the long delay in ultimate warming due to ocean heat uptake, and the capital-intensive global energy infrastructure, the case is strong for beginning action now. The challenge is to devise national and international approaches to this problem involving all countries, encompassing a wide range of energy options, and based on sound economic practices. It is time to take a measured first step toward both mitigation and adaptation to future climate change. That step should be based on sound science and foster innovative technologies.

Reference

MIT Joint Program on the Science and Policy of Global Change website: http://web.mit.edu/globalchange/www/.

Parallel Session 1

Potential health impacts and policy responses

Simon Hales, Wellington School of Medicine and Health Sciences, Otago University and Alistair Woodward, Head of School of Population Health, University of Auckland

Climate is one of the fundamental influences on human health and well-being, through the direct impacts of weather extremes, effects on the disease-causing and disease-transmitting organisms that share our environment and effects on the ecosystems that shelter and feed us. Rapid climate change will have many effects, and most of them are likely to be adverse.

The associations between climate variation and measures of disease and injury are well-documented, and have the most impact in populations with few resources to protect themselves. Some argue that human adaptation and economic progress will avoid most of the harm caused by a changing global climate. According to this view, if the price of progress is wider use of fossil fuels, a richer warmer world will be healthier than one that is cooler but poorer.

This view ignores the historical reality of increasing inequality and an expanding global underclass of vulnerable people, despite strong economic growth in recent decades. It is also inconsistent with recent evidence that climate change is already shortening lives and causing illness, even in rich countries. We take as a case study the heat wave in Europe in 2003 that, on the balance of probabilities, would not have occurred in the absence of anthropogenic climate change, affected some of the wealthiest countries in the world, and caused over 30,000 deaths.

What global science assessments can and can't tell us: Policy relevant findings and open research questions

Dr Andy Reisinger, Designated Head of the Technical Support Unit for the preparation of the Synthesis Report Intergovernmental Panel on Climate Change (IPCC) and former Senior Advisor with the Ministry for the Environment in New Zealand.

Global science assessments such as those produced by the Intergovernmental Panel on Climate Change (IPCC) have provided crucial underpinnings for policy decisions. I firstly describe the process by which these assessments are achieved and present some selected key findings, as well as some more recent results from the research literature. Secondly, I consider which open questions are most likely to influence future global policy directions, and discuss the extent to which these questions can be answered by scientific research alone or require a broader political and societal engagement. Finally, I discuss what steps may be necessary to translate global scientific assessments by the IPCC into policy-relevant information and decision support tools at a national level.

Ocean acidification and its impacts

Carol Turley, Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth, PL1 3DH, UK

The world's oceans contain an enormous reservoir of carbon, greater than either the terrestrial or atmospheric systems. The fluxes between these reservoirs are relatively rapid such that the oceans have taken up around 50% of the total carbon dioxide (CO_2) released to the atmosphere via fossil fuel emissions and other human activities in the last 200 years. Whilst this has slowed the progress of climate change, CO_2 ultimately results in acidification of the marine environment. Ocean pH has already fallen and will continue to do so with certainty as the oceans take up more anthropogenic CO_2. Acidification has only recently emerged as a serious issue and it has the potential to affect a wide range of marine biogeochemical and ecological processes. This presentation will summarise some of the research in this newly evolving area of science.

Coastal hazard risk in a changing climate

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Over 20% (some 1.2 billion people) of the global population live near a coastline with this proportion increasing rapidly. In a New Zealand context this percentage is already far higher as many of our urban areas already encroach around harbours and estuaries with increasing socioeconomic pressure to develop and occupy coastal margins to satisfy desires to live and play at the coast. Whilst the effects of climate change on the drivers of coastal hazards will exacerbate risks experienced by these coastal communities, many other drivers such as socioeconomic factors including increasing national wealth and value of built assets, environmental policy and regulation, land management and stakeholder decision-making and behaviour will all feature prominently in how coastal hazard risk changes in the future and effective policy options are developed.

The role of forests in climate change mitigation

David Whitehead, Landcare Research, PO Box 69, Lincoln 8152

New Zealand is committed to develop policy to reduce greenhouse gas emissions and develop a rigorous system of national inventory for carbon and demonstrate a reduction in CO_2 equivalent greenhouse gas emissions up to 85 Gg CO_2 equivalent by 2008-2012. While about half of this reductions target is expected to be met in the medium term by afforestation and reforestation, this is unlikely to be achieved using plantation forest. However, natural regeneration of pastoral hill country into indigenous shrubland and, eventually, tall forest, provides a viable alternative, with additional benefits including erosion control. Removal of methane by forest soils is also a major contribution to decreasing net greenhouse gas emissions. Robust estimation and verification of carbon storage at the national scale can only be achieved by a process-based approach incorporating measurement and modelling at a range of spatial and temporal scales

Climate change and Australian agriculture

Mark Howden, and Rohan Nelson, CSIRO, Sustainable Ecosystems, Canberra

The climate in Australian agricultural regions varies from monsoonal to cool-temperate/sub-alpine, from high rainfall to hyper-arid. Agricultural activities are adapted to these variations in mean climate. Just as importantly, Australian agriculture has also adapted to the high level of climate variability in addition to high price volatility and related pressure on terms of trade. This adaptation to climate has historically been undertaken in an environment of moderate regulation, high levels of research, development and extension capacity and without significant subsidies. Current trends however, include increased emphasis on the effective management of natural resources (e.g. soil, water and biodiversity) and decreased funding for research, development and particularly extension. In response, there has been increased policy emphasis on facilitating community-based decision-making and social learning through participatory research. It is an open question whether these changes in governance and practice will be adequate to cope with significant climate change. However, governance is becoming a critical issue because there is growing confidence that technical adaptation could substantially ameliorate the uncertain impacts of climate change, provided these technologies are refined and adopted. Funding research into governance to support adaptation in the agricultural sector is a challenge given its small contribution to GDP compared with the energy, transport and industrial sectors that generate most of Australia's greenhouse gas emissions. We suggest that broader systems approaches to adaptive governance are necessary to create an appropriate mix of evolving policy.

Parallel Session 2

How vulnerable is New Zealand to the impacts of global warming?

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Climate change adds new dimensions to the challenges already facing individuals, communities, business, and governments. Eastern parts of New Zealand are likely to become warmer and drier with reduced runoff, although western areas are likely to become warmer and wetter, giving more water to large eastern flowing rivers. Sea level rise could accelerate. The frequencies of major floods, fires, droughts, heat waves and severe subtropical storms are likely to increase. While potential benefits are likely to accrue for particular sub-regions and sectors, there are likely to be substantial negative impacts. Our vulnerability to these depends on adaptation capacity (rather than any likely mitigation). Adaptive capacity is limited for most natural ecosystems, but is much larger for many human systems. Vulnerability is likely to be high in a number of "hotspots", and sectors such as water resources, coastal communities and critical infrastructure.

New Zealand climate change: water and adaptation

David Wratt[1], Brett Mullan[1], Gavin Kenny[2] and Sylvia Allan[3], National Institute of Water and Atmospheric Research, Wellington,[2] Earthwise Consulting Ltd, Hastings
[3] MWH New Zealand Ltd, Wellington

Past New Zealand Prime Minister Sir Geoffrey Palmer made a famous statement that "New Zealand is an irretrievably pluvial country". However, projections for the coming century suggest that rainfall in eastern parts of the country is likely to decrease, and that drought risk will increase in already drought-prone areas. Somewhat paradoxically, the frequency of very heavy rainfall episodes is predicted to increase in many places. These predictions will be discussed, along with potential implications for agriculture, electricity generation, irrigation, infrastructure, and hazards. A risk-management approach through which local government organizations can identify and address changing climate hazards will be described, as will vulnerability and adaptation options identified by groups of farmers in eastern areas

Mitigating methane emissions from New Zealand ruminants

Harry Clark, Rumen and Welfare, AgResearch

New Zealand is in a unique situation internationally in that CH_4 emissions from ruminant livestock make up approximately 32% of total CO_2 equivalent GHG emissions. CO_2 equivalent emissions of CH_4 from ruminants in New Zealand have risen from 22,105Gg in 1990 to 24,141Gg in 2003. Developing mitigation solutions for grazing animals poses a particular challenge since mitigation options have to be appropriate to systems where, in many cases, animals are handled infrequently and where there may be limited opportunities to manipulate or supplement the diet. At present there are limited options available for farmers wishing to reduce CH_4 emissions but a number of mitigation options are being actively researched. These include improving the efficiency of production, improving herbage quality, breeding forage plants with low methane yield, direct manipulation of the rumen microbial ecosystem and exploiting animal to animal variation in methane production.

Climate trends and projections in small islands

P.F. Lefale, Pacific Climate Analyst, World Meteorological Organisation

This paper reviews past, present and future trends in changes in climate and sea level in small islands in the Caribbean, Pacific, Mediterranean and Indian Ocean. New observations and reanalyses of temperatures averaged over land and ocean surfaces since the IPCC Third Assessment Report (TAR) show consistent warming trends in all small islands' regions over the 1901 to 2004 period. However, the trends are not linear. For instance, recent studies in the Southern Pacific region show the annual and seasonal ocean surface and island air

temperatures have increased by 0.6 to 1.0^{o}C since 1910 throughout a large part of the South Pacific, southwest of the South Pacific Convergence Zone (SPCZ) where as decadal increases of 0.3 to 0.5^{o}C in annual temperatures are only widely seen since the 1970, preceded by some cooling after the 1940, which is the beginning of the record, to the Northeast of the SPCZ. For the Caribbean, Indian and Mediterranean regions, analyses shows warming ranged from 0 to 0.5oC per decade for the 1971 to 2004 period.

Analyses of the longest available sea level records which have at least 25 years of hourly data from 27 stations installed around the Pacific basin show the overall average mean relative sea level rise around the whole region is +0.77 mm per year. The Caribbean region experienced on average a mean relative sea-level rise of 1 mm per year during the 20th century. Considerable regional variations in sea level were observed in the records due to large scale oceanographic such as the El Niño, coupled with volcanic and tectonic crustal motions of the Pacific Rim which affect the land levels on which the tide gauges are located.

Analyses of trends in extreme daily rainfall and temperature across the South Pacific for the period 1961 to 2003 show significant increases were detected in the annual number of hot days and warm nights, with significant decreases in the annual number of cool days and cold nights, particularly in years after the onset of El Niño, with extreme rainfall trends generally less spatially coherent than were those of extreme temperature. In the Caribbean, the percentage of days having very warm maximum or minimum temperatures increased strongly since the 1950s while the percentage of days with cold temperatures decreased The maximum number of consecutive dry days is decreasing and the number of heavy rainfall events is increasing. These changes were found to be similar to those changes reported from global analysis.

Variations in tropical cyclones, hurricanes, typhoons in all small islands' regions are dominated by ENSO and decadal variability which result in a redistribution of tropical storms and their tracks, so that increases in one basin are often compensated by decreases in other basins. For instance, during an El Niño event, the incidence of tropical storms typically decreases in the Atlantic and far western Pacific and the Australian regions, but increases in the central and eastern Pacific.

In the tropical South Pacific, the distribution of tropical storms and their tracks are of tropical cyclones are dominated by ENSO and decadal variability with small islands to the east of the dateline highly likely to receive a higher number of tropical storms during an El Niño event compared to a La Niño event and vice versa. In the Caribbean, intense hurricane activity was significantly greater during the 1950s and 1960s, in comparison with the 1970s and 1980s and the first half of the 1990s except, as discussed below, during 1988, 1989 and very recently during 1995. The years 1995 to 2000 experienced the highest level of North Atlantic hurricane activity in the reliable record.

Projections
Projections of changes in temperature, precipitation, extreme events and sea level for small islands are less well understood compared to other regions. Small islands are still disadvantaged in the sophistication, clarity and breadth of climate change and sea level projections.

Based on a range of AOGCMs simulations using IPCC emissions scenarios, temperatures are likely to increase in all small islands by 2099, with those located in higher latitudes warming up faster than those in tropical regions. Changes in precipitation, extreme events and sea level for all small islands are highly uncertain.

Strategies for adaptation: the Pacific Islands framework for action on climate change

Taito Nakalevu, Climate Change Adaptation Officer, South Pacific regional Environment Programme

The adverse effects of climate change and sea level rise present significant risks to the sustainable development of Pacific Island Countries and Territories (PICTs) and the long-term effects of climate change may threaten the very existence of some of them. Reducing the risks associated with the impacts of extreme weather and climate variability needs strategic thinking, planning and commitment from all concerned. At the national level, Pacific Island countries are already taking action to address climate change through their national sustainable development strategies, or their equivalent, which are linked to national budgetary and planning processes. There is recognition that more needs to be done. Addressing the

issues of climate change requires an integrated regional effort that will support and compliment national programmes. The Pacific Islands Framework for Action on Climate Change 2006 – 2015 is a strategic document that Pacific Island countries and regional partners have developed mapping out the Pacific's strategies for adaptation into the future. It provides a strategic platform not only for use by policy and decision makers at all levels, but also for the development and strengthening of partnerships for implementation of national and regional adaptation initiatives.

Overview of impacts and adaptation in the Pacific

Richard A Warrick, International Global Change Institute, Waikato University,Hamilton.

Pacific island countries currently face large risks from climatic extremes due to natural variability, including droughts, floods and tropical cyclones. Changes in climate over the longer term from global warming threaten to exacerbate many of these risks. Recent work in the Pacific aimed has focussed on linking climate change to natural climate variability and extremes in order to facilitate the "mainstreaming" of climate change adaptation into policy, planning and development in the Pacific islands. This presentation offers some examples from the Pacific in which the incremental risks from a changing climate are explicitly identified, along with the incremental adjustments in risk reduction – adaptation – that are required to take account of climate change over time.

Day 2, Plenary Session 4

Sleeping giants: surprises in the climate and the Earth system

Will Steffen,Director, Centre for Resource and Environmental Studies, Australian National University and Chief Scientist, International Geosphere-Biosphere Programme (IGBP)

Over the past few decades much of the interest in global change has focused on the physical climate system, with the mantra of 'reducing uncertainties' becoming somewhat of a holy grail in the research community. However, the range of uncertainty that must be considered has actually increased, not decreased, as a result of more recent insights into other global environmental changes in the atmosphere, oceans and land. This talk will explore a number of processes that have the potential to generate significant surprises in Earth System functioning as global change continues to unfold – climate sensitivity, ocean chemistry, instabilities in the cryosphere and vulnerability of human systems. These so-called "sleeping giants", if awakened, may well revise our definition of what constitutes "dangerous climate change", as well as focus attention on other aspects of global change that may have serious implications for modern societies.

Interpreting the economic impacts of reducing greenhouse emissions

Steve Hatfield-Dodds, CSIRO

Economic modelling overwhelmingly suggests that achieving emission reductions will involve lower, but still positive, rates of economic growth relative to the 'business as usual' scenario – usually referred to as the 'cost' of reducing emissions. Interpreting these results is not as simple as adding up all the costs and benefits, however. First, gaps in modelling capacity suggest current estimates are likely to overstate the net costs of action over the medium to long term. Second, it is clear that there is only a weak relationship – at least in developed countries – between increases in real income and important aspects of wellbeing, such as life expectancy, happiness, health status, and literacy. Third, empirical studies indicate that people much less concerned about 'forgone gains' (such as lower income growth) than by 'losses' (involving reductions in income or environmental quality from current levels).

Each of these considerations suggests that popular interpretations of economic modelling results tend to overstate the likely wellbeing impacts of emissions reductions. The social and economic consequences of climate policy choices will be very significant, however, and better information is required to craft sensible policy options and build the consensus required for implementation. Particular information needs include the social and economic risks of climate change, the size of the 'insurance premium' associated with different policy options for

managing these risks, and the incidence of these costs and benefits across time and groups of countries.

Framing policy action in the short and long term

Murray Ward, Principal, Global Climate Change Consultancy

World political and business leaders seem increasingly to be heeding the elevated level of the warnings of climate change scientists. Climate change is described as the greatest challenge of the 21st century. But there are few signs that this call to urgent action is being taken up by key governments and industries worldwide. The public seems similarly lethargic. Why do we seem to be so stuck? Is the nature and scale of the task too big to comprehend or personalise? We seem to fear the cost of action more than the risk of possibly catastrophic climate change. Is technological optimism misplaced? The challenges need to be reframed and people called on to become excited about and embark on the task ahead.

Parallel Session 3

Action on the ground in Australia

Howard Bamsey, Chief Executive, Australian Green House Office

Australia has a clear national interest in, and a strong commitment to, an effective global response to climate change. We face a sharp potential economic exposure to both the impacts of climate change and poorly-conceived global emissions mitigation action. Australia is well advanced in implementing its climate change strategy, with a mix of regulatory and incentives-based measures which will ensure we meet our Kyoto target and accelerate necessary technology development for the longer term. Australia's domestic policy will continue to closely align with its international approach.

The logic of European action

Joop Oude Lohuis,Team Manager of the Climate and Global Sustainabiliuty unit at the RIVM-Netherlands Environmental Assesment Agency

The EU Member States regard climate change as a serious problem. Ever since the first global climate conferences European countries have expressed their commitment to finding solutions that will limit the effects of climate change, setting a target of a global mean temperature rise of 2^{o} Celsius. In recent years, new views have been developed on the sensitivity of the climate system that, even given the normal high margin of uncertainty seem to point to temperature effects that could perhaps be higher than previously expected. It is also becoming increasingly clear that preparing for the inevitable climate effects is a sensible choice; adaptation to climate change has therefore rapidly risen on the EU agenda.

This presentation will give an overview of current EU policy measures and their effects, both those already achieved and those expected. Since the early 1990s energy and climate policy has been implemented both by the individual member states and by the EU as a whole. This includes of course the EU emission trading system, but also new policies on non-CO2 greenhouse gases and energy saving. A strong motivator, too, for implementing changes in the energy system is the positive effect on decreasing acidifying emissions and other damaging substances to air quality. These co-benefits are crucial in a cost-benefit analysis of climate policy.

Finally, current European ideas on how to progress after 2012 will be looked at. On this topic, a common EU vision has yet to be developed. There is a tendency to focus on other strategies than targets and timetables, in particular clean development and technological cooperation. Some of these options will be discussed.

Climate change and business investment

Kirsty Hamilton, Climate and Business Consultant, UK

Substantial investment will be required, in the near term, to provide energy supply and infrastructure to meet rising global demand. How much of such investment is channelled towards low/zero carbon technologies and systems, will play a significant role in determining the world's capacity to tackle climate change. Given that much of such capital is anticipated to come from private sector investment (or public-private), it is important to understand the views on climate change that are starting to emerge from the investment community. Additionally, the role and characteristics of international and domestic policy needed to accelerate investment into climate friendly solutions, is also critical. This presentation will focus on the latter two elements, bringing in international examples, including recent work on UK-based business views of the international climate regime.

U.S. climate change policy

Jeff Fiedler, Natural Resources Defense Council

Despite the intransigence of the current Administration, climate change policy in the U.S. is reaching a tipping point. Many States have adopted mandatory policies and emission reduction targets. Public opinion remains solidly supportive of action. Businesses and other stakeholders are increasingly urging mandatory national policies. Support is also emerging in many "non-traditional" constituencies, such as the religious community, hunters, and energy security experts.

Developments in Congress reflect this rising tide of concern and action. The Senate recently passed a non-binding resolution supporting mandatory national emissions limits and emissions trading, and such an approach will clearly form the basic architecture of U.S. domestic policy. There is active engagement of key stakeholders by Congressional leaders. International linkages through emissions trading and other cooperation will follow naturally, even if full international re-engagement in the "Kyoto Track" takes longer to accomplish.

From the perspective of other countries, successful implementation of Kyoto and associated domestic policies is a critical demonstration of political will and practical policy-making. Weakening of these efforts, especially if done in an attempt to reach some consensus with the current U.S. Administration, will be counter-productive.

Lessons from the insurance sector

Elayne Grace, IAG (NZ) Ltd

Weather and climate are "core business" for the insurance industry. Insurers underwrite weather-related claims and catastrophes by calculating, pricing and spreading the risk and then meeting claims when they arise. The role of insurance in underwriting weather-related risk is an important component of the national economy. A changing, less predictable climate has the potential to reduce our capacity to calculate, price and spread this weather related risk. Insurance Australia Group (IAG) believes that human-induced climate change is a reality and that it must be addressed with appropriate urgency. It only takes very small changes in the global temperature to have very large impacts e.g. rain disruption, extreme weather events, drought and evaporation, economic losses, damage to infrastructure health and damage to natural ecosystems. IAG claims data shows that once wind gusts reach a certain level, entire roof sections are blown off, or additional damages are caused by falling trees. Yet below this level damage may be minimal. In order to reduce the threat of climate change, greenhouse gas emissions need to be reduced and we need to adapt to the anticipated changes that are occurring.

Plenary Session 5

After oil……?

Lord Ron Oxburgh, Distinguished UK Geologist, ex Chairman, Shell

Oil is a finite resource and although it will never be exhausted, it will simply become too expensive and too scarce to use as a basic fuel. Even if this were not so, the imperatives of climate change mean that we must use other energy sources. What are these sources? What will they cost?

Energy is needed largely for electricity generation and for transport and these two requirements are likely to be met in different ways. For transport, bio-fuels, largely produced from organic wastes/bye-products rather than from fuel crops, are likely to be used, with or with out fuel cells. For electricity there are more possibilities – nuclear, hydro, wind, tide, etc. and coal. But many developing countries are likely to use coal which is highly polluting.

If we begin now it should be possible to achieve significant emissions reductions without excessive cost, but our efforts could be totally eclipsed by emissions from the developing counties. Their collaboration is essential if climate change is to be controlled.

The transport fuels of tomorrow

Ralph Sims, Director, Centre for Energy Research, Massey University

Is the world's "bottle" of oil already half empty? When peak conventional oil will occur and what effects it will have on the crude oil price nobody knows. A range of assessments over the past 40 years have been made but considerable uncertainty remains. This paper outlines the view that the world will not run out of transport fuels as other supplies will undoubtedly be brought on stream from deep water wells, oil shales, tar sands, heavy oils, coal to liquids etc. once the conventional oil price stabilises at a high enough level and for a period long enough to give confidence for new investments to be made. The question then is what will be the carbon emissions / km of vehicle travel compared with today's use of gasoline and diesel? The potential for carbon neutral biofuels, new vehicle engine technologies and hydrogen as an energy carrier will also be discussed.

A way forward on climate policy for New Zealand

Ralph Chapman, Victoria University of Wellington

New Zealand has a clear national interest in responding actively to the threat of climate change, and being a responsible international citizen. To these ends, it has ratified the Kyoto Protocol. But responsible action requires more effective domestic policy, and this is all the more difficult in the wake of the recent decision to drop the 2007 carbon tax. I set out strategic considerations for New Zealand climate change policy in the form of a critique of ‘misleading stories we tell ourselves’ about policy. I address climate change policy options for New Zealand, discussing key policy elements and giving examples, from the areas of energy, transport and land use. Key policies have the potential to maximise synergies across policy domains, yielding economic and social benefits as well as mitigating climate risks.