Submission to the Inquiry into the Kyoto Protocol
Joint Standing Committee on Treaties

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Summary

- *The Science of Climate Change*
  There is almost unanimous scientific agreement that the observed global warming over the last 100 years is real and due, at least in part, to an enhanced greenhouse effect. There is stronger evidence now of a human influence on global climate than at the time of the IPCC Second Assessment Report in 1995. It is likely that increasing concentrations of greenhouse gases have made a substantial contribution to the observed global warming over the last 50 years.

- *Greenhouse gas emission reductions*
  To achieve stabilisation of atmospheric greenhouse gas concentrations, it is likely that global greenhouse gas emissions will need to be reduced in the future to less than 30% of 1990 levels ie 70% below 1990 levels. This emission level has to be achieved globally in an environment of increasing population and increasing energy use, particularly in developing countries. Hence, developed countries, including Australia, are likely to need to reduce their emissions to around 10% of present levels or less. The emission reductions in the Kyoto Protocol are the very important, first small step in achieving the target of stabilisation of greenhouse gas concentrations in the atmosphere.

Introduction

Australia is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), established following the United Nations Conference on Environment and Development in 1992. One of its objectives is "the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Kyoto Protocol was agreed at a Conference of Parties to the UNFCCC in 1997. The greenhouse gas emission targets in the Kyoto Protocol are aimed at reducing the growth in greenhouse gas concentrations in the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC) is a joint body of the UN Environment Program and the World Meteorological Organization. Every 5 years, it provides an assessment of climate change science, the impacts of climate change, and approaches for mitigation and adaptation to climate change. It also provides information on policy-relevant questions to governments around the world. It includes representatives of the governments of more than 100 countries, including Australia. The IPCC assessments are approved and accepted by consensus agreement of the government representatives.

The IPCC Second Assessment Report (SAR) was published in 1995. I am involved in the preparation of the IPCC Third Assessment Report, due to be published in 2001, as Coordinating Lead Author of the chapter *Detection of Climate Change and Attribution of*

Causes in the volume *The Science of Climate Change*. My submission to the inquiry provides a brief update of the state of climate science in this area. I address the current scientific theories on global warming and the greenhouse emission levels required to achieve stabilisation of greenhouse gas concentrations in the atmosphere.

The Science of Climate Change

The IPCC Second Assessment Report (SAR) in 1995 concluded:

- greenhouse gas concentrations have continued to increase;
- climate has changed over the past century;
- the balance of evidence suggests a discernible human influence on global climate;
- climate is expected to continue to change in the future.

The SAR also noted uncertainties in a number of factors, including internal climate variability and the magnitude and patterns of climate forcing and response, which prevented them from making a stronger conclusion. Much research has been carried out on these uncertainties since 1995 in order to better assess the SAR conclusions.

Three of the last five years (1995, 1996 and 1998) have been the warmest in the instrumental record, consistent with the expectation that increases in greenhouse gases will lead to continued long term warming. The global mean temperature has increased by about $0.7^{o}C$ over the last 100 years. Palaeoclimatic reconstructions of the last 1000 years and model estimates of natural climate variations suggest that the observed warming over the last 100 years is exceptional and unlikely to be solely natural in origin.

Estimation of climate change signals has improved through the use of newer climate models, ensemble simulations and the inclusion of additional anthropogenic and natural factors. New simulations of the climate response to natural forcing alone, including volcanic eruptions and changes in solar output, fail to explain the observed warming over the last 40 years.

There is growing evidence that the global patterns of climate change expected to occur due to the enhanced greenhouse effect can be found in observed large-scale patterns of climate change. These include greater warming at high latitudes than in low latitudes, greater warming over land than over the oceans, greater warming in winter than summer, and greater warming at night than in daytime.

The detection and attribution of anthropogenic climate change signals is accomplished through a gradual accumulation of evidence. There is stronger evidence now of a human influence on global climate than at the time of the SAR in 1995. Attempts to quantify the anthropogenic influence indicate that the climate response to increasing greenhouse gases is likely to account for a substantial fraction of the observed global temperature change over the last 40 years. However, the accuracy of these estimates continues to be limited by uncertainties in estimates of internal variability, natural and anthropogenic radiative forcing and the climate response to external forcing.

Greenhouse gas emission reductions

The Kyoto Protocol includes agreed targets for reductions of greenhouse gas emissions for developed countries. The overall target is an average reduction of greenhouse gas emissions in 2008-2012 by about 6% below 1990 levels. The target for Australia is an 8% increase in

2008-2012 above 1990 levels. This was argued to be a significant reduction on the increase that would have occurred in Australia without emission controls.

In practice, the emission reduction targets in the Kyoto Protocol will have only a small effect on global greenhouse gas emissions, as they do not include developing countries. In addition, they will have an even smaller influence on atmospheric concentrations of greenhouse gases, which are affected by emissions over about the last 50 years or more. It is likely that the rate of increase of greenhouse gases in the atmosphere will be reduced by only a very small amount if the Kyoto targets are met.

The IPCC has provided estimates of global greenhouse gas emissions that are required to achieve stabilisation of atmospheric concentrations at specified levels. Although the global carbon cycle is complex and not fully understood, it is very likely that global greenhouse gas emissions will need to be reduced in the future to less than 30% of 1990 levels to achieve stabilisation at any atmospheric concentration. This emission level has to be achieved globally in an environment of increasing population and increasing energy use, particularly in developing countries. Hence, developed countries, including Australia, are likely to have to reduce their emissions to around 10% of present levels. Even after a stabilisation of atmospheric greenhouse gas concentrations, the climate will continue to warm for at least the following century or longer as the coupled ocean-atmosphere-ice system reaches a new equilibrium.

The ratification of the Kyoto Protocol and meeting its targets for greenhouse gas emission reductions are a very important first step in achieving the objective of the UNFCCC of stabilising greenhouse gas concentrations in the atmosphere.

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