Submission to Senate Select Committee on Climate Policy

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This is a personal submission by the author, not a submission from CSIRO or any other organization. The author has a PhD in climatology from MIT and has worked and published in climate research for the past twenty years.

This submission addresses only term of reference (c) regarding

> "whether the Government's Carbon Pollution Reduction Scheme is environmentally effective, in particular with regard to the adequacy or otherwise of the Government's 2020 and 2050 greenhouse gas emission reduction targets in avoiding dangerous climate change"

Summary

The government's 2020 and 2050 targets of 5% and 60% reductions below 2000 levels respectively are not sufficiently stringent to avoid dangerous climate change. In fact, they yield a high likelihood of triggering irreversible changes in the climate system. Such likelihoods can be greatly reduced with far more stringent emissions reductions. However, further delay makes safer concentration targets unattainable and begins to lock in dangerous climate change.

Dangerous climate change processes

The problem of defining dangerous levels of climate change has no unique solution as there are a cascade of levels of warming at which different impacts come into play (Risbey, 2006). Bearing that in mind, the international community has focused on the more catastrophic climate change impacts and the level of warming at which they become significant risks. There is a general consensus that 2°C of warming (above preindustrial temperature) is a rough dividing line below which the risk of catastrophic impacts is more moderate, and above which it becomes increasingly likely.

While there are many significant impacts from climate change, some in particular pose global scale threats of high or unknown magnitude, and have thus been the focus of concern (Risbey, 2008). These are:

1. The risk of irreversible collapse of the Greenland and West Antarctic ice sheets, contributing roughly 7m and 5m respectively to sea level rise. Based on evidence from previous glacials and interglacials, these ice sheets may be committed to melt, regardless of further actions, once the temperature rise is in the vicinity of 2–3°C (Gregory et al., 2004). Such sea level rise could occur at rates observed during previous transitions to interglacials, up to 5 metres per century (Weaver et al., 2003).

2. The rise in acidification levels of the global oceans. Increasing carbon dioxide concentrations in the atmosphere lead to increasing concentrations of dissolved carbon and higher acidity in the ocean. At levels of carbon dioxide above about 450ppm, calcifying marine organisms start to lose their ability to form shells (McNeil and Matear, 2008). The consequences of this for the marine ecosystem and foodweb are largely unknown, including potential collapse of the system.

3. The release of stored methane and carbon dioxide from natural stores in the biosphere triggered by the warming. Such feedbacks have the potential to greatly accelerate the warming and to continue that process regardless of our attempts to reduce emissions. That is, we could lose control of our ability to 'regulate' the rate at which greenhouse gas emissions increase.

4. The breakdown of snowmelt driven hydrological systems. The water resources of a large fraction of the global population (India, China) depend on the gradual release of snowmelt from large winter snowpacks in the Himalayas (and other mountain regions). Loss of snowpack in these regions will lead to widespread flooding in spring and subsequent loss of available water in summer. This poses a major threat to the agricultural basis of these regions and populations.

Each of these processes are sensitive to temperature (or the direct concentration of carbon dioxide in the case of ocean acidification). Their impacts would be global, and catastrophic should they occur. While we cannot give a precise temperature at which each of these processes would occur, the threshold is thought to be in the vicinity of about 2°C in each case. Thus 2°C has been set as a loose threshold to differentiate the probability of dangerous impacts.

Implications for emission targets

There are some inevitable elements of uncertainty in setting the level of emissions that produce a given level of warming, in this case 2°C. One of these is that we must convert emissions to concentration levels in the atmosphere and that depends on factors such as the rate at which the natural system takes up carbon dioxide. This rate may decrease as the temperature rises, further exacerbating concentrations. Once we establish a concentration, that must be translated to a temperature rise, which in turn depends on the rate that oceans take up heat, and on the climate sensitivity, which is the amount the temperature rises for a given amount of carbon dioxide increase. These factors also introduce some uncertainty. Given this uncertainty, we can only express the likelihood of exceeding 2°C as a probability range for any given emissions path.

The emissions reductions target set for Australia in the CPRS, applied across all nations, correspond to a trajectory to stabilize carbon dioxide equivalent greenhouse gases above 450ppm. Following Baer and Mastrandrea (2006), we note that this stabilization level implies a 50 to 90% chance of exceeding the dangerous threshold of 2°C. In other words, this is Russian roulette with the climate system with most of the chambers loaded.

In practice, the implications of the CPRS targets are even worse than this. Fairness considerations dictate that the reduction in emissions would need to come disproportionately from the developed countries in order to converge to equal per capita emissions by 2050. As such, one can't simply extrapolate the Australian CPRS targets to the rest of the world. Thus, the CPRS targets imply much higher stabilization levels of greenhouse gases by 2050, with a near certainty of exceeding the 2°C threshold.

The work of Hansen et al. (2007, 2008), Baer and Mastrandrea (2006), and others indicates that stabilization of carbon dioxide equivalent concentrations of greenhouse gases near 350ppm is necessary to reduce the likelihood of exceeding 2°C to moderate levels. Such stabilization is technically possible, but requires immediate steps to begin the reduction of emissions. Further delay makes this kind of target unattainable and begins to lock in the dangerous consequences described above.

References

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