Committee Secretary,
Senate Select Committee on Climate Policy
PO Box 6100, Parliament House
Canberra ACT 2600

Dear Secretary,

As a biophysical scientist with more than 40 years of professional experience in areas that include climate modelling and other relevant aspects, I wish to make the following submission to your inquiry. Its main points are summarised as follows:

1. **New evidence invalidates the data on which the proposed CPRS is based**
   Recent observations have clearly shown that polar and glacial ice are now melting significantly faster and ocean levels are rising more rapidly than the mid-range predictions of the Intergovernmental Panel (IPCC, 2007). Unfortunately, the analyses of Stern (2006) and Garnaut (2008) assumed the mid-range predictions, and the CPRS cap was apparently based on these analyses. Recent research has also provided new evidence on ice mass 'tipping points' and the effects of global warming on extreme weather conditions. An urgent review of the CPRS is now required in the light of all this new information.

2. **The worst case scenario has a high probability of commencing before 2030**
   Some of the new evidence suggests an irreversible meltdown and progressive collapse of the West Antarctic and/or Greenland ice mass is likely to commence when the atmospheric concentration of CO_2 reaches 450 ppm. This would result in a catastrophic rise of at least 5 metres in ocean levels. It can be shown that there is a high probability of such an event commencing before 2030 unless the equivalent global carbon emissions are reduced to less than 37% of their present rate well before that year.

3. **Schemes similar to CPRS have serious problems**
   A substantial amount of information has been collected recently to show that other schemes similar to CPRS have resulted in a number of unintended adverse consequences, and have been less effective than expected in reducing carbon emissions.

4. **There are particularly serious problems with forestry credits in CPRS**
   Attempts to include reafforestation and forest management in CPRS may be shown to have particularly serious problems. Forests have important potential contributions to the reduction of CO_2 but other incentives are needed to maximise these contributions.

5. **CPRS is incompatible with demands for global equity and justice**
   The proposed CPRS is likely to shift much of the burden of mitigation to poor countries. It also tends to maintain the unfair external costs of coal to people who have benefited the least from coal, and favours major polluters over minor polluters. CPRS is therefore incompatible with recent international demands for global equity and justice in mitigation.

6. **The flexibility of CPRS is inadequate for responsible risk management**
   Climate change mitigation is essentially high order risk management. With such large risks and uncertainties, responsible measures require the flexibility to cope with a wide range of possible future outcomes but CPRS is inadequate in this regard.

Further explanation of these points will be given below.

New evidence on polar ice melt, ocean level rise and weather extremes

In the latest report by the IPCC (2007), the ice mass conditions and ocean level rises referred to were all prior to 2003. These have been superceded by more recent assessments of accelerated melting of glaciers and the unstable ice masses of Greenland, by Mote (2007), Saupe (2007), Maslenik *et al* (2007), and Tedesco (2007). Similar updated assessments of the unstable West Antarctic ice mass have been made by Rignot *et al* (2008) and Steig *et al* (2009). The recent acceleration of rises in ocean levels has been observed in many countries throughout the world, with scientific documentation by Hansen (2006) and Church and White (2006). Accurate measurements of these rises show they are higher than the worst case predictions in the IPCC reports used for the Stern and Garnaut analyses and the formulation of CPRS.

Although recognition was given in the IPCC reports of the increased probabilities of severe storms and other extreme weather conditions likely to occur with global warming, this was not emphasized and their economic significance was therefore probably much underestimated in the Stern and Garnaut studies. It is now more widely recognised that such conditions are due either to the increased energy levels in weather systems, or to the disruption of ocean and atmospheric circulations (especially for conditions of drought and extreme cold weather). Their increasing significance has been confirmed and indications that extreme conditions will become an even more important feature of global warming are given in recent studies such as by Thompson *et al* (2006), and Elsner *et al* (2008).

Ice mass tipping points and worst case scenario

Climatologists have adopted the term 'tipping point' to refer to a set of conditions in which a small change can trigger relatively large irreversible reactions eventually producing a set of conditions significantly different to the original (see Pearse, 2008). A number of past ice mass tipping points have been identified in various palaeoclimatological studies and these were recently examined in detail by the eminent geophysicist, James Hansen. He concluded that the global temperatures coinciding with these conditions were only slightly higher than current global temperatures, and the corresponding atmospheric CO_2 concentration would be 450 ± 100 ppm. This is now regarded as the best available estimate of the ice mass tipping point for the global warming worst case scenario which would result in one or both of the following :

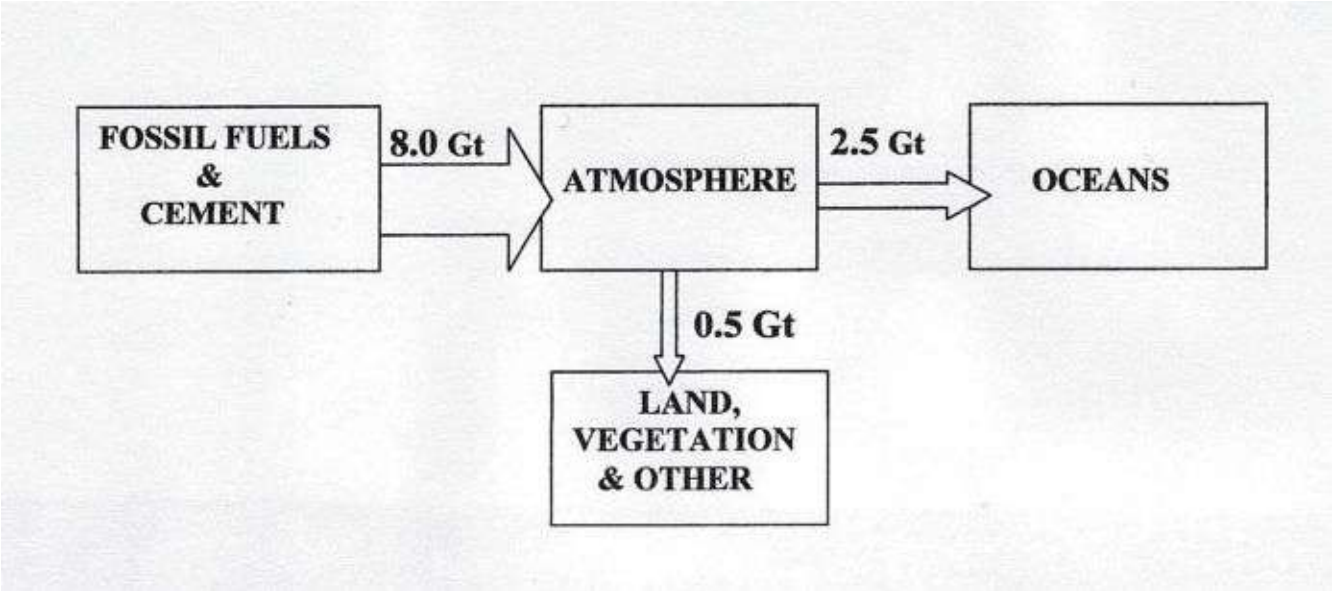
- collapse of the extensively unstable West Antarctic ice mass, causing a rise in ocean levels of at least 5.5 metres over a period expected to be between 50 and 500 years,
- collapse of the similarly unstable Greenland ice mass, causing an additional 6.5 metre rise in ocean levels over a comparable period.

Either of these events would result in inundation of many of the world's most densely populated areas, dislocating a billion or more people and eliminating much of the productive land needed to feed them. The definite possibility of such catastrophic changes is acknowledged by the IPCC (2007, Chapter 5) but with no attempts to assess their probabilities and impacts. As suggested by Hansen (2006) and mentioned earlier, continuing accusations of 'alarmism' by sceptics have made IPCC very reticent about reporting the progress of research in this politically sensitive but vitally important area for the future of humanity.

If the earth's largest ice mass over East Antarctica were to melt completely, ocean levels would rise a further 70 metres. Because of the size and stability of this ice mass, however, such an event would take place over many thousands of years. Although this has actually occurred a few times in the distant geological past it has not been regarded by scientists as a feasible consequence of the present global warming.

Probability of tipping point commencing before 2030

Because of all the relevant uncertainties it is not possible to predict the occurrence of the ice mass tipping point with a high degree of reliability, but relatively simple calculations can provide reasonable indications of the associated probabilities. Such calculations assume the global carbon cycle may be represented by aggregated storage systems and transfer processes as represented in the following diagram.



ESTIMATED TRANSFER RATES IN GLOBAL CARBON CYCLE FOR 2008
(extrapolated from data in Marland *et al*, 2006; Houghton, 2003; IPCC, 2007)

In this diagram the estimated carbon transfer rates between the aggregated global storages for the year 2008 are shown in Gigatonnes (Gt). As its carbon content is increasing, the assimilation capacity of the atmosphere is being exceeded by the inputs. The magnitude of the assimilation capacity of the atmosphere is therefore equal to the net sum of the outputs, and is estimated at 2.5 + 0.5 = 3.0 Gt. If the clearing of forest and other vegetation could be eliminated or replaced with compensating afforestation, the transfer of carbon to land, vegetation etc would increase to about 1.5 Gt, and the assimilation capacity of the atmosphere would effectively increase to 4.0 Gt.

It may also be shown that each additional Gt of carbon remaining in the atmosphere increases the CO_2 concentration by about 0.8 ppm, and it may be assumed that the best estimate of the CO_2 concentration corresponding to the tipping point is 450ppm (as indicated previously). Several feasible, optimistic conditions will now be considered:

CONDITION A
With this condition global emission rates remain fairly steady at 8.0 Gt per year but atmospheric assimilation capacity is effectively raised to 4.0 Gt through major programs to reduce vegetation clearing and increase afforestation. The CO_2 concentration of the atmosphere therefore continues to rise each year by (8.0 - 4.0) x 0.8 = 3.2 ppm.

As the 2009 CO_2 concentration is about 390 ppm the tipping point will be reached with a further increase of 60 ppm. The number of years for this to occur with Condition A may be calculated from 60/3.2 = 18.8, corresponding to the year 2028.

CONDITION B
With this condition global emission rates remain fairly steady but the food needs for continuously increasing populations in undeveloped countries prevent any effective reduction in the assimilation capacity through afforestation and the reduction of clearing.

Calculations similar to those for Condition A show the tipping point would be reached in 2024.

CONDITION C
With this condition global emissions are reduced 5% from the present rate but there is no net increase in the atmospheric assimilation capacity (because vegetation offsets would be included in the 5% reduction through carbon trading schemes).

Calculations similar to those for Condition A show the tipping point would be reached in 2025.

It should be clear from these simple but quantitatively rational considerations that there is a high probability of the worst case scenario commencing before 2030 unless much more effective measures are taken to stop atmospheric concentrations increasing. Similar considerations show that to stop atmospheric concentrations increasing, global emissions must be less than the assimilation capacity of 3.0 Gt per year. This means, essentially, that global emissions must be reduced to less than 37% of their present values as soon as possible.

Evidence of problems with similar schemes

Carbon reduction schemes similar to the proposed CPRS have been implemented in other countries, notably in Europe and some American states. A number of studies of the consequences and effectiveness of these have been published recently, including Bond et al, (2009), Harvey and Findler (2007), Lipow (2007) and Spratt and Sutton (2008, pp 187-193). Most of these studies have revealed the occurrence of many unintended adverse social and environmental consequences, none of which appear to have been adequately considered in the Green and White Papers describing CPRS. Furthermore, although a number of undeserving 'carbon entrepreneurs' have apparently made large profits from manipulative trading in carbon credits with the European and American schemes, there is little evidence of their effectiveness in reducing carbon emissions.

One of the basic problems with carbon trading schemes such as CPRS is that the main objective of participants is to gain financial advantage. This objective obscures and completely subordinates the carbon reducing objective, and the complexity of the schemes makes the links between the two objectives very indirect and tenuous. The complexities also make such schemes prone to market manipulation, inequitable outcomes, and detrimental externalities.

As pointed out by Stern (2006), the global warming problem is the consequence of an enormous market failure. It is essentially due to the market-determined costs of coal and oil being very much lower than their full true costs (which include the cumulative social and environmental costs). Coal and oil have therefore been subsidised as cheap forms of energy by the entire world for many years, and part of the cost of this subsidy is in global warming. In protecting the coal industry, the proposed CPRS maintains the subsidy and fails to raise the revenue needed to provide compensation (see Allott, 2007; Hansen, 2009). Theoretically and practically it would be far preferable to provide incentives for carbon reduction by directly taxing carbon emissions or the use of coal and oil. The revenue so raised should then be allocated to alleviate the problems of people affected by the necessary changes, and to the development of the socially benign energy resources that Australia is so fortunate to possess.

Why forests should be treated differently

The protection and management of forests and other vegetation have obviously important roles to play in reducing carbon emissions, but should not be included in any emission trading schemes for the following reasons:

- Vegetation can be both sources and sinks for CO_2, depending on factors such as species, season, time of day, stage of growth, moisture and nutrient status of soil, air temperature, humidity and so on. The resulting extreme variability in time and space make it difficult and very costly to quantitatively assess the contributions of specific areas of vegetation. Such contributions are therefore unlikely to be properly assessed, making them very highly vulnerable to misrepresentation, manipulation and fraud in emission trading transactions.
- Some of the most significant areas of vegetation for the global carbon cycle are essential for the maintenance of global biodiversity and also for the survival of indigenous cultures. These functions are likely to be seriously compromised by their management and modification to maximise the values of the areas for 'carbon entrepreneurs' (see Williams *et al*, 2005; Australian Academy of science, 2005).
- The inclusion of forests in CPRS is likely to result in much investment for the purchase of cheap carbon credits from developing countries. This would effectively shift the burden of mitigation measures overseas and minimise efforts to reduce emissions in Australia.
- CPRS would contribute to possible extensive reafforestation of agricultural areas needed to produce future food for the continually growing global population.

Schemes other than CPRS are needed to provide incentives for reafforestation and for the protection of vegetation and to avoid the above serious defects.

New global moves for actions to be just and equitable

At a recent meeting in Copenhagen it was indicated that a theme to be emphasised by the United Nations would be justice and equity in climate change mitigation (Robinson *et al*, 2009; University of Copenhagen, 2009). A number of aspects of the proposed CPRS are not compatible with this theme. At the international level, such aspects include the likely tendency for CPRS to shift the burden of mitigation measures to developing countries (as mentioned previously). Also incompatible is the failure of CPRS to obtain revenue from the coal industry to help compensate victims of coal use and global warming. Such victims include the Pacific Island people soon to be displaced through ocean rise. These people are amongst those who have benefitted the least from coal use but will be amongst the first to suffer.

At the national level it may be argued that the proposed CPRS unfairly favours the major polluters with large resources to purchase carbon credits, and disfavours minor polluters with limited resources. CPRS also unfairly shifts the very large risks away from those most able to bear them, to Australian taxpayers, many of whom may consequently suffer hardship.

Need for flexibility and responsible risk management

Because of the large uncertainties in both the science and economics of climate change, its mitigation measures could be regarded as a form of high order risk management. A particularly significant factor with climate change is that the worst case scenario involves consequences of inestimable magnitude and it also has a high probability of occurrence. Under these circumstances, according to principles of scientific risk management, responsible mitigation plans need to be highly flexible. This is to enable the changes and adjustments that are expected to be found necessary as more information becomes available in the future. Unfortunately, CPRS does not appear to have this flexibility, and the likely large future changes may again impose large costs and hardship on taxpayers.

The complexity and potential market manipulations of CPRS also tend to conceal the magnitudes of the risks in the trading mechanism and management measures. This could deceive and distort the decision-making with potentially disastrous results in much the same way as the obscuring and concealing of risks in complex market transactions apparently contributed to the recent financial crisis (see Soros, 2008).

Conclusion

Much effort will be required to reduce carbon emissions sufficiently to avoid the disastrous occurrence of an ice mass tipping point, but the proposed CPRS will retard this effort rather than assist it. Even if an ice mass tipping point does not occur, CPRS is likely to have quite detrimental social, environmental, and economic consequences for Australia. To avoid these consequences it is necessary to replace it with other more direct, more transparent, and less complex measures for reducing emissions.

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My backgound and experience

My first degree was in applied mathematics and natural resources from the University of Sydney, and my higher degrees were from the University of NSW in civil engineering, hydrology, and the mathematical modelling of natural processes.

In my 40+ years of professional experience in natural resources, climatology and environmental impact analysis I have held appointments for various periods in the Water Conservation and Irrigation Commission of NSW; Department of Works, Darwin, NT; Commonwealth Department of Natural Resources; NSW State Pollution Control Commission; Institute of Hydrology, Wallingford, U.K.

I have also held academic and research appointments at the University of NSW; Florida State University, USA; Colorado State University, USA.

In recent years I have worked mainly as a consultant in both the public and private sectors, with major projects in assessments and analyses of water resources, environmental impact assessment, mathematical modelling of climatological and ecological processes, climate changes for specific areas due to global warming, and risk assessments for natural hazards. I am the author or co-author of about120 publications and major reports resulting from my assignments and research.