Submission to Senate Select Committee on Climate Policy

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Climate Change: Science, Impacts and Solutions (2nd. edition), Barrie Pittock, 2009: see www.publish.csiro.au.

Summary

This submission argues that climate change under a business-as-usual scenario, or even under one of only moderate reductions in greenhouse gas emissions, will be extremely costly to Australia and the world. It further observes that so-called geo-engineering solutions such as putting reflecting particles into the upper atmosphere or fertilising the oceans, would be dangerous. It argues that a suite of measures to reduce greenhouse gas emissions are needed urgently, and that these may need to be varied in the light of experience. Further, it argues that the climate change problem, and the current global economic crisis, while presenting problems and costs, also present significant opportunities that must be seized. We have in the global and Australian economy many highly carbon intensive industries that will not be viable in the long-term, and increasingly unviable even in the short-term. The longer these activities continue the more it will cost to replace them, with increasing losses from stranded investments. Indeed, as the climate change situation worsens, carbon-intensive industries will inevitably be exposed to sovereign risk as governments are forced to act. Large investments in and incentives to foster low-carbon technologies are needed and will give rise to a new generation of industries which will be the wave of the future. If existing carbon-intensive companies are not willing to change, then they will fail and be replaced by new entrepreneurial companies and technologies, just as the horse and buggy was replaced by the automobile and the telegraph by the world-wide web. Seizing the opportunities early would give both investors and governments an advantage and minimise the costs of climate change. A minimum overall target of 80% reduction in emissions by 2050 requires about a 5% reduction *relative to business-as-usual* each year, starting now. This should be subject to periodic review and must be the target for major polluters under any emissions trading scheme, with voluntary reductions by smaller emitters including households being additional.

Note that most of what is contained in this submission is discussed much more fully in my revised text-book *The Greenhouse Effect: Science, Impacts and Solutions* (CSIRO Publishing, see www.publish.csiro.au, which will be on sale by about the end of March 2009. A version of the concluding chapter, with endnotes, is appended to this submission as an appendix.

Full Submission

Nature of the problem

Central to the problem are at least three facts concerning climate change:

1. Accurate predictions and even detection of climate change in all its manifestations are necessarily uncertain, but with quantifiable probabilities. Coping with these uncertain but potentially damaging effects requires a risk management process, similar to that applying to insurance. We do not insure a house against fire because we are certain it will burn down, but because it just might. Thus despite a minority of denialists, we need to take account of what many respectable scientists are telling us. This is an essential component of responsible risk assessment.

2. Recent climate change is almost certainly due in large part to human society increasing the concentrations of various greenhouse gases which lead to a warmer Earth with many climatic and other consequences, including sea-level rise, acidification of the oceans and regional changes in rainfall. This process is cumulative and may become self-reinforcing. It is at once a long-term problem not readily perceived by businesses who think in terms of shorter-term profitability, and also a process that has effects evident already, in reinforcing natural climate variability, causing progressively more severe extreme events.

3. Nature does not change the landscape and ecosystems (which we rely on, and indeed are part of) gradually, but in many instances does so through the operation of extreme events that dramatically change things. Examples include:

- It is not the slow average sea-level rise (currently a few mm per year) that causes coastal erosion and damages so much as increases in the number and severity of coastal storms and storm surges.
- It is not gradual reductions in rainfall that cause loss of crops, but increasing frequency, severity and length of droughts due to a combination of low rainfall years and higher evaporation higher temperatures.
- It is not gradual increases in average temperatures that cause major health problems and crop losses but rapid increases in the frequency and severity of extremely high temperatures, causing heat waves and increasing deaths of people (as in Paris in 2003), animals and vegetation.
- It is not gradual adjustment of land cover that occurs due to changing climate but disastrous changes due to increasingly severe, widespread and frequent large-scale wildfires. Major conflagrations are Nature's way of overcoming the existing inbalance between the land cover and the climate. Single large wildfires may lead to regeneration of existing bush, but repeated fires can kill the seed beds and the saplings, leading to the eradication of species unsuited to the new climate. Three large-scale extreme fire seasons in SE Australia in 2003, 2006-7 and 2009 are evidence of this process at work. Until the land cover and climate are in

equilibrium, we may raise our defences against fire, but sooner or later an extreme event large enough to overwhelm our defences will occur.

These changes in the frequency and intensity of extreme events are occurring now and are very costly to society and the economy. They are forerunners of more severe problems which will occur if we do not stop human-induced climate change very soon.

Geo-engineering is not a viable solution.

Some scientists, despairing of urgent action to limit climate change by reducing greenhouse gas emissions, are advocating studies of artificial means of keeping the planet cool, such as putting reflective particles in the atmosphere or fertilising the oceans. Some industrialists see this as a way out of the climate change problem. This is very dangerous thinking.

Reasons why geo-engineering is dangerous are:

1. While geo-engineering can be designed to cancel out the effects of increasing greenhouse gases on global average temperature it cannot as yet be designed so as to avoid regional differences in its effects on temperature and especially on rainfall, which are likely to be damaging to some countries.
2. It will not reduce carbon dioxide concentrations in the atmosphere and therefore in the ocean waters, and so the problem of increasing acidification of the oceans will continue and grow. This threatens ocean fisheries and ocean ecosystems in general, including coral reefs. This in turn will adversely affect world food supplies and reduce the effectiveness of fringing coral reefs as protectors of coasts from major storms and wave erosion.
3. Once such a scheme is implemented, and greenhouse gas concentrations continue to increase, any cessation of controlled geo-engineering measures would lead to a rapid increase in global temperatures. Once geo-engineering is implemented any interruption, due for example to war or economic emergencies, would thus lead to disastrous consequences.
4. Disagreements about what detailed geo-engineering actions should be taken, perhaps because of different regional impacts, could well lead to international conflict, especially if such schemes are implemented unilaterally by some major power such as the United States, China or Russia. International agreement would be essential before geo-engineering is implemented.
5. Any belief that such geo-engineering schemes can work will likely lead to pressure by major high carbon emitting industries to use such schemes to allow them to continue to emit greenhouse gases. This would make the above problems worse.

A suite of measures is necessary.

Rapid reductions in carbon-intensity will only come from a wide variety of activities, including;

- increased energy efficiency in homes, industry and transport
- substitution of natural gas for coal and oil
- co-generation of electricity and heat
- wind generated energy, especially in coastal areas
- solar energy, both photovoltaics, which can be used widely dispersed on rooftops to generate electricity for local use (examples in Germany); solar thermal, which can be large-scale and plug in to the electricity grid (examples in California); and solar hot water, which again can be widely dispersed on rooftops (examples in Turkey)
- geothermal power, from hot rocks, which is being actively pursued in Australia, notably in the Cooper Basin
- wave and tidal power, with particular application to both electricity generation and desalinisation of seawater
- energy storage for base-load power from renewable sources such as solar and wind, by a number of means such as: melting of salt in tanks; hydro-electric pumping and storage; generation of electrolytes, hydrogen, or compressed air; and recharging of batteries for electric cars
- second generation biofuels from cellulosic raw materials such as organic waste, thus reducing land fills and avoiding competition with food production
- carbon capture and sequestration from fossil fuel power plants if safe and economic
- generation of biochar for sequestration in soils by the pyrolosis of organic matter including waste material (by decomposition into hydrogen, methane and charcoal by heating without oxygen)
- nuclear power with all safeguards (safe storage or avoidance of nuclear waste, safeguards against accidents and terrorism, etc.), if economically viable
- improved management of forests to maximise carbon storage
- improved management of agricultural soils to store carbon.

These and other remedies are all possible, although many have pros and cons, and it is only by a large suite of such measures that large reductions in emissions will be possible. Carrots and sticks (incentives and penalties) need to be deployed in all these relevant fields, including putting a real price on carbon emissions through a carbon tax and/or emissions trading. The extent and mix of these measures will evolve as we learn by doing, and in the light of future rates of climate change and technological development.

However, it should be noted that carbon taxes and emissions trading by themselves will very likely not be enough. Many obstacles or barriers exist to initiatives and products competing with established large-scale industries such as fossil-fuel production and fossil fuel based electricity generation. Such obstacles include established infrastructure for carbon-intensive industries, e.g., petrol distribution stations versus hydrogen fuel or battery recharging stations; subsidies for fuel exploration (again the oil industry); and electricity grids that favour distribution from coal-fired power stations rather than geothermal, solar, wind or tidal power which is potentially generated in other (often remote) locations.

Strong start-up subsidies and incentives will be needed to allow renewable energy to reap economies of scale, optimise its technology, and become competitive. Such subsidies

would include special feed-in tariffs for renewable power, and the gradual setting up of a truly national common-carrier electricity grid. The latter would allow renewable energy from remote sources to be plugged in progressively without each new enterprise having to build its own long-distance power lines. The proven value of high-voltage direct current cables such as Basslink, for low-loss electricity transmission over long distances suggests that such a truly national grid is both possible and potentially economic.

Australia is blessed with the largest solar energy potential of any nation (at least equal to that of the whole of North Africa), large geothermal energy (some now being developed in the Cooper Basin), and major tidal and wave power potential especially in north-western Australia. If we develop these potentials we will decrease our reliance on imported petrol and oil. Given a substantial price on carbon emissions, a large renewable-electricity industry would be able to compete economically with fossil-fuel based electricity.

Whether nuclear power or fossil-fuelled based generation with carbon capture and storage (CCS) will be competitive remains to be seen. We should certainly not put all our eggs in the nuclear and CSS baskets.

The most common arguments used for nuclear power are that renewables cannot supply base-load power, and that nuclear will be cheaper. That argument is clearly wrong. Economical storage of renewable energy is proven, e.g., solar-thermal power in California, and would be made far less essential if there were a widespread national electricity grid that could average out variable solar, wind, geothermal, tidal and wave power. Besides, much of the peak load demands can be supplied at optimum times by solar power, notably power for air-conditioning systems in the hottest part of the day. Increasing thermal storage capacity in energy-efficient buildings would also work against the need for high peak loads on cold mornings.

History suggests that cheap nuclear power is largely a myth to date. The countries with major nuclear power industries include the United States, Russia, France, the UK, China, and India. All these countries developed nuclear power in close relation to nuclear weapons development, and nuclear power was thus subsidised. In the case of the US and the UK, after the nuclear power industry was privatised virtually no new nuclear power stations have been built, mainly because they were not profitable. Moreover, the cross-over of technology and expertise between civil and military applications of nuclear power is such that any country developing nuclear power will have the ready ability to develop nuclear weapons. This is clearly behind the widespread fears in relation to nuclear power in Syria and North Korea. Only Germany and some of the Scandinavian countries provide possible exceptions to this experience.

Regulations and other incentives, such as minimum energy efficiency ratings for buildings, domestic appliances and motor cars, or car registration rates tied to fuel efficiency, would also play a major role in reducing greenhouse gas emissions.

Effect on the economy

Prior to the present global economic downturn it was clearly established by the Intergovernmental Panel on Climate Change (IPCC), based on numerous studies, that in the long term (decades to a century) the potential costs of unmitigated climate change would be much greater than that of necessary efforts to reduce greenhouse gas emissions. Observations of climatic events, and new scientific results since the last IPCC report was published in 2007 strongly suggest that climate change is happening faster than the IPCC projected, and that it will prove more costly, mainly through the rapid increase in the frequency and severity of extreme events. Local evidence comes from the "long drought" in the Murray-Darling Basin and the increase in severe bushfire events in SE Australia, both of which are clearly exacerbated by global warming.

The current economic crisis has raised arguments about the cost of reducing greenhouse gas emissions during the crisis, and has bolstered industry calls for a delay in emissions reduction measures. However, the response to the economic crisis must include ways of stimulating the economy for future growth, and this cannot be growth in carbon-intensive industries, which would be setting the economy up for a further crisis when it becomes even more urgent to curtail such industries. As we have seen, the increasing frequency and intensity of extreme events is already impacting on the economy, and when this is more widely recognised internationally and in Australia, measures will have to be taken to stimulate low-carbon technologies and curtail high-carbon ones. We will likely be faced internationally with economic penalties on the latter and preference for low-carbon products and technologies.

Indeed, several economists have noted that economic crises are times when old and no longer appropriate and profitable technologies get phased out in favour of new more appropriate ones. We therefore have an opportunity now to act to provide incentives and market share to renewable and other low-carbon technologies and to phase out the high-carbon sectors. Up to a point BP and Shell have already done this, by placing emphasis, at least in their publicity, on going "beyond petroleum" (BP) and setting up solar and other renewable programs within their organisations. BP and other companies have also set internal targets for reducing their emissions and increasing their energy efficiencies. This has in fact led to dollar savings within these organisations. The appropriate response to economic crises is to develop new products that are more economically and environmentally sustainable through ingenuity, entrepreneurship and investment.

Fossil-fuel intensive industries have had decades of warnings from scientists that a high-carbon economy is unsustainable. Professor Wally Broecker in 1975 stated that "… by early next century [carbon dioxide increases will] have driven the mean planetary temperature beyond the limits experienced during the last 1000 years." In 1979 the World Meteorological Organisation stated at its First World Climate Conference that "the world should try to foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity." At the Villach conference in 1985 international

scientists repeated Wally Broeker's warning with much greater authority, and at another scientific conference in Toronto in 1988 scientists called for a 20% reduction in carbon dioxide emissions by 2005. They stated "Humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to global nuclear war." [In several papers written by me in the early 1980s I projected that southern Australia would get drier and northern Australia wetter as the climate got warmer – which has happened.]

The fossil fuel industries apparently failed to take notice, although some of them have lobbied governments to ignore these warnings, and funded so-called "sceptics" to undermine public confidence in the scientific results and warnings. These so-called sceptics have not been genuine sceptics in that they have questioned the middle to high end of the uncertainty ranges while uncritically endorsing the low end. The sceptics and the companies that have supported them have failed completely to take a risk-management approach, preferring that the problem would go away and denying its very existence. This is rapidly becoming counter-productive for high emissions industries as they will soon find their assets stranded and face financial ruin. These companies will only survive by changing their ways and rapidly investing in low-carbon technologies. If they fail they have only themselves to blame.

Several studies in the United States and elsewhere have demonstrated that large scale renewable energy industries create more jobs than are created with new investments in fossil-fuel industries. Modern fossil fuel and nuclear power industries tend to be more capital intensive and centralised than renewable energy industries. The latter tend to be more widely dispersed and better suited to Australian conditions.

The car industry is a case in point. My grandfather was a coach builder, but in later life had to change employment as motor cars took over. Now we have a motor car industry that is far bigger, but now in a downturn, in part due to its reliance on oil, which rose remarkably in price in the last few years. With the realisation that oil supplies are limited and are likely to rise in price again once the recession eases and demand increases, and because of the present financial insecurity, many people are not replacing their cars. Now most major car companies are developing hybrid or all-electric cars that will be more economical to run and more environmentally-friendly. Cars propelled by compressed air are also coming on the market through start-up companies in the US (Zero Pollution Motors) and Europe (MDI) and Tata Motors in India. In Australia the development of new more environment-friendly models has been slow and the industry is in difficulties. Moreover, the demand for public transport is rising rapidly, and new toll roads are not meeting financial expectations.

Up to a point the free market is responding to the financial and environmental crises in the correct way, with sales of fuel expensive cars down, and demand for mass transit up. However, this is being frustrated by existing subsidies for fossil-fuel intensive industries and transport, their market dominance and dominance regarding infrastructure, and a lack of investment and incentives to change. Lack of good public transport in outlying suburbs

of our major cities is forcing many people who cannot afford it to rely on two or more cars per family. This is both environmentally and economically unsustainable.

In general, the economic and environmental crises will both ease when proper investment is made in sustainable environmentally friendly industries that will grow and employ more people.

Setting targets

It should be clear from the above that setting targets can only be tentative at present since there are many uncertainties about the rate of climate change to be expected and what is "safe" in the sense that there would be negligible risk of damaging climate change. Certainly the targets need to be ambitious, and the minimum of an 80% reduction by 2050 sits well as a starting point. It may well be that as we learn by doing we find that this can easily be achieved with large scale renewable energy, which will probably be cheaper than many expect. In that case we would of course raise the target to a 100% reduction, or even take CO_2 out of the atmosphere so as to lower the concentration in the atmosphere to even safer pre-industrial values (what IPCC calls an "overshoot" scenario).

If we accept an 80% reduction target by 2050, this obviously suggests an interim target around 2% or more per year between now and then. And as at present global emissions are rising by some 2 or 3% per annum, that suggest we need a target of some 5% per annum below so-called business-as-usual. This is far greater than the target presently proposed by the Government. Obviously, any delays in getting started will increase the rate of reductions needed later, possibly at extra cost.

Furthermore, it is clear that as any further reduction in emissions is desirable, we should ensure that all efforts and means of emissions reduction are cumulative, that is, that a target set in one area does not lower or devalue efforts in other areas. All emissions should be seen as cumulative, not as alternatives. Thus the target in an emissions trading scheme should be the target for participants in that scheme, not a general national target. It would serve little purpose if a target set under an emissions trading scheme meant that emissions permit holders could lower their own targets if others reduced overall emissions, for example by home insulation or using public transport. Such individual actions should not detract from the obligation of large emitters to reduce their emissions.

Let's seize the opportunities!

Within a decade increased investments in fossil-fuel intensive industries will have to be written off. They will be stranded investments. Meanwhile we have the opportunity to invest in many low-carbon industries, some well-proven but not yet scaled up to the point where they are competitive with fossil fuels. Any policy to reduce greenhouse gas emissions must be directed at encouraging investment in the technologies of the future, and this is best achieved through whatever instruments will put an additional cost on fossil fuel usage and increase the scale and improve the technology of low-carbon alternatives. I have listed above many such initiatives. They are all part of a portfolio of

actions that together can achieve a breakthrough to a low-carbon technology with greatly reduced greenhouse gas emissions. This is imperative for economic and environmental reasons, and will increase employment in sustainable industries. I urge the committee to adopt such a broad-based policy and to support all the necessary policy components to make it happen.

While many energy-saving and renewable energy technologies are proven at the local scale, their large-scale development and rapid technological evolution will lead to rapidly improving economic competitiveness. Large reductions in the cost of renewable energy have occurred in recent decades and these reductions will continue.

Moreover, further changes in the global economy and in the scientific understanding of the rates of climate changes and their perils will necessitate an adaptive approach. This would be driven by a process of learning by doing. We cannot afford not to act. Action and supportive legislation must remain capable of rapid adaptation to changing circumstances. No single piece of legislation will suffice. We need a suite of measures, closely monitored for their effectiveness. This is urgent. Our country's future depends on rapid action to curb greenhouse gas emissions.