

CARBON ABATEMENT SUBMISSION – 2009 Senate Inquiry

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Submitted as MS Word document to climate.sen@aph.gov.au

PRECIS part 1:

I submit here a detailed response to the terms of reference of the Senate Inquiry. Briefly, my answers are (in **bold**):

1. On the choice of emissions trading as the central policy to reduce Australia’s carbon pollution, taking into account the need to:
 - A. reduce carbon pollution at the lowest economic cost.
It won’t even go close.
 - B. put in place long-term incentives for investment in clean energy and low-emission technology.
It may, but depending on how stretched the ‘long term’ is.
 - C. contribute to a global solution to climate change.
No. It hasn’t a hope of doing that.
2. the relative contributions to overall emission reduction targets from complementary measures such as renewable energy feed-in laws, energy efficiency and the protection or development of terrestrial carbon stores such as native forests and soils;
These may help, but political compromise will probably stifle them.
3. 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;
As the 2020 and 2050 targets fall well short of what precautionary scientific opinion is urging on national governments everywhere, this is unlikely even if the targets are met. But the nature of the cap and trade system predetermines that they almost certainly will not be in any case.
4. an appropriate mechanism for determining what a fair and equitable contribution to the global emission reduction effort would be;
Carbon taxation.
5. whether the design of the proposed scheme will send appropriate investment signals for green collar jobs, research and development, and the manufacturing and service industries, taking into account permit allocation, leakage, compensation mechanisms and additionality issues;
Hardly likely, though it will almost certainly generate a huge amount of work and income for lawyers.

6. any related matter.

See below.

PRECIS part 2:

THE POLITICS, ECONOMICS AND SCIENCE UNDERPINNING THE NEED FOR TRANSITION TO A GREENHOUSE –NEUTRAL ECONOMY FOR AUSTRALIA.

(For ease of reference, I have submitted this précis and the full document in numbered point form.)

A. A CASE FOR ADOPTING THE PRECAUTIONARY PRINCIPLE ON CLIMATE CHANGE, AND FOR TREATING IT AS A MATTER OF URGENCY.

1. The present federal government, for what I believe is perfectly understandable short-term political caution, is not treating the climate situation and the potential global catastrophe offering with nearly enough urgency.
2. I begin by recognizing that there is some inevitable uncertainty in the scientific community regarding anthropogenic global warming. Nothing in science is ever absolutely certain. However, indications are that a majority in the world meteorological community, and an overwhelming majority in the climatological community, regard anthropogenic global warming as good as proven. Professor Ross Garnaut acknowledges this. It appears that a majority of Federal Cabinet do not, and particularly those in the key relevant ministries.
3. The atmosphere is clearly warming, and it is a matter of urgency.
4. There is not all that much air around the planet, and by comparison with the watery oceans, it is easily polluted. CO₂ levels in the atmosphere now stand at 387 parts per million (ppm), up almost 40% since the start of the industrial revolution and the highest for at least the last 650,000 years. We need to lower this to 350 ppm in the view of many experts, to keep the planet safe from possible runaway climate change.

B. CAN GEOSEQUESTRATION OF CO₂ SAVE AUSTRALIA'S COAL INDUSTRY?

5. In brief, no. I give detailed reasons as to why not. Not only can it not succeed in its aim of burying carbon forever, it would be folly if it could; for perhaps only 100 or so years' time, humanity will need the carbon dioxide for plant food material. By then Peak Oil will be past and Peak Coal will be creating shortages of carbon, the principal reducing agent for the smelting of iron, and the principal fuel for thermal power stations.

There are better investments than CCS, as many companies which have got into it and out again will testify.

C. HOWARD'S POLICY OF DENIALISM VS THE RUDD-WONG OPTIMISTIC MINIMALISM.

6. The response of the Rudd government to this situation has only been marginally better than that of the previous government of the Liberal Prime Minister John Howard, which was as we all know, based on climate change denialism. By meagre contrast, PM Kevin Rudd and Minister Penny Wong practice what we might call a form of optimistic minimalism. That is, doing the barest minimum to head off the danger of runaway climate change, but with maximum optimism, and hopes of minimal antagonism generated in the voting public. This contrasts with the policy advocated by an increasing number and by far the majority of atmospheric scientists, who display high levels of concern, and who are now warning us that runaway greenhouse is fast approaching and that we have less time than they originally thought to get things right. If we do get into a runaway greenhouse situation, we know it will remodel our planet's climate disastrously for us.
7. A 5% reduction of emissions by 2020 – about half of one percent per year from a base of the 2009 level, is woefully inadequate tokenism in the face of the present danger; which I stress again lies in the *probability* that the climatologists and other climate alarmists are right.
8. By our industrial activities, we the human species have been transferring carbon from the sedimentary strata below to the atmosphere above and around us. In time, that carbon will move back to the biosphere via photosynthesis, from whence it originally came however many millions of years ago. But because the carbon is being moved to the air faster than natural systems can remove it (hence the 1 ppm per year rate of accumulation) there are unwanted side effects, like increasing ocean acidity, global warming and others we may not yet know about. These are all too likely to spell disaster for world civilisation. The task before the concerned governments of the world is to slow down the rate at which CO₂ is added to the air sufficiently for the natural removal systems to gain the upper hand again. Inescapably, that means a massive reduction in the burning of fossil carbon and its replacement with carbon neutral (whole plant) biofuels and other carbon and energy sources.
9. In a market economy, that means using cap and trade regulations or the tax system to make fossil carbon sufficiently more expensive as to reduce its use eventually to about 10% of present levels. This I would emphasise, is a transition we will have to make anyway in the lifetime of a baby born today, because fossil fuel is finite and running out.
10. Carbon taxation is the best way to achieve this.
11. The task for the government on the international stage is one of avoiding being seen as a greenhouse shirker. Because in the (too likely) event of climate change producing increasingly savage outcomes in the short to medium term, Australia is equally likely to become the target of economic retaliation designed to bring this country to heel, particularly as Asia's water supplies disappear with the retreating glaciers.

C. THE TRANSITION TO BE BORNE IN MIND: AUSTRALIA MASSIVELY RESTRUCTURED

12. To be safe, in the next 40 years, the world has to pull its fossil fuel consumption back to 10% of what it is today. For Australia, this means an economic transformation greater than any before, including the 19th C gold rush, the rise of the pastoral industry or post WW2 reconstruction.

13. The revenue raising (cap and trade or taxation) has to be capable of getting us there, be generally perceived as fair and equitable, and have the simplest possible mechanisms for detecting and penalizing rorting and corruption .
14. Business as usual is the alternative to transforming the economy along such lines, and if followed, will arguably remain in until its own heat death. Those still around will watch Australia gradually turning into a sun-baked desert country of dwindling plant and animal life, whose citizens face ever diminishing quality of being.
15. The global political challenge: What we should be doing is finding a position just in front of the frontrunners of the pack and leading from there.

END OF PRECIS

CARBON ABATEMENT SUBMISSION; SENATE INQUIRY 2009

THE POLITICS, ECONOMICS AND SCIENCE UNDERPINNING THE NEED FOR TRANSITION TO A GREENHOUSE –NEUTRAL ECONOMY FOR AUSTRALIA.

A. A CASE FOR ADOPTING THE PRECAUTIONARY PRINCIPLE ON CLIMATE CHANGE, AND FOR TREATING IT AS A MATTER OF URGENCY.

1. The present Federal Government, for what I believe is perfectly understandable political caution, is not treating the climate situation and the potential global catastrophe offering, with nearly enough urgency. It is behaving as if it believes either that climate change ('so-called') is nothing to worry about, or that if it is, there are more urgent economic problems to attend to, and there is plenty of time to deal with it. The government is behaving like a junta of climate change skeptics out to calm down an agitated and perceivably irrational crowd in the public square.
2. I begin by recognizing that there is some inevitable uncertainty in the scientific community regarding anthropogenic global warming. Nothing in science is ever absolutely certain. However, indications are that a majority in the world meteorological community, and an overwhelming majority in the climatological community, regard anthropogenic global warming as good as proven. [1]
3. In these circumstances, the Precautionary Principle [2] offers the only sensible guide to policy formation. Climate disaster is too likely for comfort and complacency: the problem is not so much one of mere planetary warming, bad as that is, but of Earth facing at some time in the relatively near future a situation of runaway global warming. This sort of disaster may

well overtake the lives of those who are presently children, teenagers, and perhaps even young adults. Professor Ross Garnaut acknowledges this. It appears that a majority of Federal Cabinet do not, and particularly those in the key relevant ministries.

4. Many scientists outside the climatological community have written on this subject and have offered their reasoning and opinions. Two whose names spring to mind are the climate change 'alarmist' James Lovelock (author of *The Vanishing face of Gaia* [3] and Freeman Dyson, [4] prominent physicist and climate change 'sceptic'. Likewise, I am not a climatologist, my scientific training having been in biology. But to me the clearest indicator of global warming is the fact that glacial retreat is now so common as to be universal.
5. In Asia and Alaska, using satellite images and aerial photographic comparison over long time spans, there have been extensive glacier terminus surveys illustrating long term retreat involving no less than 95% of the glaciers. In 2005 there were 442 glaciers examined, of which only 26 were advancing, 18 were stationary and 398 were in retreat: that is, 90% of them retreating. In 2005, for the first time ever, no observed Swiss glaciers advanced. And of the world's 26 advancing glaciers, 15 were in New Zealand. [5].
6. According to a report in the Melbourne Age of 6.4.2009, "up to one-third of all Antarctic sea ice is likely to melt by the end of the century, seriously contributing to dangerous sea level rises, updated scientific modelling on global warming shows... The modelling is the first release of a landmark study being conducted by the global scientific body the Scientific Committee on Antarctic Research, made up of the peak scientific bodies from 23 countries including Australia." [6]
7. I am also a keen skier. In July when it is cold, snow falls and builds up. In October, when it is warm, the snow melts. I have been watching that cycle happen since I was 10 years old. Warming air causes the melting ice and snow in one of the clearest and most regular causal-effectual relationships nature provides. And though I am ever ready to learn one day that someone has written a paper proving that the melting of the snow is what causes the air to warm in Spring, it has not happened yet.
8. The atmosphere is clearly warming. It is now possible to fulfil Lord Franklin's dream and sail the Northwest Passage over the top of Canada from the Atlantic to the Pacific, at least for one month or so in the Northern summer. Possibly within the next ten years ships will be able drop anchor in an essentially ice-free Arctic Ocean, right at the North Pole. That more than anything testifies to the rapidity of global warming, and of the onset of the positive feedback loops that can only further accelerate it. The safest assumption we can make, in short, is that we face a planetary climate emergency, requiring urgent economic reforms on a comparable scale to those which took place in Australia after the declaration of war in 1939.
9. We do not have much time for this. Perhaps as early as 2015, runaway greenhouse may establish. The government acts as if on an assumption that it has plenty of time for whatever action it chooses to take. In that it is possibly wrong. People like Heather Ridout, Chief Executive of the Australian Industry Group and Malcolm Turnbull, Leader of the Opposition, have no trouble making their cases for action on climate change to be deferred. The trouble is, it will never be the 'right time', at least not while there is still time. It will only

10. Carbon dioxide, which is just one of the greenhouse gases being increased in concentration in the atmosphere thanks to human activity, is already having measurable effects on marine life. A panel of 155 scientists from 26 countries and other international groups has called for “urgent action” to sharply reduce emissions of carbon dioxide due to its effects on ocean life. (That is just one of a deluge of scientific papers and communiqués stressing the need for immediate, thorough and urgent action.) This applies particularly to organisms low on the food pyramids, such as the corals and their symbionts, and the effects carry through to a wide variety of ocean life. So completely independent of its greenhouse effect, there is an urgent ocean acidity reason for curbing CO₂ production. [7]
11. The watery oceans cover 72% of the Earth’s surface, and are on average 3.8 kilometres deep. That is, 3,800 metres. The atmosphere can also be regarded as something of an ocean, but one covering all of the Earth’s surface. If condensed to the liquid state, the atmosphere would only be 12 metres deep. That is the depth of the ocean of liquid air that would form if say the Earth were somehow relocated to an orbit beyond that of Saturn, where it would have a maximum temperature around – 200C, at which the air would condense to liquid. In short, compared with the oceans, there is not all that much air around the planet. By comparison with the watery oceans, it is easily polluted. That 12 metres of liquid is less than the maximum water depth of Lake George, at least, as it was when it last had water in it. (It was last full about 20 years ago, and is now a dry pasture with cattle grazing all over it.)
12. Scientists at the Mauna Loa observatory in Hawaii say that CO₂ levels in the atmosphere now stand at 387 parts per million (ppm), up almost 40% since the start of the industrial revolution and the highest for at least the last 650,000 years. [8]
13. In the light of the above, I do not find that surprising. We need to lower this to 350 ppm in the view of many experts, to keep the planet safe from possible runaway climate change. As it is put on the website Understanding 350:

“Make no mistake--getting back to 350 means transforming our world. It means building solar arrays instead of coal plants, it means planting trees instead of clear-cutting rainforests, it means increasing efficiency and decreasing our waste. Getting to 350 means developing a thousand different solutions--all of which will become much easier if we have a global treaty grounded in the latest science and built around the principles of equity and justice. To get this kind of treaty, we need a movement of people who care enough about our shared global future to get involved and make their voices heard.” [9]

That is why I am making this submission to this Inquiry.

14. Pieter Tans of the US National Oceanic and Atmospheric Administration has said of the climatic threshold uncertainty:

“Our biggest science problem is that we do not know how strong the climate feedbacks are, or even whether we know all of the ones that are important on decadal and longer time scales... Especially the latter are intrinsically very hard to figure out because they are (by definition) slow, and they could all be working simultaneously, some positive, some negative. Basically, we are playing Russian roulette, with the revolver pointed at the generation of our children and grandchildren.” [10]

15. The carbon dioxide which makes up those 387 parts per million of the volume of the present atmosphere, would make up the same proportion of the liquid depth were the atmosphere condensed the way I have described. One one-millionth part of that depth of 12 metres is approximately one one hundredth of a millimeter, or 0.01 mm, which is almost exactly the thickness of ‘Glad-Wrap’ polythene wrapping. So if we represent the each part per million of CO₂ in the air with a single layer of ‘Glad-Wrap’ – which is a valid model more or less on a molecular basis – then 387 layers of it, the equivalent of a single polythene sheet about 4 mm thick, roughly equates to all the atmospheric CO₂. That is, the depth of it which would condense out if all other gases were somehow removed from the atmosphere. We are presently adding to that by one thickness of “Glad-Wrap’ per year, and that is having a detectable effect on the Earth’s climate according to the majority of the world’s climatologists. (While I do not equate 0.01 mm of polythene with 1 ppm of CO₂ in the atmosphere in terms of their respective heat-trapping properties, that I suggest is nonetheless a chastening thought for a parent to have while wrapping up a child’s school lunch. Polythene, as it happens, also makes quite an effective greenhouse when used to cover plants: even just a single layer of it.)
16. The Earth’s axial tilt or the obliquity to the ecliptic is 23° 26’. This produces a difference of 46° 52’ in the midday elevation of the sun between midsummer and midwinter, which varies the mean midday maximum temperature in Canberra by 17 Celsius degrees between January and July. Each average degree rise is produced by a ‘slight’ (some might say ‘negligible’) rise of 2.8 degrees in the elevation of the noonday sun. So in the context of that, I think that adding the equivalent of one sheet of ‘Glad Wrap’ per year to the covering of the air will conceivably have an effect along the same lines. How many degrees per sheet, or degrees per part per million of CO₂ is still open to debate, but it is certainly greater than zero.
17. As has been observed by others, we are running an uncontrolled experiment on the planet which will tell us something of what happens as a result of the increases we have seen in our lifetimes in the concentration of atmospheric CO₂ and other greenhouse gases. It is uncontrolled because we are not isolating the factors and dealing with them one at a time while holding all other factors and conditions constant, and also because we don’t have a pristine sister planet to serve as a reference Earth; that is, as an experimental control. If we had such a comparison planet, we could perhaps find out the effect on global temperature of stripping all the CO₂ out of the Earth’s atmosphere. (My money would be on a much colder planet Earth.) Computer models I understand are around that purport to do this, but the best computer for it would be a duplicate planet Earth.
18. Climate change deniers often claim that the Earth has been warmer before, and that the atmosphere has held greater concentrations of CO₂ before. Those claims may in part be

true, but the matter of concern in the climate precautionists' camp is the *rate of increase* of CO₂ concentration, which the biological systems for CO₂ removal cannot keep pace with, and which may well be unprecedented in the entire climate history of the Earth. That rate of CO₂ accumulation is the result of burning in about 250 years the megatonnes of fossil carbon (about 90% of it coal) resulting from millions of years of photosynthesis and sedimentary accumulation, from about the Carboniferous on.

19. Though the climate change deniers whistle in the dark and purport to make merry at our expense, we climate change precautionists have the luxury of being able to say that we wish that the other side in the 'debate' was right. (Or rather say, in what little 'debate' there is left.) They don't seem to mind if the planet gets rattled around in a cup like a die and cast out on the gaming table. We do.
20. In the last analysis, it's that simple. Which brings me to what we might do about it, and inevitably therefore, to the carbon geosequestration issue; the dice throw on which the Howard and Rudd governments have bet so many of the nation's chips.

B. CAN GEOSEQUESTRATION OF CO₂ SAVE AUSTRALIA'S COAL INDUSTRY?

21. Geosequestration (otherwise known as 'clean coal technology') is seen by coalmining interests and both sides of politics as the hope and salvation not only of the coal industry, but of the biggest part of the country's foreign trade, and therefore of the country financially. Remember please that iron ore exports are useless to their buyers without carbon to smelt them to iron. Greenhouse thus threatens iron ore too.
22. Understandably therefore, geosequestration is soaking up a lot of research money at present. That money could be put to better and more immediate use, and I am not the only person to argue this way. (I am sure that the futility of geosequestration must even be dawning on its most keen aficionados in the coal and iron ore industries, though that probably will not inhibit them from accepting government handouts. Not even the most free-market fundamentalist Wall Street bankers these days are averse to taking government taxpayer-funded handouts.)
23. The following is from Andrew C. Revkin of the New York Times:

Many experts say that neither the original [US] plan nor the revamped effort, nor the few [geosequestration] projects underway in other countries, are sufficient to set the stage for pumping tens of billions of tons of compressed carbon dioxide into the earth or sea bed starting 10 or 20 years from now.

Vaclav Smil, an energy expert at the University of Manitoba, has estimated that capturing and burying just 10 percent of the carbon dioxide emitted over a year from coal-fire plants at current rates would require moving volumes of compressed carbon dioxide greater than the total annual flow of oil worldwide — a massive undertaking requiring decades and trillions of dollars. "Beware of the scale," he stressed. [11]

24. I have written a long article on this under the title *The Future of Carbon*, in which I have independently arrived at much the same estimate as Smil, and which is on my blog site [12].

- To put it in a nutshell, geosequestration involves each year pumping huge masses of liquid CO₂ into deep rock strata. (To dispose of all industrially produced CO₂, we are talking tonnages of about three times the total tonnage of coal, petroleum and gas consumed per year). The captured CO₂ gas has to be pumped at around 100 atmospheres pressure down shafts drilled to about a vertical kilometer into subterranean aquifers or the seabed. There is no question as to its technical feasibility on a small scale, but at the industrial scale required is another matter again.
25. However, all the available space down in the possible aquifers is presently occupied either by the material of the rocks, or by the liquid that saturates them, which is in most cases water. As liquids are incompressible, the fact that the CO₂ can be pumped down at all means that water is being displaced out of its way. In other words, whatever liquid is presently down there has to be free to go somewhere else than where it presently is.
 26. It would be different if CO₂ were insoluble in water, and could be stored underground as gas or liquid over water, as the insoluble hydrocarbons are stored in natural deposits. But unlike hydrocarbons, CO₂ is reasonably soluble in water. (The solution is commonly known as soda water.) The hope of the geosequestrationists is that in the long term (over thousands and probably millions of years from the time of sequestration) the CO₂ will slowly react with iron and magnesium compounds down there to form permanent mineral deposits bonded into the rocks. What we do not know is whether or not that happens, and on what time scale. But long before that might happen, the dissolved CO₂ will too likely have managed to migrate through the aquifer rock to reach the ocean at an underwater outcrop of the aquifer. For as I said, if the CO₂ can be pumped down, some liquid is moving to make way for it, and it all surely has to go somewhere. Just where is uncertain, but scientific perceptions are resting in too large a part on the economic needs of coal and steel interests for us to have unreserved confidence in them.
 27. Australia's coal burning power stations and iron and steel plants are located relatively close to the coast, as are its coal mines. This fits in by and large with the global pattern for location of major coal burning facilities. The economic imperatives of pumping all the CO₂ they produce down into the sedimentary strata below as liquid mean that the geosequestration sites should ideally be as close to the coal burning sources of CO₂ as possible, which thus means close to the coast: giving the CO₂ minimal distance to migrate through the rock in order to emerge into the seawater, where there is already too much of it. This threatens to make the proposed carbon geosequestration one of the greatest follies of all time, and a monumental waste of money.
 28. But wait. There's more: Perhaps only 100 or so years from now, humanity will need the carbon dioxide for plant food material, as by then Peak Oil will be past and Peak Coal will be creating shortages of the principal reducing agent for the smelting of iron, and the principal fuel for thermal power stations.
 29. A disclosure at this point: I own BHP shares, so in a way I am operating against my short term financial interest here. But I believe that I am operating in the far more important longer term interest of the biosphere, of which I, those dear to me, and anyone reading this cannot help being a part. The best information I have seen indicates without a shadow of a

doubt to my mind that a government policy based on the hope that geosequestration will save the coal industry is a chase after a complete illusion.

30. The carbon we use as fuel was sequestered after the rise of the land plants, the first fossils of which appear in sedimentary rocks of Silurian age (laid down between 443 and 417 million years ago.) But the period of geological time that stands out for coal formation is the Carboniferous (354 to 290 million years ago), there followed, as the race callers say, by the Permian (290 to 248 million years ago). The formation of coal, oil, natural gas and limestone are processes which have never ceased, and can be seen still going on today.
31. Nothing on the face of the Earth or under it is static; everything material is part of some cycle or other. We reading and debating members of the human species are not just passive spectators in the drama of birth, death and decay; we actively intervene in all known processes, and sometimes not even consciously.
32. How much carbon is in the coal, as distinct from the rocks generally? There are 909 gigatonnes (Gt), of which 479 Gt are high grade (bituminous coal and anthracite) and 430 Gt are sub-bituminous and lignite (ie brown coal). The world's remaining oil deposits contain another 130 Gt, and natural gas another 110 Gt. As the mass ratio of the carbon in CO₂ to that of the whole molecule is 12:44, considerably more CO₂ by mass will be produced as compared with the mass of fossil fuel burnt; particularly for coal, which is 50-80% carbon. (The carbon statistics above are from a Columbia University source cited in *The Future of Carbon.*) [13]
33. The remaining coal reserves contain 79% of the fossil fuel carbon, the oil reserves 11%, and the natural gas reserves 10%.
34. The Utsira aquifer in Norway, which is the world's most advanced geosequestration project to date, has shown that it can take one million tonnes of CO₂ produced in the adjacent oilfield in a year. However, this is dwarfed by the just the *increase* of emissions of greenhouse gases from the EU-25, which increase was 18 million tonnes (0.4 %) between 2003 and 2004. Emissions from the EU-15 increased by 11.5 million tonnes (0.3 %) in the same period.
35. That is to say, the increase per year alone is eighteen times the mass of CO₂ injected per year to date into the Utsira aquifer, which helpfully is in close proximity to the CO₂ source: the Sleipner oilfield. Something like Utsira, although impressive in size, might be used for all of Norway's future emissions, but not all of Europe's. That would require a multitude of sequestration sites closer to the points of production.
36. The concentration of CO₂ in the atmosphere is increasing by 0.4% per year, because the natural sequestering systems cannot cope with the Earth's total annual increase in CO₂ production. So the mass of CO₂ that must be sequestered globally per year by other than natural means, just to hold the global atmospheric concentration constant, is 0.4% of the annual global CO₂ production of 3,000 Gt, or 1.2×10^{10} tonnes. When we write that out in longhand, it comes to 12,000,000,000 tonnes per year, or 33 million tonnes of CO₂ *per day*.

37. Australia's share of the task is no trifle either. In 2004-5 Australian total domestic energy consumption was 5,525 petajoules (PJ). Of this, 41 % came from coal, 35% from oil, 19% from natural gas and 5% from renewables. 41% of 5,525 PJ is 2,265 PJ, which translates to 79 million tonnes of coal. If we assume this to be on average 70% carbon, that makes 55 million tonnes of coal, which burned to yield around 200 million tonnes of CO₂ that year; around **560,000 tonnes per day**: the mass that must be buried under Australia if locally-burnt coal is to contribute zero CO₂ to the global atmosphere and ocean problems.
38. Former Prime Minister Paul Keating once said that it is not the role of government to pick winners. However, in some of the most successful economies in the world, such as those of Germany and Scandinavia, governments have long been doing just that. The Australian government has been persuaded by the coal industry and the coal mining unions that carbon capture and storage is a winner, and it has picked it, and it has subsidised it heavily.
39. What I have submitted above shows clearly that CCS is a loser from the very start. The money would be better invested in renewables, and in phasing down coal fired power generation and retraining those workers involved in all stages of that industry. There is no doubt about the long term value of the coal as a feedstock for the chemical industry (including plastics), as the source of the reducing agent for iron smelting, and as a source of road tar. (What we are going to drive motor vehicles on after it is all the coal is gone is an interesting question. And another disclosure: I own shares in the gas producer Santos, which has wisely abandoned CCS.)
40. To my mind, titanium has a big future as a replacement metal for steel. It is the ninth most abundant element in the Earth's crust and Australia is the world's leading producer of it. Research on it to date indicates that future mass production of it will be electrolytic, along the lines of present aluminium production and potentially at around the same cost per unit mass as aluminium. I am sure that money of the amount that is presently being plunged into the boondoggle of CCS would be far better invested in areas like this. Needless to add, the electricity for the production of both aluminium and titanium can be generated in ways other than by coal fire. (Disclosure: I own shares in Iluka Resources, a leading producer of titanium minerals.)

C. **HOWARD'S POLICY OF DENIALISM VS THE RUDD-WONG OPTIMISTIC MINIMALISM.**

41. A 5% reduction of emissions by 2020 – about half of one percent per year from a base of 2009 levels, is woefully inadequate tokenism in the face of the present danger; which I stress again lies in the probability that the climatologists and other climate alarmists are right. Government policy is comparable to the stance of the pacifists in 1939, or to some plan to increase British defence spending by half of one percent per year in response to Hitler's invasion of Poland. But the choice of a cap-and-trade scheme as the vehicle whereby remedy will be brought about makes it almost certain that even that pathetic reduction will not be achieved. As Bernard Keane of crikey.com observed: *The Government scheme will not establish incentives to reduce emissions and will not drive any transition to low-carbon industries and the jobs that will emerge from them. And by offering such an unambitious target it will undermine efforts to establish a global deal that might prevent Australia from suffering the worst effects of climate change, with the employment consequences that will flow from that.* [14] That is putting it mildly.

42. To put the issue in context: By our industrial activities, we the human species have been transferring carbon from the sedimentary strata below to the atmosphere above and around us. In time, that carbon will move back to the biosphere via photosynthesis, from whence it originally came however many millions of years ago. But because the carbon is being moved to the air faster than natural systems can remove it (hence the 1 ppm per year rate of accumulation) there are unwanted side effects, like increasing ocean acidity, global warming and others we may not yet know about. These are too likely to spell disaster for world civilisation. The task before the concerned governments of the world is to slow down the rate at which CO₂ is added to the air sufficiently for the natural removal systems to gain the upper hand again. Inescapably, that means a massive reduction in the burning of fossil carbon and its replacement with carbon neutral, whole plant biofuels and other sources. (Diverting grain into biofuel production is extremely energy inefficient, and an affront to the undernourished of the world. It should be outlawed.)
43. In a market economy, that means using cap and trade regulations or the tax system to make fossil carbon sufficiently more expensive as to reduce its use eventually to about 10% of present levels. This I would emphasise, is a transition we will have to make anyway in the lifetime of a baby born today, because fossil fuel is finite and running out.
44. Cap and trade can be selective, and both sufficiently subtle and sufficiently selective as to be apparently painless to the voter, thereby mollifying any tendency on that voter's part to vindictiveness. Hence its attraction for political parties wishing to win elections. But it is also cumbersome, grossly inefficient, and unlikely to be either rort-free or workable.
45. Carbon taxation on the other hand can be targeted precisely at the real source of the problem, which is fossil fuels, and progressively adjusted to achieve the desired effect. Provided the accounting is completely open, the revenue raised can all be seen to be being spent on greenhouse neutral substitute forms of energy. However it is inevitable that a proportion voters watching the numbers roll on the petrol pump, and perusing their quarterly electricity bills, will be disturbed, upset or even outraged by what they see. In a few countries, the price of carbon neutrality via taxation could well be civil war.
46. At the present time the simplest and easiest way to find out what an industrial plant's CO₂ output has been over any time period is to calculate it from the mass of carbon-based fuel inputs consumed there in that period. Calculating CO₂ output from carbon or hydrocarbon input is effectively the only method guaranteed to be fair, and therefore dispute free. (All the carbon inputs: the gas, coal and petroleum, are measured scrupulously in the marketing process before they reach the furnaces or the engines.) In the unlikely event of geosequestration coming into play and making any difference, net CO₂ release to the atmosphere will be a straightforward calculation from carbon input less that part of the output geosequestered. To base carbon accounting on outputs such as measured CO₂ in flue gases is to open up a real can of worms and create a potential banquet for lawyers.
47. Entitlements to pollute the air must not be exceeded if a system of cap and trade is to work, but as the incentives for rorting are huge, attempts to do so can only be expected. Indeed, the scheme has opened for business with a huge rort in the form of free permits for the major polluters. Moreover, there is no cap and trade system in satisfactory operation

anywhere in the world on which Australia's can be modelled. The paperwork, accounting, policing, inspection and dealing with offenders will make the present GST and BAS accounting look like child's play by comparison. The only mitigating circumstance in the scheme's favour is that it will not cover even half of the CO2 emission sources.

48. Major CO2 sources like agriculture and motor transport both public and private will be left right out of it. Understandably, keeping account and settling disputes over emissions from millions of tractor and car exhausts would create an enormous number of jobs, so one wonders why, if only for that reason, it was not chosen. Cap and trade if applied effectively will, by its very nature, penalize the big emitters but let the numerous small emitters escape. Politically, that looks attractive in many ways. However small emitters like individual farms, motor vehicles, stationary engines and garbage tips produce most of the country's emitted greenhouse gas. This is clear on the government's own website [15] And inherently taxable carbon inputs figure in nearly all such sources.
49. I would stress here that once the country is locked into cap and trade, it will be very difficult to change to carbon taxation with preserved equity and fairness. Those who purchase carbon credits will feel entitled to value for their money, and cheated if their asset is suddenly devalued or rendered worthless by a switch in government policy. The politically most pain-free solution would be along the lines of the US Government's recent rescue of the Wall Street banks: to buy the troublesome assets using huge volumes of the taxpayers' money.
50. Alternatively this sort of problem would not present itself in a future switch from carbon taxation to cap and trade. Taxes are abolished quite frequently and painlessly.
51. I conclude that the Government is looking for what it thinks is the easiest course politically. The alternative to cap and trade is the far more simple, direct and flexible method of carbon taxation, which is easier to set in place, to administer, to vary as circumstances demand, and (judging by the literature for and against that I have read) to make a case for. However, fuel and electricity price hikes resulting from deliberate government taxation policy would give a marvellous opportunity for every populist, climate change denying opportunist commentator in the land to cane the government. (Most of them seem to work for Rupert Murdoch.) But in this connection, according to the *Wall Street Journal* of March 18, no less than the American CEO of the Ford Motor Company, Alan Mulally, has called for petrol to be made *more expensive* by taxation. [16] He gives his reasons in that article.
52. As I see it, the most rational way around such predictable objections to carbon taxation from the Murdochian commentariat and the vested interests they speak for is for the Federal Government to follow a sequential process:
 - (a) start investing significantly in alternative energy,
 - (b) produce some tangible results from it of value to the mass of the population, and then
 - (c) tax carbon inputs to conventional energy generation to cover the outlays.
53. That as I see it would be easy to defend politically, particularly in the light of the hundreds of millions of public dollars already donated to such entities as the private car companies for

- their own use in research and development of their own products. Obvious areas for expenditure of the public revenue are biofuels (where the CSIRO and Monash University have reportedly made significant breakthroughs), high temperature solar, photovoltaic cells, fuel cells, the vanadium redox battery [17], electrolytic reduction of iron and titanium, afforestation projects and sequestration of carbon in soil.
54. The advantage of taxing inputs rather than trying to police, restrict and penalize outputs, as with cap and trade, is that the fossil fuel inputs are easily traceable and accountable through the relatively few points of bulk sale of the coal, petroleum and gas. The money collected can then be spent in the ways outlined above: on alternative energy and carbon sinks. However, for this to work satisfactorily at a political level, the accounting must be totally open. Otherwise, the opportunities for graft and corruption will be enormous.
 55. There will be many opportunities for corruption under cap and trade, but the major political problem will be widespread perception of unfairness as big polluters get set up with all the free permits they want, leaving a minority of medium polluters to carry the can, but avoiding direct imposts on the majority completely. As well, cap and trade will fail to reward those whose greenhouse footprint is negative, such as those who install rooftop solar panels and water heating.
 56. The task for the government on the international stage is one of avoiding being seen as a greenhouse shirker. Because in the (too likely) event of climate change producing increasingly savage outcomes in the short to medium term, Australia is equally likely to emerge as an apologising, coal touting international pariah on the issue, and to become the target of economic retaliation designed to bring this country to heel. Such punitive measures would not cost their users much, and indeed, could be very much to their advantage.
 57. Let us just consider the one important area: Australia's relationship with China. As the Chinese government knows only too well, climate change threatens China's water supplies in two of the three major rivers fed from the snows and glaciers of the Himalayan Plateau: the Yellow and the Yangtze. The flow in these rivers is already diminishing as climate change bites into the mountain glaciers and wetlands that feed them. (China's third great river, the Pearl, is threatened more in its heavily populated delta by rising sea level than by reduced water flow.) China therefore will have to become a leader in GHG reduction, and will likely become poorly disposed to those it perceives as acting cavalierly on the greenhouse gas front. The potential for domestic civil unrest in China resulting from diminished water supplies will probably be enough to push its government towards such an attitude. The Qinghai-Tibet Plateau used to boast of 36,000 glaciers covering an area of 50,000 sq km. In the past 100 years, their area has shrunk by 30 percent. [18]
 58. Trade sanctions, which have already been threatened, will in the absence of countervailing measures elsewhere, produce a fall in the Australian dollar. Ironically this will make the goods we sell to the world such as iron ore and coal cheaper to buy, and with less return for this country. When push comes to shove, nobody much stands to lose by finding reasons to punish Australia for climate inaction.

D. THE TRANSITION TO BE BORNE IN MIND: AUSTRALIA MASSIVELY RESTRUCTURED

59. The scale of the task ahead should not be underestimated or dismissed, as the climate change deniers would have us do. To be safe, in the next 40 years, the world has to pull its fossil fuel consumption back to 10% of what it is today. That means at the one extreme, a tenfold increase in carbon use efficiency, or at the other, a 90% reduction in planetary consumption of coal and petroleum, and of the commodities made involving use of carbon-based fuel. Or something in between amounting to change no less drastic. Without any trade-offs between sectors, that means in turn 90% less iron and steel, 90% less coal fired power, 90% less cement and concrete, 90% less transportation and possibly 90% less aluminium. Supply and demand will have such an upward effect on prices that rationing will be seen as the only fair basis for distribution by an ever increasing number.
60. The revenue raising has to be capable of getting us there, be generally perceived as fair and equitable, and have the simplest possible mechanisms for detecting and penalizing rorting and corruption . (I know of no better example of a system which became by its very nature a by-word for such rorting and corruption than the 'cost-plus' system put in place to finance war production in Australia during World War 2. I have met many who were directly familiar with it, and not one who had a good word for it. Cap and trade could well finish up more notorious.) Popular perceptions are vitally important politically.
61. What follows are some elements of a possible and quite likely future scenario: The Australia we inhabit in 40 years time (I will be 110 years old by then and likely somewhat slower than I am now) will have been changed utterly by comparison with the country we know today, either for the better or the worse. But business as usual is neither a safe option nor likely.
62. Suburban rooves will form a vast sea of photovoltaic cells and solar water heaters. Wind generation towers will be a common sight on hills, mountains and ridges. Large solar-thermal mirrors will be providing the concentrated heat necessary for industrial processes like brick and glass production. Coastlines will be dotted with wave and tide driven generators, many of them completely submerged and out of sight. The Latrobe and Hunter valleys as we now know them will be history, with coal production restricted by worldwide agreement on CO2 output. Electric vehicles, likely made out of aluminium, titanium and plastics, will be humming down roads everywhere, and electrically smelted titanium will be increasingly the material of choice to replace steel for many purposes. The suburban quarter acre block will be hailed as a marvellous example of foresight in town planning, and be the source of much of each household's food, which in supermarkets will be expensive and in shortening supply. Water will be drawn from traditional rain catchments and be supplemented increasingly with water sourced from treated sewage and solar distillation of seawater. Water delivered via the mains will be often severely restricted, and plastic tanks and underground reservoirs will catch the runoff from most rooves. Cotton clothing will be expensive, and so made to last longer than at present, both by design and repair. Restoration of our National Parks will have failed to keep pace with their rate of destruction by wildfire, but controlled burning will be far more frequent, producing a smoke haze over forested regions of the continent for much of autumn and winter, (a phenomenon first recorded by Bass and Flinders in 1796, then due to Aboriginal firestick farming.) The surfaces of Sydney Harbour and of Port Phillip Bay will have risen by 30 centimetres relative to their shores, causing tidal wash problems at the Sydney Opera House. Many fire-resistant crops such as old man saltbush will be grown for their carbon-sequestering potential, and

biofuels will be the main source of carbon-based energy. Flax will possibly replace irrigated cotton for many purposes, and crops will be more restricted in yield and distribution. Irrigated crops and horticulture will be based increasingly on drip and single plant irrigation, as they are in Israel. If cattle and sheep are still around, they will be living in symbiosis with benign, non-methanogenic gut bacteria. Aircraft and ships will receive preferential concessions for fossil fuel use, made up for by reductions in other areas of the economy where substitutes are more readily used. At the same time, most coal production will be for feedstock for the roadsurfacing, synthetic rubber and plastics industries.

63. Fossil fuel prices will have risen so far as to reduce consumption by 90%, necessitating in turn much rationalization of fossil-fuel burning transport. Smart meters will regulate household and business power consumption. There will be at least a 90% increase over today in carbon-neutral home and water heating, as well as cooking, with electricity used for boosting the hot water tanks to optimum temperature rather than heating them the whole way. Price increases for containers made of glass, aluminium and steel will favour redesign of those so that they can be refilled and reused, or else phased out.
64. Business as usual is the alternative to transforming the economy along such lines, and if chosen, will remain in place until its own heat death. Those still around will watch Australia gradually turning into a sun-baked desert country of dwindling plant and animal life, in which frequent gang warfare settles disputes over food and fuel, and whose citizens face ever diminishing quality of being. There is a country in Africa like that, whose people live in desperate squalor today. Their ancestors however, enjoyed a much more prosperous life. Greek merchants and traders went there in ancient times in order to purchase myrrh and frankincense, which were extracted from the *Commiphora* and *Boswellia* trees which grew in the country's then more far abundant forests. Both of those substances were highly valuable commodities, required for many perfumes and religious ceremonies, and were in great demand throughout the Roman Empire, Asia, India and China. As the Gospels tell it, myrrh and frankincense were presented by the Wise Men of the East to the newborn Jesus.
65. In the year 1331, a visitor had this to say about the capital city and its people: *It is a town endless in its size. Its people have many camels, of which they slaughter hundreds every day, and they have many sheep. Its people are powerful merchants. In it are manufactured the clothes named after the city, which have no rival, and which are transported as far as Egypt and elsewhere.*
66. In case you have not already guessed, the city referred to was Mogadishu, capital of the now failed state and poverty-wracked desert country known as Somalia. It did not descend to its present level through climate change alone, or in the manner that now threatens Australia. But it provides us none the less with a chilling look into a possible Australian future if we do not deal properly with global climate change. [19]
67. The moral: enjoy the view of contemporary Australia while it lasts, because if nothing serious is done about the probably forthcoming catastrophe and the highly probable part that atmospheric CO₂ will be playing in it, contemporary Australian reality could turn rapidly to a fond memory, providing some relief perhaps from an awful actual situation. The country we know, which has developed over thousands of years of Aboriginal prehistory, colonial times, two world wars and postwar immigration could well turn out to be but a

- transient illusion. Much of it faces replacement by a sun-blasted and dried out reality beyond the imagination even of a poet like Dorothea MacKellar, and taking hundreds if not thousands of years to restabilise ecologically and climatically. Refugee politicians and their descendants will seek their place out of the sun of course, but not on this continent: more likely in cooler, better watered locations like Macquarie Island and the shady side of Mount Erebus. The Australia portrayed in the *Mad Max* films was the result of imagined nuclear catastrophe, but the greenhouse variety would have served its makers just as well.
68. The global political challenge: Australia under the Howard government was rightly held up to scorn and ridicule internationally for refusing to sign the Kyoto Accords. However, a policy identical to Howard's in all but in name is being followed today by the Rudd government, which is timidly making any action on this country's part conditional on what other nations do, trying so to speak, to lead from the rear.
 69. What we should be doing is finding a position just in front of the frontrunners of the pack and leading from there. Let me stress that: *just in front*. To borrow a term from the *Tour de France*, we should move to a position at the front of the *peloton* and try to stay there for the duration of the event, not bring up the rear and hope that a last minute charge through the field will enable us to snatch a credible result in the race.
 70. So in the light of whatever reduction in per capita CO₂ output has been achieved by the best in the world, we have to just exceed it to have the best political credibility, and challenge the world to play leapfrog with it from there. We need to put in a performance the rest of the world can admire, and we (for a change) can be proud of. We should progressively improve our greenhouse record in such a way as to work our way up the ladder into first place, and hold that place by the smallest margin possible. If the rest of the world drags its feet we will go down anyway; but we cannot afford to give the rest of the world an excuse for doing so.
 71. Tariffs and other economic penalties will be imposed on shirkers as the climate situation deteriorates. The way things are shaping up, we stand to have them imposed upon us by some we would trade with. But whatever we choose, cap and trade or taxation, our citizenry will become just as vindictive towards shirkers as any in the world.
 72. However I expect that on performance to date, and under the inevitable self-centred and short-sighted lobbying and pressure from vested interests, Australia's government will try to stay on the cap and trade path. It will be a miserable and tokenistic failure, but cheered to the bitter end by the lawyers who make their fortunes from the voluminous litigation in the Federal Cap and Trade Court. It cannot by its very nature be otherwise. But when it finally becomes completely unworkable and goes down, we will likely find that our solar and other renewable industries will not be in a position to replace even a fraction of our export income from coal, and with the coal industry at the same time an unreconstructed shambles. Geosequestration, finally abandoned because it forced up the cost of coal and its derivatives too far, will be an item in *The Guinness Book of Follies*. Neither in this country nor in those we have tried to sell the combination of coal and geosequestration technology will there exist viable markets for either.

73. However, by that time the main concern for the country may well be not be how to sell coal, but how to deal with the waves of Bangladeshi and other SE Asian climate refugees braving the sea crossing to seek refuge in Australia.

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END OF SUBMISSION