# REVIEW ARTICLE

# POLICY ON 'CATASTROPHIC' CLIMATE CHANGE


## Barry Naughten


**Review of:**

Frank Ackerman, 2009, *Can we afford the future: the economics of a warming world*, Zed Books, London and New York, $35

Garnaut, R., 2011, *Garnaut Climate change Review — Update 2011, Update Paper one: Weighing the cost and benefits of climate change action. www.garnautreview.org.au*

John Quiggin, 2008, 'Uncertainty and climate change policy', *Economic Analysis and Policy*, vol. 38, no. 2, pp. 203-10. *http://www.realclimateeconomics.org/uncertainty_and_risks.html*

We clearly face a crisis in Australian 'climate politics'. The three major contributions considered in this review article offer materials for a re-framing of this debate so as to put the main focus where it should be: on averting a multi-dimensional ecological catastrophe facing our children and grandchildren.

Frank Ackerman's thesis has two key elements insufficiently prominent in our recent climate debates. The first is the necessity to avert extreme climate events that could be catastrophic to human civilisation. The second is his case against misuse of cost-benefit analysis and discount rates in conceptualizing policy responses. Ackerman's book[1] provides a

1 In the broader context of critical political economy, a shorter form of Ackerman's argument is in the useful anthology edited by Driesen (2010).

critical economist's perspective but is also important to the campaign because of its accessibility and clarity, including to non-economists.

The other two contributions, by Australian economists, share the elements of Ackerman's twin thesis. Following Ross Garnaut's 2008 Review, the main focus here is on the first of his series of Update Papers published during early 2011. John Quiggin's paper is an argument about the connection between climate policy and climate science, drawing on his long-standing, innovative focus on the economic analysis of risk and uncertainty[2].

Ackerman is involved in *Economists for Equity and Environment* (*www.e3network.org*). This web-site complements his book and includes important downloadable papers substantiating his twin thesis, notably Quiggin's published article. Garnaut's 2008 Review and his 2011 Update Papers are readily available on-line.

Ackerman's critique, like Garnaut's review, extends to some leading scholars from mainstream economics who have addressed climate change, especially the senior Yale economist William Nordhaus (2008). Ackerman is somewhat more supportive of Nicholas Stern, whose major report to the UK Treasury (2007) has been subjected to theoretical criticism by other mainstream economists including Nordhaus.

Readers may want to connect Ackerman's arguments with those in the previous issue, devoted to the political economy of climate change (*JAPE* 66, 2010-11). This is part of a broader and necessary productive debate within 'progressive environmentalism'.

## Political Context and Essential Re-Framing of the Australian Debate

Prompted by the Greens and three independents following the 2010 Federal elections, the Australian Government has renewed its commitment to action on climate change. A fixed price on 'carbon' has been announced as a step towards a tradable emissions scheme. This has meant political polarisation given that the Opposition under Tony Abbott has been allowed to get away with his wild swings between outright

2 See also Quiggin (2005). He has published other articles on climate change policy not considered here.

denial ('climate change is crap!') and token acceptance of climate science, tailored according to his audience[3].

For the Government and other proponents of abatement action this policy debate has not been going well. In their campaign, these proponents of mitigation have not sought sufficiently to 'frame' the debate so as to highlight the damage from 'dangerous' climate change and the benefits from averting that damage. Instead, the debate has been largely fought out on the opponents' favoured ground, focusing almost entirely on the costs of such abatement, how these should be borne and with what policies ('a great big tax'). Among proponents of mitigation, there has been too much wishful thinking around the vague proposition that 'we are all believers now' in human-caused climate change[4].

The three sources reviewed here together offer important contributions toward a paradigm to reframe the debate, rectify this shortcoming in the science-based campaign for climate change mitigation, and expose Abbott's demagoguery and cynical opportunism.

Opponents of action on 'dangerous' climate change have asserted that Australia should not be 'taking the lead' in global mitigation and that any such allegedly 'unilateral' action would be ineffectual. This claim fails to take account of the lagging role that Australia has had to date relative to

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3 On Abbott's own climate change, see the sharp characterisation by former Coalition leader Malcolm Turnbull (2009). Abbott, the demagogic spin-doctor, now (Owen 2011) says he is "… all in favour of doing the right thing by the environment because we've only got one planet, and we've got to look after it, and we've got to hand it on to our kids and grandkids in better shape than we found it. But we have to do it in ways that don't make the life of ordinary people worse."
The final sentence in this rhetoric is essentially the same as President GW Bush's impossibility condition (Hunold & Dryzek 2002) essentially ruling out anything but token action to abate greenhouse gas emissions. No economically literate commentator suggests that the kind of abatement necessary can be obtained without cost. But Abbott has been allowed to conflate the issue of real resource costs with that of a tax such as a carbon tax, which is essentially a transfer and revenue from which can be used to reduce taxes elsewhere in the economy (implying no necessary deadweight loss) and/or to compensate, for example, vulnerable lower income energy consumers. See further discussion below.

4 Garnaut's Update Paper five, addressing the science of climate change, confirms this where he notes that: "Despite the increased scientific understanding of climate change, and confidence in the science's conclusions about climate change, public confidence in the science seems to have weakened somewhat in Australia and some other countries since 2008".

states like E.U. members, other non-U.S. OECD states and even China. It also ignores Garnaut's conclusion that 'Australia has a greater interest in a strong mitigation outcome than any other developed country' (2011: 6). Australia is also globally the highest *per capita* $CO_2$ emitter due to its high dependence on coal-fired electricity and its prodigal use of energy. Further, as an affluent and growing economy immune to the worst effects of the GFC, it has a higher capacity to pay than most OECD countries.

## Global Emission Targets and Atmospheric Stabilisation Levels

Economists vary as to their perspectives, derived from climate science, about future feasible and necessary limits on greenhouse emissions and corresponding implications for global temperature rise (Smith 2011: table 1). For example, compared with the pre-industrial level of 280 ppm (parts per million) of $CO_2$ equivalent, the target proposed by Nordhaus is the least demanding in terms of mitigation effort, at 745 ppm by 2100.

Stern's specified limit (2007: 265) was to stabilise at 550 ppm by 2050. Part of his stated reason at that time for not targeting 450 ppm was his concerns about the economic consequences of pursuing a target that stringent (2007: 276). However, this assessment is not easily commensurable with the relatively insignificant cost attributed to meeting his then preferred much less ambitious target of 550 ppm.

As regards the 450 ppm target, Garnaut also argues that Stern is unnecessarily pessimistic about the scope for markets with $CO_2$ priced, and R&D policies, to induce required technological progress in ways that have been observed historically[5]. In his Update Paper seven, Garnaut is able to cite significant technological progress made since 2008.

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5 In his *The Free-market Innovation Machine*, William Baumol (2002: 1) notes that mainstream economic theory has strangely neglected the role of markets in revolutionizing technology. He observes ironically that it was Marx and later his bourgeois equivalent Joseph Schumpeter who were fully cognisant of this central role of markets. However, he had also acknowledged that entrenched capital can profoundly inhibit technological progress (Baumol 1990). This obstruction is well exemplified by the abysmal performance of Detroit in recent decades leading up the quasi-bankruptcies of 2008-09, with its ultimately self-defeating lobbying efforts to oppose both tighter U.S. regulation of vehicle energy efficiencies and higher transport fuel tax rates (Goel 2004). By extension and contrary to this latter

Levels of both comfort and necessity about a target as low as 450 ppm are motivated by a widely shared concern that an associated 2 degrees Celsius of global warming is the upper limit of acceptability (Department of Climate Change 2007-08: 14). Garnaut had noted (2008: 280-1) that:

> there are advantages to Australia if the world commits itself at some time to a credible agreement that adds up to the objective of 400 ppm [$CO_2$-e]. This would require agreement on and progress towards a 450 objective, with a subsequent lift in ambition.

More ambitiously (if not central to his main argument), Ackerman (2009: 92) focuses on 350 ppm, less than the present level of 390 ppm which is itself probably the highest level for millions of years.

## CBA: Flawed Framework for Economic Analysis of 'Dangerous' Climate Change

Averting climate change may appear to be a problem suited to the standard economists' technique of cost-benefit analysis (CBA). In such a framework the main *costs* would be those of emissions abatement while the corresponding *benefits* (net of adaptation costs) would reflect longer-term future damage avoided by this investment in mitigation. Purely illustrative paths[6] in such mitigation costs together with benefits of climate change averted over a period of 100 years are indicated in Ackerman's figure 2.1.

CBA can be a component part of so-called 'integrated assessment' models such as those of Nordhaus. These models attempt to capture ('endogenise') within one single ambitious framework the interactions between (i) technologies and policies abating greenhouse gas emissions;

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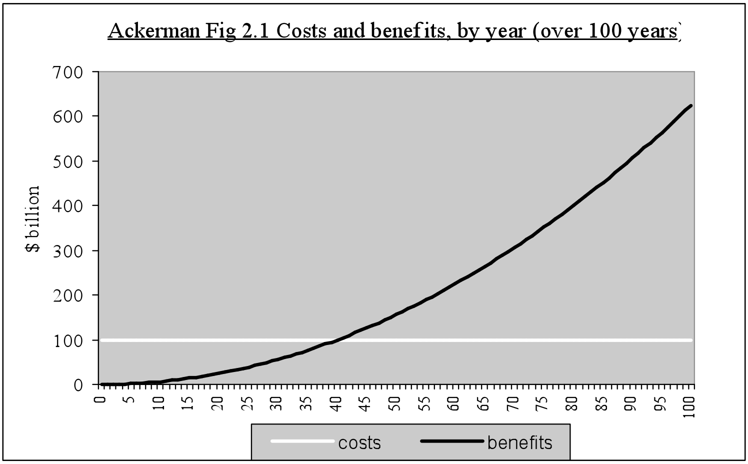
experience, human influence on technological change can occur through the 'social embedding' of markets, the pricing of emissions being a case in point. See Garnaut's Update Paper Seven on low emissions technology and the innovation challenge.

6 This comparison is illustrative or 'heuristic' only. For example, Ackerman's curve representing benefits of damage costs averted rises over time according to a simple quadratic function while his abatement costs are assumed to be constant over time. This smooth benefits curve by no means seeks to capture the very high averted costs that might be associated with 'catastrophic' climate change as discussed below.

(ii) climate damage thus averted, and (iii) adaptation to residual climate change. These models do so over relevant very long future time periods of 100+ years.

As applied to policies to avert climate change, Ackerman strongly questions the validity of the cost-benefit framework. Among economists he is not alone in this. As we shall see, economists of the stature of Jeffrey Sachs and also Garnaut take a similar view.



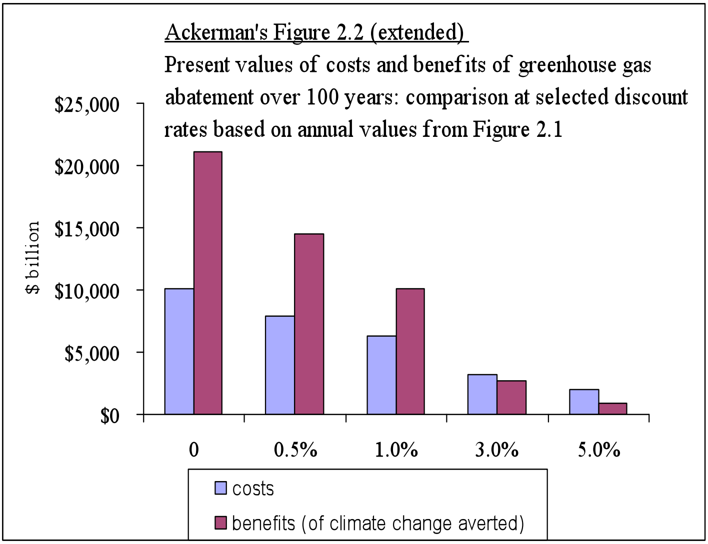

The first of Ackerman's objections to CBA is that many key damage costs, and consequent benefits from their mitigation, are both potentially large and difficult to quantify or evaluate, to the point of impossibility.

A second concern stems from misuse of the discounting process and discount rates in the CBA in existing analyses of climate change policy. As Ackerman says, (2009: 18):

> the choice of discount rate becomes decisive for the whole analysis. It is not an exaggeration to say that the discount rate is the most important single number in climate economics.

In particular, a bias is imposed because the damage from climate change grows over time and its most severe impacts would be on future generations. But the discounting of both mitigation costs and benefits of climate change averted means that net present values of policy action (benefits minus costs) can be radically reduced or even made negative.

This sensitivity is illustrated[7] in Ackerman's figure 2.2. For any discount rate of 3% or more in this case, the discounted net present value of costs exceeds the benefits of greenhouse gas abatement. That being so, if normal CBA principles were followed, mitigation policy would not be recommended in this simplified illustrative example.




For the lay-reader, Ackerman provides an excellent primer on the various purposes, rationales and interpretations of the discounting process. But these are by no means settled issues among economists.

There is little argument that discounting in economics is, and should be, about *efficiency* in the allocation of resources over time. However, it is

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7 Ackerman's diagram is here enhanced to include the important case of a zero discount rate as classically discussed by Ramsey (1928). But note that this comparison as presented is influenced by ignoring costs and benefits over the period beyond 100 years. Inclusion of later periods will of course significantly affect the illustrative comparison at the very low discount rates.

often assumed, very questionably, that discounting can also be used to address the quite distinct question of intergenerational *equity*. Ackerman convincingly argues that discounting does not function to ensure intergenerational *equity*, especially over the very long period that is so central to the problem of climate change. The identities of those who might bear much of the cost of climate change mitigation (the present generation), may overlap with, but are also distinct from, those bearing much of the damage and risks of climate change. His chapter heading sums it up: 'your grandchildren's lives are important'.

The 'integrated assessments' of Nordhaus exemplify this misuse of 'market-related' discount rates in addressing both intertemporal efficiency and intergenerational equity. Nordhaus concludes, not surprisingly, against urgent and significant action to abate greenhouse gas emissions, adopting instead a 'wait and see' attitude supposedly pending more definite scientific findings. On this basis, Nordhaus specifically rejects the urgency of abatement action underlined in Nicholas Stern's analysis which incorporates a significantly lower discount rate than that of Nordhaus. As cited by Michl (2010: 542), his critical (and colourful) comment is as follows (Nordhaus 2007: 642):

> The [Stern] Review takes the lofty vantage point of the world social planner, perhaps stoking the dying embers of the British Empire, in determining the way the world should combat the dangers of global warming. The world, according to Government House utilitarianism, should use the combination of time discounting and consumption elasticity the Review's authors find persuasive from their ethical vantage point.

The dispute should not be simply around the *level* of discount rate. As noted above, the more fundamental point is that discounting is no way to deal with the problems of intergenerational equity and long-term sustainability of human civilisation due to climate change; and a corresponding objection can therefore be made about the technique of CBA. But as Ackerman notes, even Stern is not exempt from retaining the CBA approach.

Yet, as will be argued later in the present review article, the discount rate indeed has an important role in analysis of the *efficiency* issue of cost-effectiveness in attaining a *given* emissions target by means of abatement policy. This procedure, known as cost *effectiveness* analysis (CEA) does not include benefits but only the costs of such abatement, and is about the minimization of these costs, an increasingly important requirement as emissions targets become more ambitious.

Thus, there is no means of avoiding the necessity for informed policy judgments about the target levels of emission reduction required, at both national and ultimately global levels. These judgments are necessarily based on political and expert deliberations at the national and international levels, informed by the climate science as well as by considerations of fairness and equity, again both nationally and internationally.

The case against use of CBA in climate change policy is also implicit in the argument put by the leading U.S. economist Jeffrey Sachs (Lackner, Sachs *et al.* 2005). This argument was put in the context of the G.W. Bush / John Howard era:

> the [UN Framework Convention on Climate Change] calls for a *cost-minimizing* approach to limiting significant deleterious effects on natural and managed ecosystems, rather than a balancing of overall costs and benefits of mitigation (and adaptation). This is a reasonable approach to a situation where significant ecosystem changes due to anthropogenic climate change are assumed to have large but also *unquantifiable* consequences on global society. In practice, however, the United States and some other countries (*Australia, for example*) have failed to respect this approach, reverting instead to a cost-benefit test. The Bush administration has argued that the costs of mitigation would exceed the benefits and has therefore rejected any specific climate targets. (Italicization added)

Coming from such a source, this special reference to the Australian (Howard) Government’s policy may at first sight seem startling. It simply says that Howard was content to discount the dangers of climate change by implicitly adopting what was in effect a CBA paradigm[8].

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8 The Howard Government’s stance was one of cooperation with President GW Bush’s Administration in undermining the Kyoto protocol. Howard’s opposition could be viewed as not about Australia as a ‘stand-out’ but using its leverage with the U.S. to *sabotage* the international agreement itself (Hamilton 2007; Naughten 2007; Sharp 2007). Howard’s position identified the national interest with the special interests of the export coal industry and its dependence on future Asian electricity markets that would expand less rapidly if $CO_2$ were (eventually) to be priced in that region in accord with international agreements.

As reported in his *Update Paper One*, Ross Garnaut does undertake cost-benefit analysis (2011:11) of mitigation consistent with a target of 450 ppm $CO_2$e. However, as regards averted damages from climate change, this part of his analysis is confined just to 'currently measurable market benefits' of such mitigation — that is 'impacts on consumption, incomes and economic output occurring before 2100'. On this restricted sub-set of benefits, the present discounted value of such benefits is found to approximate total abatement costs, with the discount rate being in the range 2-3 per cent.

Significantly, Garnaut's analysis does not rest there. From such a limited cost-benefit analysis he has deliberately and specifically excluded (or abstracted from) three vital additional categories of averted damage that he says cannot plausibly be incorporated in a CBA framework. These other important categories are: (ii) 'market benefits not readily measurable'; (iii) 'insurance value of mitigation'; (iv) 'non-market benefits', including 'environmental' values such as conservation of the Great Barrier Reef.

By highlighting these less tractable elements, Garnaut's method is aligned with Ackerman and Sachs rather than with the notion of Nordhaus and others that the problem can be encompassed within a CBA (or 'integrated assessment') framework. Garnaut argues that, combined with his first category of measurable and predictable damage mitigation, these other benefits must ultimately be decisive. Thus, inclusion of benefit categories (ii), (iii) and (iv) clinches the case for urgent and strong mitigation.

We return later to the question of whether this (four part) approach of Garnaut's, involving some use of CBA, albeit heavily circumscribed, is the most appropriate.

## 'Deep Uncertainty': Characteristic of Future 'Catastrophic' Climate Change

The inability of standard CBA to deal with 'catastrophic' but uncertain climate change events is the third of its major deficiencies in this context.

Garnaut's category (iii) of the 'insurance value of mitigation' is the special focus of Ackerman's argument and that of co-thinkers he draws upon. Central to this argument are concerns about *uncertainty* relevant to the problem of 'catastrophic' climate change[9].

John Quiggin's 2008 paper is the most valuable and accessible conceptual discussion of the economic and policy significance of uncertainty in the context of climate change: see also Quiggin (2005).

As Quiggin points out, it is the depth of more-or-less *certain* knowledge that has been accumulated by climate science and tested by peer review that first needs to be recognised. This knowledge rests on well-verified theoretical principles[10] and on observation and analysis of key indicators of the more-or-less distant past (paleo-climate science). An improved understanding of future implications is also incorporated in computerized and increasingly sophisticated global climate models. Analysis of the possible *effects* of climate change extends much more widely within the physical and biological sciences. The central summations for these scientific findings are successive reports of the International Panel on Climate Change (IPCC) under UN auspices.

As Quiggin also notes, a standard ploy of those obstructing mitigation of climate change is '*fabricated* uncertainty', that is, dispute of scientific consensus[11], or quasi-consensus, by trading on the public's often flawed

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9 As to terminology, 'dangerous' climate change and 'catastrophic' climate change could usefully be distinguished as follows. The former is defined in terms of the Article 2 of the United Nations Framework Convention on Climate Change (UNFCC) which requires stabilisation of greenhouse gases at a level that prevents 'dangerous human intervention with the climate system'. This is often taken as referring to a threshold of 2 deg. C above pre-industrial levels and in turn this will require substantial greenhouse gas emissions reductions over the next 20-40 years (Department of Climate Change 2008: 14). 'Catastrophic' climate change refers to the type of *mechanism* by which climate change could turn out to be dangerous: that is, through positive feedback loops and 'tipping points' of the type described above. The cited Commonwealth publication (for example, p. 15) makes *no reference* to these kinds of mechanisms.

10 The theory of the greenhouse effect and the role of atmospheric $CO_2$ was first developed in the 19$^{th}$ century, notably by Fourier (1827) and Tyndall (1872) while Arrhenius (1896) was the first to predict large climatic effects from growing human influence on $CO_2$ emissions.

11 One claim by 'sceptics' (Aitken 2011) is that this quasi-consensus is merely 'orthodox' science. This quaint term is presumably on a dubious analogy with 'orthodox' and 'alternative' medicine; or with the value-laden human sciences, not least economics and political economy! Even if were true that some form of 'non-orthodox' science had something to offer (which might be conceivable) the 'prudential' case still holds.

notions of the broad scientific project. In addition, *perfect* scientific consensus is *not* required in order for abatement action to have a sound scientific and policy basis in the prudential terms set out by Ackerman.

It is ironic that many unwilling to bear the costs of mitigation, or are apathetic about mitigating climate change, want to rely on 'science' to produce 'technical fixes' without the need for policy intervention. This form of wishful thinking involves several major fallacies.[12]

Garnaut's 'insurance value of mitigation' is about averting 'catastrophic' climate change. Drawing on Quiggin, Ackerman and others, this latter in turn has several aspects: (a) very large ecological and human impacts, especially on vulnerable populations and regions; (b) 'tipping points' and 'positive feedback loops'; (c) unpredictable *suddenness* of such large changes such that strategies of human *adaptation* are scarcely viable; (d) *'deep uncertainty'* associated with such effects, given the limits of existing science—not so much in its knowledge of the past or of basic scientific principles, but in its ability to foretell highly complex futures, even with the aid of the sophisticated climate models noted above.

Noting such 'catastrophic' effects is not to downplay *other* forms of damage (listed above by Garnaut) that may be less catastrophic but more predictable, the science of which may be better understood and in respect of which (in some cases) valuation can be attempted.

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12 A degree of technological optimism can be bolstered by legitimate historically-based faith in the market's ability to spur innovation, the claims of Baumol (2002) having previously been noted. However, there are at least two major qualifications to such technological optimism or 'manna from heaven'.
First (as in the case of carbon capture and storage (CCS) relevant market-driven innovations are unlikely to occur in the absence of relatively high rates of emission pricing and expectations thereof.
Second, fundamental limits are imposed by scientific laws such as first and second laws of thermodynamics. As Georgescu-Roegen puts it (1975: 361): "Even if technology continues to progress, it will not necessarily exceed any limit; an increasing sequence may have an upper limit. In the case of technology this limit is set by the theoretical coefficient of efficiency … Substitution within a finite stock of accessible low entropy whose irrevocable degradation is speeded up through use cannot possibly go on forever."

## The Uncertain but Real Risk of 'Catastrophic' Climate Change

Ackerman's argument here is in two parts. The first of these is his third ground for criticism of the cost-benefit framework, namely its typically exclusive focus on 'average' or 'more likely' projected future outcomes.

Ackerman argues that the focus should also be on the range of possible *deviation* from these long-term projections, even on plausible *outliers*[13].

Analogically, precisely this kind of deviation or plausible extreme case provides the rationale for households taking out life assurance or accident insurance. In this analogy, the assumed probability of a given dreaded outcome may be low but its results are deemed so serious that commercial insurance is highly valued by risk-averse insured households or firms, and also profitable for commercially-oriented insurers.

Even this insurance analogy[14] does not fully convey the gravity of the problem regarding 'catastrophic' climate change. This is because in the case of private commercial insurance, the pooled risks for the insurer are typically and necessarily *calculable* through statistical analysis of historical data. Under conditions of 'deep uncertainty' associated with catastrophic climate change, however, such confident and quantitative estimates of risky consequences and costs are not possible.

On the contrary, the notion of 'catastrophic' climate change[15] refers to significant unknowns over and above projected damage trends which are

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13 Quiggin puts it as follows (2008: 209): "Because the damage associated with climate change is potentially catastrophic, it is important to consider the entire probability distribution, rather than a limited number of parameters suchas mean and variance. Policy options that provide protection against low probability events inthe right-hand (high damage) tail of the distribution yield substantial expected benefits."

14 Global climate change evidently implies insurance market problems for property-owners at risk from extreme weather events exacerbated thereby. This insurance *analogy* used in the text should not be confused with any notion that *private* insurance markets can be capable of addressing the fundamental problem of greenhouse gas emissions as cause of human-induced 'catastrophic' climate change (Tol 1998).

15 Alternative terminology includes 'dangerous' climate change or abrupt climate change. The latter captures an additional important point about (human) adaptability or resilience. A given change in climate occurring over a few hundred years may be so amenable but not if such change were to occur over a few

judged to loom larger as greenhouse emissions and global temperatures increase.

Involved are possible ‘tipping points’ and ‘positive feedback loops’ such as: ice-cap melting (meaning less white ice to reflect the sun’s heat), disruption of the thermohaline circulation (Atlantic Gulf Stream), large scale release of the permafrost’s methane, itself a potent greenhouse gas, etc. The eminent climate scientist Wallace Broecker (2003) offers a representative treatment of such cases. See also Garnaut’s Update Paper 5 (2011: 33-4). A listing of such potential positive feedback loops and tipping point situations has been compiled by a distinguished ANU paleo-climate scientist (Glikson 2011), as indicated in the table below[16].

This list, while daunting, is by no means exhaustive. For example, it does not include the whole major set of impacts, direct and indirect on human health, and in particular effects on the geographical pattern of climate-sensitive major transmissible diseases, like malaria, and heat-wave related deaths (McMichael 2011; Epstein & Ferber 2011).

When climate events such as those listed can happen, even at the 99th percentile of risk, this is not something that can be ignored. Mean temperature increases of between 10 and 20 degrees Celsius could be involved[17]. Ackerman (2009: 39) refers to several papers by the Harvard economist Martin Weitzman (for example, 2007), pointing out that:

> Such high temperatures have not been seen for hundreds of millions of years … Because such hypothetical temperature changes would be geologically instantaneous, it would effectively destroy planet Earth as we know it. At a minimum this would trigger mass species extinctions and biosphere ecosystem disintegration matching or exceeding the immense planetary die-

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decades, as has been the case over the long-run history of climate change prior to human civilisation.

16 For other writings by this author see Glikson (2009 and 2008).

17 Quiggin (2008) notes that “… expected damage, measured in either physical or monetary terms, is a convex function of the rate of change of global temperature. An increase in global mean temperatures of 4 degrees Celsius over the next century would cause far more than twice the damage associated with an increase of 2 degrees Celsius, and an increase of 8 degrees Celsius would be utterly catastrophic. So, the expected damage associated with an uncertain future increase in temperature is more than that associated with a mean or median projection of temperature change.”

> offs associated with a handful of such previous geoclimate mega-catastrophes in Earth's history.

In developing this distinction between calculable risk and 'deep uncertainty' in the context of 'catastrophic' climate change Ackerman once again draws on the mathematical analysis of Weitzman (2007). This analysis has its arcane side but its essence can be understood in terms of Ackerman's simple card-game analogy as follows. Calculable risk is exemplified by choosing a predicted playing card from a standard deck where the probability may be low but is precisely known. Increases in both mean values and diversity of outcomes over time can be represented by the dealer's secretly removing respectively the low cards and then the mid-range cards from the deck.

*Deep uncertainty* by contrast is more analogous to a situation where the dealer replaces chosen cards from the deck with 'wild cards' that may have significantly higher values than those in standard deck. In this case repeated experiments (analogous to projections from recent history) may give little indication of what could feasibly happen.

Within the minority and heterodox political economic tradition of John Maynard Keynes, notions of 'deep uncertainty' also play a central role in explaining 'systemic financial fragility' and deep, persistent economic crisis[18]. As in the case of climate, the theoretical importance of deep uncertainty has been ignored by mainstream neoliberal economic theory during its three decades of recent ascendancy (Skidelsky 2009: 84-90, 174-5).

## Thinking Seriously about the Politics of Climate Catastrophes and National Interest

Possible climate catastrophes such as those listed have highly significant spatial as well as inter-temporal characteristics. Consider the implications of sea-level rise and extreme weather events due to climate change as such a combination might apply to a populous, low income, vulnerable,

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18 Ackerman notes the relevant emphasis on the importance of disequilibria in Keynes (and Marx) but not the parallel emphasis of these authors on 'deep uncertainty' as a fundamental cause of catastrophic economic collapse such as occurred in the 1930s and threatened in 2008 (2009: 11).

**Table 1: Potential Mechanisms For Catastrophic Climate Change Through Positive Feedback Loops**

| Mechanism | Nature of positive feedback |
|---|---|
| 1. The albedo (reflection)-loss factor inherent in the melting of land ice, sea ice and snow, opening sea and lake water surfaces which absorb infrared radiation, warming the water and leading to further ice melt (the so-called albedo-flip effect). | ↑ temperature → ↑ temperature → |
| 2. Elevated atmospheric greenhouse gas levels result in higher temperatures which, in turn, result in further release of CO2 from water (which have lower solubility of CO2 with higher temperatures) and from drying and burning biosphere, notably tropical forests (Amazon, Congo). | ↑ temperature → ↑ $CO_2$ → ↑ temperature → |
| 3. Warming ocean water to a depth of 3000 meters, resulting in release of seabed methane-bearing clathrates as amplifying feedback of climate change. | ↑ temperature → ↑ $CH_4$ → ↑ temperature → |
| 4. Release of methane from melting permafrost, with consequent rise in greenhouse gas levels, further warming and melting of more permafrost. | ↑ temperature → ↑ $CH_4$ → ↑ temperature → |
| 5. Decreased salinity of the North Atlantic Ocean consequent on (1) increased precipitation; (2) supply of Greenland fresh ice melt water, and (3) lesser extent of sea ice, retarding the meridional overturning circulation which drives the North Atlantic Thermohaline Current (NATC), thus threatening its shutdown. | ↑ temperature → ↑ temperature → |
| 6. A slowing down or collapse of the NATC will result in lesser heat transfer from tropical oceans to high latitudes, increasing low-latitude temperatures which ensue in tropical hurricanes. | ↑ temperature → ↑ temperature → |

*Note*:↑ = 'increasing'; → = 'leads to'

*Source:* This list is from Glikson (2011) with the right-hand column added by the present author. These mechanisms are separately listed, but they could be mutually reinforcing, each being activated by rising global temperatures.

low-lying country such as Bangladesh[19]. Australia is increasingly an organic part of the Asian region. Under both Abbott and Howard (his predecessor as some-time denialist of climate change), the Coalition has also sought to make political capital out of popular fears concerning

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19 The case of the low-lying small Pacific states also vulnerable to climate-caused sea-level rise is often cited, and rightly so. Realistically, because of the tiny populations involved, this case *alone* is not likely (within the Australian electorate and otherwise) to give strong political support to global mitigation policies. However, it certainly can be viewed as justification for such populations to be given guarantees of re-settlement in less vulnerable circumstances. Populous and densely populated Bangladesh is a very different case among vulnerable and low-lying countries. See Climate Institute (2011).

waves of sea-borne refugees from Asia. In the debate about mitigation of climate change, Abbott and his co-thinkers should therefore be required to address a not-so-implausible ‘hypothetical’ about waves of ‘environmental refugees’ in such a circumstance of catastrophic climate change (Sachs 2007).

Such scenarios form only a sub-set of many that might be encompassed by ‘climate wars’ (Dyer 2009) where future national interests, and those of our grandchildren, could be threatened by ‘catastrophic’ climate change in these particular ugly ways also. In ethical and in realist terms, young Australians alive today could potentially face very ugly ‘lifeboat earth’ scenarios (Hardin 1974) in which future nationalist demagogues of Abbott’s ilk would be expected to demonize foreign peoples not prominent in the causation of global climate change catastrophe, but nonetheless principal victims thereof[20].

## Two Approaches to Limiting the Role of CBA in Climate Policy

Within the ranks of those economists critical of the use of CBA in formulating climate change policy, some differences of approach have been noted above.

In particular, Garnaut has made limited use of the CBA approach. But he has heavily circumscribed it by underlining the importance of major benefits from abatement not capable of effective treatment within CBA. Use of a discount rate, doing questionable double-duty with respect to both efficiency and equity is thus confined in Garnaut’s analysis to a comparison of mitigation cost with just those benefits deemed to be more probable and/or quantifiable, albeit not in the ‘catastrophic’ category.

Compared with Ackerman and Quiggin, Garnaut has also placed less emphasis (two pages in his Update Paper five) on this category of

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20 In these ethical terms the climate case is thus very different from Hardin’s example in which he sought with his imagery about repelling life-boat borders to justify self-interested action by the industrialised countries in the face of failure of poor countries to restrain their population growth. Schelling (2007) has noted that it is low income states, often in the tropics, that would bear the brunt of ‘dangerous’ climate change, states that are least able to adapt.

*catastrophic* scenarios, perhaps on the basis that some of these are deemed of low probability *in the period to 2100*.

A distinct approach to climate change policy is to reject CBA altogether as fundamentally flawed. This approach is persuasively counseled by Jeffrey Sachs and colleagues, and seems to be implicit in Ackerman. However, as argued in the next sections, such an exclusion of the technique of CBA from climate change analysis by no means precludes an essential role for rigorous cost-*effectiveness* analysis (CEA).

## Cost-Effective Emissions Abatement: Economic Principles and Political Lessons

The cost-benefit analysis framework is either rejected or tightly circumscribed by economists such as Ackerman, Sachs and Garnaut. However, the contribution from applied economists remains significant not least in cost-*effectiveness* analysis to achieve a given ('exogenously specified') emissions target at the least possible cost. Such analyses can take a variety of forms depending on whether the focus is national or global, whether on macro-economic variables (in 'top-down' models) or on technology choices over time (as in so-called 'bottom up' models).

Such approaches have importance in terms of reconciling environmental with other macro-policy policy goals, in attaining efficient allocation of resources and (sometimes notoriously) in political terms.

As regards economic efficiency, such analyses reaffirm the efficacy of putting a price on emissions that is consistent with the emission levels targeted. Models incorporating technological options and technical progress, can also indicate the types of technological (and behavioural) change that can most cost-effectively reduce emissions. Such model-based analyses can also address the effects on emissions of moderating growth in economic activity and population.

Ackerman favours the pricing of emissions but has two qualifications. The first is that (contrary to Garnaut among many others) he favours carbon taxes over tradable emissions permits[21]. The second is that he also favours rigorously selected 'complementary measures', as do both

21 As does Nordhaus (2011); for the opposite view, favouring cap-and-trade, see Keohane (2010).

Garnaut and Stern. Ackerman thus cautions against relying on the price mechanism alone (2009:116, 124):

> Market-based policies are a second best, less efficient option for dealing with a threat to global survival, a compromise with political reality rather than a theoretical ideal.

But 'second best' is a technical term in this context: Ackerman's argument does not imply support for a 'command and control' or so-called 'direct measures' as the main approach to reducing emissions. His later comments indicate that such approaches can easily be corrupted.

This brings us a 'political science' case for seeking cost-effectiveness and broad social efficiency in reducing emissions. Before that, some remarks are needed about the immediate Australian climate politics.

Under Tony Abbott, the Opposition has broken from the former bipartisan consensus favouring the pricing of emissions and adopted (at least for its rhetorical purposes) what Abbott has chosen to call a 'direct approach' and others have called a version of 'command and control'. This position is adopted neither on ideological grounds (quite the contrary!) nor on efficiency grounds, but on the most cynical *political* calculations. The single-minded tactic—based on inducing fear through TV grabs, and even concocted rallies and street protests—has been to present the Government's intention to price emissions as being to introduce a 'great big tax' and an attack on the so-called 'battlers'.

In the 'political' debate there are several lines of rebuttal. Thus, if Abbott were) really committed to reducing $CO_2$ emissions and (as he may claim) to the same degree as the Government, then the resource costs and shifts required to do so would be more burdensome, and not less, than those entailed by pricing emissions. Greater increases would occur in resource costs, such as in electricity generation, and in jobs lost in high-carbon industrial sectors. But no tax revenues would be available to compensate low-income electricity consumers or to fund retraining and relocation of employees of such sectors. That these costs would be *greater* under a 'command and control' regime such as Abbott's is likely to be true for two related reasons: first, relatively inefficient resource allocation in abating emissions; second, induced wasteful rent-seeking by vested interests standing to gain or lose from such 'direct action'[22].

As to the 'political science' cases for both cost-effective abatement and for use of 'market instruments', these remain intact for the above reasons, and are not simply based on 'market fundamentalist' beliefs. Indeed, the more 'ambitious' are the emission targets on grounds of the climate science, the more important that such targets be addressed by methods implying the least aggregate cost to the economy and to the community, both nationally and internationally. Such political acceptability also depends on fairness and equity criteria as reflected, for example, in compensation arrangements.

## Cost Effective Analysis of Abatement and Discount Rate Choice

Major reconfiguration of national energy sectors over time (not instantaneously!) is vital to the cost-effective abatement of greenhouse gas emissions. Technologies used in this sector (say power stations, buildings or vehicles) have long physical lifetimes, can take lengthy periods to plan and construct and in the case of existing assets can imply high costs of replacement or refurbishment[23]. Rates of growth in the extraction and transmission of energy inputs and in the demand for energy services over the forecast period are also important, as are the projected constraints on greenhouse gas emissions themselves. Relevant modelling forecast periods may be around 30+ years. Because of all

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22 Innumerable examples of 'direct action' are of course strongly supported by advocates of cost-effective climate change mitigation and of emission pricing. These include remediation or protective action against *effects* of whatever degree of climate change is already irreversible. Such examples include higher sea-walls, inhibiting spread of climate-sensitive contagious diseases, installing hurricane-resistant buildings, land-use zoning etc. Such forms of 'adaptive' direct action are fully recognised by the IPCC, analysis of which is reflected in its reports.

23 Recent and unnecessary confusion in the debate has revolved around a lower emission price necessary to induce gas-fired CCGTs in preference to *new* coal-fired capacity as distinct from the higher emission price that would be required to induce early retirement of older *existing* coal-fired capacity in favour of CCGTs or other less emission-intensive electricity generation technologies.

these time-related considerations, assumptions about discount rates are important in pursuit of efficient allocation of these physical and energy resources over time.

A related issue is whether discount rates selected in analysis are to be understood as being in Garnaut’s terms (2011:17) ‘positive’ *versus* ‘normative’ or in Ackerman’s equivalent terms as ‘descriptive’ *versus* ‘prescriptive’ interpretations (209: 23).

In cost-effectiveness analysis, the case for risk-inclusive—and hence, higher, market-related rates—is associated with the ‘real options’ approach to the analysis of ‘real world’ investment decisions (Dixit & Pindyck, 1994). Such ‘high’ rates are associated with a more cautious approach to investment that incrementally assesses changing risks as further information comes to hand over time.

Use of low, risk-free rates in the analysis of abatement would fail to address the risks associated with investments and be especially inappropriate where such risks are borne by the investors themselves. This would be the case subsequent to ‘market reforms’[24] that have transferred (some) risk-bearing away from governments and taxpayers.

Such ‘low’ discount rates (whether in analysis or as actually adopted by investors) would impart a bias toward investment in capital-intensive supply technologies. In electricity generation such investments would be in capital-intensive, ‘lumpy’, long lead-time technologies, notably, coal-fired generation and especially nuclear generation.

Past analytical use of low, ‘prescriptive’ discount rates has hidden the fact that Governments have borne associated risks as implicit subsidies to such capital-intensive technologies. In the case of nuclear power, such subsidies are also implicit in governments’ carrying the cost of premiums against disasters uninsurable via private commercial arrangements[25].

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24 ‘Market reforms’ should *not* be identified with privatisation but can equally refer to ‘corporatisation’, where companies may remain in government ownership and subject to parliamentary scrutiny and government regulation but become more autonomous with respect to investment and other decisions, and less likely to be the recipients of hidden subsidies not justified by a public interest.

25 For example, when electricity generation was privatised in the UK, this process did not include the nuclear generation sector. As noted by Thomas (2005: 31-32) “(a) particularly difficult issue with nuclear economics is dealing with and putting on a common basis for comparison the streams of income and expenditure at

By contrast, the analytical use of higher, risk-inclusive, market-related discount rates will favour less capital-intensive, short lead-time and more 'modular' technologies, such as gas-fired combined cycle gas turbines (CCGTs), decentralised cogeneration and (at least as regards modularity) wind-farms.

Choice of discount rates will also have implications for reconfiguring the energy sector to meet greenhouse gas emission targets. For example, under ideal conditions and as a base-load generating technology, CCGTs favoured by risk-inclusive discount rates have less than half the $CO_2$ emissions of coal-fired generation per kWh. This technology has particular relevance for systems currently dominated by coal, such as China, India, the U.S and Australia (Naughten 2009, 2003; IEA 2006; Jones, Peng & Naughten 2004). Other features of CCGTs, such as their short start-up times compared with coal (and nuclear), mean these technologies are more compatible with renewable technologies in electricity generation. Further, because of their modularity and short lead-times in construction, CCGTs are also more compatible with policies to enhance end-use energy savings. This is because long lead-time technologies such as coal and nuclear, in the face of uncertain long-run demand projections, are more subject to unintended excess supply capacity, in turn undermining such energy efficiency policies.

As regards the latter however, in analysis of $CO_2$ abatement, analytical use of higher market-driven discount rates will in a sense 'understate' the efficacy of energy-efficient end-use technologies that offer savings in future use of energy. This is because the market-related discount rates reflect empirical findings that consumers of appliances empirically do not place a high weight on the value of these future savings from energy-efficient appliances (Hassett & Metcalf 1993). But such evidence could also reflect informational or institutional[26] market imperfections correctable by regulatory policies such as energy efficiency labeling.

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different times in the life of a nuclear power plant. Under UK plans, the time from placing a reactor order to completion of decommissioning could span more than 200 years". As in the case of 'catastrophic' climate change, issues of intergenerational equity also arise with regard to nuclear power, for example, as to safe disposal of long-term wastes. Once again, it can be seriously doubted that the use of low rates of discounting can be a means of addressing this problem.

26 A case in point is the principal-agent problem, for example, where drivers of company cars, as a tax-free (non-salary) benefit do not have to bear the excise-w

Finally, the high risk situation now facing investors in the expansion of energy technologies, whether on the supply-side, or in conserving of energy, is massively dependent on how (and by what mean) the political issue of climate change is resolved over time. In Australia, Abbott's abandonment of the pre-existing bipartisanship has increased this risk.

The discount rate has a necessary role in analysis and promotion of economic efficiency in mitigation. Analytical questions such as those discussed above will remain open but lack of full resolution need not hamper mitigation action.

In the CBAs or 'integrated assessments' of Nordhaus, Stern and others the use of 'low' rates intended to somehow address intergenerational equity would also have the undesirable and unwanted effect of imposing such inappropriately low rates in analysis of the configuration of technologies to abate emissions, as discussed above.

We can conclude that the choice of discount rate is a more tractable problem when its use is confined to cost-effective mitigation—and not required to address the ethical issue of intergenerational equity in bearing the costs of 'dangerous' climate change, a role for which it is ill-suited.

## 'Complementary' and Non-Market Regulatory Measures

As just discussed, the key rationale for pricing $CO_2$ emissions is about minimising the cost of meeting increasingly strict emissions targets. However, a rigorous case can also be made for certain policy measures 'complementary' to emissions pricing. As a counter to 'rent-seeking', these options can be required to pass cost-effectiveness tests based on empirical evidence, efficient correction of identified forms of market failure and rigorous modelling of cost-effective emission abatement exemplified by the IEA's recent 'bottom-up' analyses (2006).

The 'imperfect information' and institutional obstacles to energy-efficient technologies exemplify such complementary policies. A second set of cases involves forms of 'double dividend': that is, where correction of a market failure (or external cost) will *also* reduce $CO_2$ emissions. The reduction of traffic congestion can be a case in point where reduced fuel combustion in private vehicles also occurs but this result is not automatic, as underlined by the literature on so-called 'rebound effects'[27] However, as will now be indicated, not all proposed 'complementary policies' pass the tests of rigour and cost-effectiveness.

## 'Magic Bullets that Miss the Target'

Ackerman (2009: 16-19) applies this term in dismissing certain flawed and high-cost options in abating $CO_2$ emissions. His examples are not comprehensive but include biofuels and especially corn-based fuel ethanol, nuclear power and geo-engineering—or 'tinkering' with the climate itself, a solution not discussed here but promoted by Nordhaus.

The first two of these fit the cases of 'rent-seeking' or 'vested interests'. Corn-based fuel ethanol has very dubious greenhouse credentials given significant use of fossil fuels in its processing, notably at the distillation stage. It is heavily subsidised and tax-exempt in the USA. In Australia, producers of wheat-based and sugar-based ethanol have called for and received similar support from governments, notably in the form of a subsidy equivalent to full exemption from transport fuel excise, and protection from imports of fuel ethanol, but also in various other ways. Ackerman also rightly underlines the disastrous effects on global food security due to Government support to biofuels such as corn-based fuel ethanol.

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27 An exogenous improvement in energy efficiencies will in general not be *fully* reflected in end-use savings of energy. This is because the consequent reduction on the unit costs of the relevant energy *service* (such as lighting services from a compact fluorescent lamp) may well result in some increase in consumption of that service (the light is left on for longer). This means some (partially) offsetting increase in the energy input, the so-called 'rebound effect'. But it is erroneous to conclude that such energy efficiency improvements are *fully* negated, thereby incorrectly discrediting such policies. In a hypothetical case where a full offset occurs, the term 'Jevons paradox' or 'backfire effect' has been applied. Rebound effects more generally can be removed by a tax applied on the energy input or on the energy services output, such a tax itself encouraging improved energy efficiencies and savings over the longer run. This efficacy of taxes on fuel inputs is illustrated by the much greater *per capita* use of transport fuel in the U.S. *versus* the rest of the OECD, where much higher transport fuel taxes apply. See Wikipaedia references.

Nuclear power has been discussed above as a lumpy and capital-intensive technology that would be often be commercially unviable in the absence of heavy state subsidies.

Ackerman's verdict is

> Cheap, safe, drought-resistant nuclear power, combined with a safe solution to the nuclear waste problem, would be widely welcomed — but is not available today. Waiting for a better nuclear option does not seem like a prudent response to the climate crisis[28].

For comprehensive argument about nuclear power's evident inability to address greenhouse gas abatement cost-effectively and safely see Sovacool & Cooper (2008). Japan's Fukushima has been a vast setback.

When emissions are priced, the cost-effectiveness of gas and methane combustion relative to coal-fired base-load electricity has also been noted above. However, recent preliminary findings about *non-conventional* sources of gas and methane (Howarth et al. 2011), cite problems such as fugitive methane emissions, methane being a greenhouse gas more potent than $CO_2$. Increasing concerns about inadequate safety and pollution regulation of methane extraction from shale illustrate the need for continued and *situation-specific* vigilance about the full range of effects including from supposedly 'green', 'low-cost' and 'low carbon' technologies. Tight, well resourced and accountable safety regulation can be expected to drive necessary innovation and occasionally highlight intractible difficulties, as in the case of nuclear power. Turning a blind eye to such difficulties is not an option for the environmental movement.

Roof-top solar panels can illustrate technologies with promise given further R&D support but, other than in niche markets, not yet consistent with cost-effectiveness except at much higher $CO_2$ prices than are currently contemplated. Over-generous feed-in tariffs and capital

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28 Garnaut, Stern and the IEA all see a role for expanded nuclear and for $CO_2$ capture and storage (CCS) from coal-fired capacity. Assuming away hidden subsidies, these options (especially the latter) cannot be on the agenda without significant emission pricing. Meanwhile, there is a 'collective action' case for requiring the export coal industry to contribute to the funding of RD&D activities in connection with CCS, including retrospective action with respect to existing coal-fired generation capacity where feasible.

subsidies have recently been withdrawn in Australia (Macintosh & Wilkinson 2010; and on the UK feed-in tariff, see Monbiot 2010).

Polemics for the electric car often fail to address its full implications for greenhouse gas emissions. In the U.S. or Australia energy inputs will from an electricity system still dominated by coal-fired generation, or even from expanded nuclear power capacity with its special short and long-run hazards other than climate-related. The case of the electric car illustrates the need for analyses of mitigation to be on energy-sector-wide and full-lifecycle bases.

Ackerman does not spell out the point but his discussion of failed 'magic bullets' points to ways that the so-called 'direct approach' is likely to be corrupted in practice and that this is an important argument for emission pricing as the core approach. This rebuts Abbott's phoney prescription where there is apparently to be *total* reliance on his 'direct approach' which is *not* envisaged as a 'complement' to price-based approaches.

Regarding the desirable emergence of an investment context more 'settled' on the question of climate change[29], two distinct 'ideal types' can thus be envisaged both at the national and at the global levels: (i) in the interests of the 'carbon polluters' the issue is indefinitely deferred once again; (ii) emissions levels necessary to stabilise the climate are accepted consistent with economic and other legitimate constraints, this being achieved by a cost-effective combination of emission pricing and complementary measures including rational R&D policies.

Achieving (ii) will also require a range of institutional reforms, implying open and accountable 'good governance' nationally and globally[30]. The requirement is for 'checks and balances', not only against vested interests such as the 'greenhouse mafia' (Hamilton 2007) but also against undue 'green rent-seeking' and costly 'magic bullets that miss the target'. Internationally, the problem is one of coping with 'hold-outs', free-riders and saboteurs but also the need to deal with the legitimate concerns of poor and developing economies.

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29 The uncertainties induced by this lack of resolution are nowhere more evident than in successive annual reports of the IEA, where starkly different scenarios are defined solely by reference to this question.

30 This is the broader topic of 'green republicanism' (Barry 2008; Slaughter 2005; Naughten 2006).

## Climate Change Debates within 'Progressive Environmentalism'

Clearly, within the progressive environmental movement, as well as within the broader movement focusing on averting 'dangerous' climate change, many important issues are open for debate, if not always early and final resolution.

The contents of the preceding special issue of this journal on 'Contesting Climate Change' *(JAPE 66,* 2010-11) reflect a diverse set of perspectives within progressive environmentalism. Of these, perhaps the contributions of Spies-Butcher and Diesendorf are most clearly aligned with the scholars reviewed here, at least in that these two accept central roles for both market instruments and state action. Diesendorf also plausibly underlines over-consumption as well as growth in global population as causes of excessive growth in emissions and resulting climate change.

These and other contributors within progressive environmentalism differ in ways that can be listed but for space reasons not discussed here. These differences include (a) suspicions about 'market instruments' of any kind (not only systems of tradable emissions permits) and a consequent preference for 'direct action' or 'command and control'[31] (perhaps especially favouring certain sorts of technologies such as generic renewables over and above the degree indicated by cost-effectiveness); (b) a primary concern with the disparity between global rich and poor, including their 'energy poverty' and grossly asymmetric responsibilities in the causation of climate change and vulnerabilities to it; (c) an ethic

31 A case in point is illustrated by Butler (2011) representing *Green Left Weekly*. The argument proposed here was that because a carbon price would allegedly encourage gas-fired CCGTs *rather than* renewables then such a price-related policy must be misguided. The valid argument might well be for a *higher* price on emissions but that is not the line taken in this article. Strangely and quite inconsistently, the article supports another price mechanism: (subsidised) feed-in tariffs. Further, the article confuses the principle of cost-effectiveness with that of social equity, which should encompass principles of compensation which can be funded from tax revenues (or indeed from the sale of emissions permits). This variant of a 'green leftist' position has not absorbed the important distinctions made by Karl Polanyi (1944) between his 'disembedded' or 'free' markets associated with *laissez faire* (and more recently with economic neo-liberalism) *versus* his contrasting case of 'socially embedded' markets. The latter are exemplified by 'market instruments' under social control and in the service of defensible social objectives.

that *prioritises* reduced material consumption in the rich countries; (d) a notion of grass-roots political power as a necessary part of a global solution, sometimes combined with a downgrading of the perceived role of state action and nation-states; (e) obversely, attitudes underlining the indispensability of global governance and of international cooperation.

The great policy issue of climate change could be expected to throw up issues of theoretical significance in critical political economy. Along with Quiggin (2011), Ackerman (2002, 2009) is critical of the failure of mainstream economics to take seriously certain of its own results such as 'the theory of the second best' and the short-comings of general equilibrium theory. However, these commentators agree with mainstream proponents such as Stern, Garnaut and Nordhaus, that there is no solution to the problem of climate change without the cooperation of nation-states and by means of government intervention against 'free market' forces. Almost as universal is a commitment to the use of Pigovian 'market instruments' as an approach to cost-effective action (Mankiw 2006).

These and other issues should be and must be rationally and reasonably debatable across the wider movement and the community as a whole.

## Lessons in Re-Framing the Debate

As proposed at the outset, and as psychologists underline (Lewandowsky 2011), the 'framing' of an issue such as climate change is vital to its analysis, structured debate and effective campaigning. The re-framing urged by Ackerman, Garnaut and Quiggin calls for a campaign incorporating three steps: (i) identifying rationally justifiable fears[32] if effective mitigation is not undertaken, 'inconvenient' though that 'truth' may be to certain vested interests, politicians and others; (ii) calling for policy responses based on prudential or precautionary approaches that treat the costs of abatement as effectively analogous to a global insurance

32 Such rationally-based or prudential fears are not narrowly self-centred, but in many ways are based on community-based altruism. Such fears are driven by Ackerman's notion that 'our grandchildren' matter. They are also based on rejection of the arguments of those denialists pressing for an 'adaptation only' approach in which the rich, and the rich states of the world, would supposedly 'cope' with the effects of future climate change but leaving the rest of the world fending for itself despite being far less responsible for a dreadful situation caused largely by rich economies and exacerbated by their uncooperative inaction.

premium; (iii) thereby offering hope and optimism with respect to the future, and future generations, instead of dread, nihilism or cynicism.

Of course, this chain of reasoning over-simplifies the political task. For example, from the plausible notion that only action at the global level can be effective, some commentators rule out mitigation action altogether since they reject either the possibility or the desirability of such global cooperation[33]. Their stance is that Australia should be a 'hold out' (or free-rider) and not join other countries in sharing any kind of leadership role internationally.

Returning to the three contributors here under review, their closely related twin theses must be taken aboard by proponents of mitigation. The first was about the risks of truly catastrophic climate change with abatement action viewed as analogous to an insurance premium. The second was that 'our grandchildren matter' implying the discount rates and cost-benefit analyses do not do justice to the problem. This review has also agreed with these authors about the importance of achieving cost-effective abatement if sufficiently stringent emission targets are to be met.

These lessons need to be absorbed if the battle with the climate science 'sceptics', the vested interests, opponents of global cooperation and political opportunists will be lost along with valuable time.

Within the progressive environmentalist movement political tendencies can agree on these basic propositions whatever their differences of emphasis and legitimate concerns about other important aspects of this complex existential problem.

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33 All kinds of rationales for inaction exist apart from the (rather few) full-time climate science sceptics. Organisations such as the IPA (Institute for Public Affairs) are not fussy about this diversity. For example, its main climate change specialist for many years was a retired CSIRO scientist (Brian Tucker). He was in no doubt about the reality of human-caused climate change but was a fervent opponent of (or pessimist about the scope for) international cooperation and instead urged an 'adaptation only' approach (Naughten 2007). As indicated above, such an approach is a recipe for 'climate wars' and environmental refugees. IPA's current main spokesperson (Moran 2011; with comment by Naughten 2011) takes on the garb of pessimism about global cooperation with the spurious argument that Australia should not 'take the lead'.

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