Garnaut's Targets and Trajectories: A Critique

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Introduction

On Friday, 5 September 2008, Professor Garnaut released his much awaited supplementary draft report on targets and trajectories. The report argues that Australia's mid- and long-term targets should be to reduce emissions net of international trading by 10 per cent from 2000 levels by 2020, and 80 per cent by 2050. This, we are told, is a proportionate contribution to the 'achievable' international goal of stabilising the atmospheric concentration of greenhouse gases at 550 parts per million (ppm) of carbon dioxide equivalent (CO_2-e).

Garnaut indicates that a 450 ppm CO_2-e target, with possible transition to 400 ppm CO_2-e, 'would better suit Australia's interests'. However, he has concluded that an international agreement consistent with these objectives is not politically feasible at this time. Accordingly, he argues for a two-staged 'overshoot' strategy. First, reach agreement on the pursuit of a 550 ppm CO_2-e stabilisation objective. Second, after the international agreement is in place and progress is being made toward the achievement of that goal, encourage the world to lower the target to 450 ppm CO_2-e.

The recommendations in the report were widely criticised in the mainstream media. Much of this debate focused on his acceptance of 550 ppm CO_2-e as the most realistic and achievable target. The inherent risks associated with this objective have led many to argue that a lower stabilisation goal is warranted, along with correspondingly lower national abatement targets.

Although there is considerable room for debate about the merit of a 550 ppm CO_2-e stabilisation target, arguably the most troubling aspects of the Garnaut Review are:

- the chain of reasoning that led him to conclude that abatement targets of 10 per cent for 2020 and 80 per cent for 2050 for Australia are consistent with 550 ppm CO_2-e; and

- the failure to fully explain the risks associated with the proposed overshoot strategy.

Do the abatement targets for 2020 and 2050 equal 550 ppm CO_2-e?

There are three aspects of Garnaut's reasoning about the choice of Australia's abatement targets for the 550 ppm CO_2-e stabilisation objective that are questionable:

- his choice of the global emissions budget;

- his assumptions concerning near-term emissions growth; and

- the proposed method for determining national targets.

The global emissions budget

The process of setting national abatement targets to reach a desired atmospheric greenhouse gas concentration goal has three basic elements. First, a global emissions budget must be calculated. An emissions budget is the total amount of emissions over a time period (typically the 21st century) that is consistent with a given stabilisation objective. Second, the budget must be allocated amongst countries. Finally, trajectories must be devised to allocate emissions allowances across time.

As is noted in the Garnaut Review's draft report, there is considerable uncertainty about what emissions budget will lead to stabilisation at 550 ppm CO_2-e. Much of this uncertainty is related to 'climate-carbon cycle feedbacks', which are feedbacks between temperature change, atmospheric carbon dioxide (CO_2) and the carbon cycle (i.e. the biogeochemical cycle by which carbon is exchanged between land, ocean and the atmosphere). Given the uncertainty, policy makers must make a choice about which budget is the most appropriate in the circumstances. In making this choice, the central issue concerns society's attitude toward climate risks. If society is risk averse, it will adopt a lower budget and *vice versa*.

The United Nations Framework Convention on Climate Change (UNFCCC) suggests that governments should be guided by the 'precautionary principle' in making decisions about climate policy. A precautionary approach is one that supports risk averse decision-making when there is scientific uncertainty and the threat of serious or irreversible environmental damage. On the basis of this legal principle, it can be argued that a low-range global emissions budget should be preferred when making domestic abatement decisions.

Garnaut's report does not explicitly outline what choices were made concerning the 550 ppm CO_2-e global emissions budget that was used to derive his targets for Australia. Information in the report suggests that his budget was derived using an old version of the MAGICC model (version 4.1 rather than the most recent version 5.3).[1] MAGICC version 4.1 was designed to be consistent with the data in the IPCC's third assessment report. Version 5.3 is designed to be consistent with the IPCC's fourth assessment report. It appears that the Garnaut team may have made some adjustments to account for scientific advances since MAGICC version 4.1 was first developed (e.g. the draft report suggests a higher climate sensitivity of 3.0°C was used for certain purposes).[2] However, it is unclear to what extent potential changes in the carbon cycle were factored into the analysis.

Using the diagrams, targets and other hints provided by the Garnaut Review, it appears the underlying carbon cycle assumptions may be at the optimistic end of those suggested by the current science. Rough calculations indicate that the carbon component of Garnaut's CO_2-e emissions budget is likely to be 20 – 30 per cent larger than the budgets generated by several reputable coupled climate-carbon cycle models for equivalent atmospheric concentration levels.[3] Obviously, had a smaller budget been used, deeper cuts would be required to stay within it.

The use of a smaller emissions budget to set domestic abatement targets would ensure greater consistency with the principles outlined in the UNFCCC. Moreover, Garnaut's assumptions regarding the potential strength of climate-carbon cycle feedbacks create a potential inconsistency in his argument. The Review's recommendations were strongly influenced by the risk of low probability, high impact events. As the report states in relation to the identification of 450 ppm CO_2-e as the preferred target in the absence of political obstructions:

> Given the benefits after 2200 of stronger mitigation, and the greater risks of catastrophic consequences to the natural environment under the 550 strategy, the Review judges that it is worth paying less than 1 per cent of GNP as a premium for the 450 strategy.

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[1] Garnaut's draft report states that emissions pathways for the mitigated scenarios (i.e. 450 and 550 ppm) were developed using the SiMCaP (see note below Table 9.1). However, the targets and trajectories report states that the concentration profiles were derived using MAGICC (see note below Figure 8.1).

[2] See draft report page 227.

[3] Interestingly the Global Commons Institute, which originally proposed the 'contraction and convergence' approach, uses a 21st century carbon budget in its Contraction and Convergence Options Model (Version 8.5) that appears to be approximately 30 per cent smaller than Garnaut's equivalent budget (ee: http://www.gci.org.uk/model/dl.html (10 September 2008)). For discussion on the relevance of coupled climate-carbon cycle models, see A. Macintosh and O. Woldring, *Climate-Carbon Cycle Feedbacks: The implications for Australian climate policy*, CCLP Working Paper 2008/3, ANU Centre for Climate Law and Policy (available at: http://law.anu.edu.au/cclp/Index.asp (10 September 2008)).

This approach is risk averse (or precautionary) – there is a small probability of very large welfare losses from climate change and the Review has judged that it is desirable to insure society against these risks. However, it has then adopted assumptions regarding the size of the global emissions budget that are essentially risk neutral. Arguably a more consistent line of reasoning would involve risk aversion toward impacts, concentration targets *and* budget selection when determining abatement objectives.

Near-term emissions growth

The second weakness in Garnaut's analysis concerns the assumptions regarding the prospect of reaching a comprehensive and effective agreement on abatement at Copenhagen in 2009. Garnaut's analysis assumes it is possible to reach an agreement that results in global emissions peaking in 2021 at a level only 5 per cent above 2012 levels. This compares to a business-as-usual projection under the SRES A1C and A1G scenarios (i.e. high growth, carbon intensive) of greater than 10 per cent growth over the same period.

If developed countries are unwilling to adopt relatively stringent abatement targets for 2020, Garnaut's short-term global emissions containment objective is unlikely to be achieved without a prolonged economic slowdown or a radical and immediate shift in the global political landscape (this obviously ties in with Garnaut's method of distributing the global emissions budget which is discussed below). The majority of global emissions growth since 2000 has emanated from developing countries. Slowing this growth in the near-term will be a substantial task, requiring developing countries to overcome significant economic and political barriers that are likely to impede abatement efforts. Consequently, without a substantial effort on behalf of developed countries to provide 'headroom' for growth in developing country emissions, the objective of keeping global emissions growth to 5 per cent over the period 2012 – 2021 is likely to be extremely difficult to achieve. Garnaut acknowledges this, describing the objective as a 'daunting short-term challenge'. Yet the impact of assuming slow emissions growth to 2021 is that it reduces the abatement required in later years (emissions avoided in the near-term are abatement avoided in the future). A more 'realistic' assumption about what is achievable in Copenhagen would increase the required abatement after 2012 – 2020.

Contraction and convergence

The third weakness in Garnaut's analysis is the method he adopts for distributing the global emissions budget between countries. He uses a modified version of the so-called 'contraction and convergence' approach, where global emissions contract and national per capita emissions converge at a given date. Garnaut assumes a linear rate of convergence of per capita emissions from 2013 to 2050, with some additional 'headroom' to allow for rapid growth in developing countries.

This allocation method is more equitable than a number of other approaches that have been mooted. However, it still results in developed countries getting an inequitable share of the 21st century global emissions budget. Around 70 per cent of Garnaut's 21st century 550 ppm CO_2-e emissions budget is likely to be expended in the first 50 years (i.e. 2001 to 2050). Under the proposed allocation method, developed countries will receive approximately 30 per cent of this 50-year section of the 21st century budget. Yet their average share of global population over this period is projected to be approximately 17 per cent.[4] Australia's share of global population is projected to rise from roughly 0.31 to 0.37 per cent between 2001 and 2050 and it will receive over 0.5 per cent of the 2001 to 2050 budget. This does not appear to be fair. Garnaut implicitly acknowledges this when he states:

> Developing countries will generally favour earlier convergence towards equal per capita rights than is embodied in the Review's proposal.

A further complication with Garnaut's allocation method is that it assumes projected population growth in all countries is equally deserving of consideration. This is a bold assumption. Most of Australia's population growth in the coming half century will be from voluntary immigration. Australia benefits from this immigration through stronger economic growth (immigration also has secondary benefits, but they are not germane to the issue in question). In contrast, most of the population growth in the developing world will be 'natural' and will arise as a consequence of essentially unavoidable factors (e.g. population profile, poverty etc.). To say that Australia's population growth should be factored into the allocation method is essentially asking the world to give Australia a benefit for receiving a benefit.

Developing countries might accept Garnaut's allocation method, but it seems unlikely at this stage unless it is accompanied with the offer of massive wealth transfers from developed to developing countries. Garnaut raises questions about transfers in his draft report, calling for the creation of a Low Emissions Technology Commitment and International Adaptation Assistance Commitment. These are similar to mechanisms already in the Kyoto Protocol, but which to date have attracted a disappointing lack of support from developed countries. It is possible that this type of approach could work. The key questions concern whether developed countries are willing to commit enough resources to the funds, how the resources are allocated and whether developing countries would have faith in compliance with such undertakings.

Theoretically, using a technology/financial transfer commitment approach as advocated by Garnaut could result in similar outcomes to those that would arise from a more equitable division of the global emissions budget. Under either method, resources are likely to flow into the developing world for mitigation projects. A more equitable allocation of the emissions budget would

[4] Between 2001 and 2050, developed countries' share of global population is projected to fall from 20 to 14 per cent.

see funds flow to developing countries through international trade in emission permits instead of through discretionary funds under special treaty mechanisms. The latter are likely to be less appealing to developing countries because they are more difficult to enforce and administer. This has been demonstrated repeatedly in international environmental agreements, where technology and financial transfer mechanisms have had a poor record of achievement.

In the end, the negotiated outcome will probably involve a mix of the two approaches. However, the budgets must be seen to be fair. Garnaut's approach arguably does not strike the right balance, with too much weight being placed on technology/financial transfers and not enough on an equitable division of the global emissions budget. If neither developed nor developing countries are willing to give ground on the allocation of the budget, the most likely outcome is an increase in its size and the abandonment of the objective of keeping greenhouse gas concentrations to 550 ppm CO_2-e (assuming there is widespread support for this target as a starting point for negotiations).

Opposition is also unlikely to be confined to developing countries. Australia's targets under the Kyoto Protocol are lax. Garnaut's proposal is built on the arrangements under the Protocol and it results in Australia getting another generous allocation compared with other developed countries. It remains to be seen whether it is realistic to think that the remaining developed countries will accept such an outcome.

The risks associated with overshoot strategies

An overshoot strategy involves following an emissions trajectory whereby the atmospheric concentration of greenhouse gases and/or the global average surface temperature is allowed to exceed a specified target for a period of time before being reduced to the desired stabilisation level. Garnaut's overshoot strategy involves the atmospheric concentration of greenhouse gases reaching or approaching 550 ppm CO_2-e, before being brought down to 450 ppm CO_2-e. The rationale provided for this strategy is that it is the best possible outcome in the current political environment.

There are several risks associated with overshoot strategies. Firstly, the evidence suggests that increases in the global average surface temperature are irreversible on human timescales. Once temperatures exceed the desired target, it is unlikely they will be able to be drawn down for hundreds of years.

Secondly, there is a risk that if the atmospheric concentration of greenhouse gases exceed certain thresholds, even for a relatively short period of time, dangerous impacts may be triggered that are irreversible.

Thirdly, there is considerable uncertainty about the reductions in emissions that are necessary to stabilise and decrease the atmospheric concentration of

greenhouse gases. A major source of uncertainty associated with this issue concerns CO_2 and climate-carbon cycle feedbacks. At present, approximately 36.7 billion tonnes (Gt) of CO_2 (10 Gt C) is emitted annually from anthropogenic sources. Approximately 20.2 Gt (5.5 Gt C) of this is absorbed by terrestrial and oceanic sinks. On this basis, one could be lulled into thinking that the atmospheric concentration of CO_2 could be stabilised by reducing emissions to the level of the current natural sink (i.e. 20.2 Gt CO_2). If emissions were reduced to this level, emissions would initially stabilise. However, the uptake of CO_2 by the oceans would decline, and eventually cease, as the oceanic concentration of CO_2 equalises with the levels in the atmosphere. To ensure the long-term stabilisation of the atmospheric concentration of CO_2, emissions would have to be reduced below the initial level of the natural sinks. In addition, climate-carbon cycle feedbacks are likely to significantly reduce the strength of natural sinks, making the task of merely stabilising the atmospheric concentration of CO_2 more difficult.

Due to these factors, decreasing the atmospheric concentration of CO_2 in order to stay on an overshoot trajectory is likely to require emissions to be reduced to a small fraction of current emissions. How far emissions would have to fall, and how quickly the atmospheric concentration of CO_2 would decline, are unknown. The capacity to reduce the atmospheric concentration of CO_2 will depend on a number of unknown variables, including technological developments and the sensitivity of the climate system to the increase in the atmospheric concentration of greenhouse gases (i.e. the larger the temperature response the larger the likely carbon cycle feedback). There is a risk that emissions would not be able to be reduced to sufficiently low levels in the required period of time, and that the atmospheric concentration of CO_2 would not fall at the necessary rate.

Attempting overshoots may ultimately be necessary due to inadequate short- and medium-term abatement. As Garnaut notes, this is already the case for a 450 ppm CO_2-e stabilisation target. However, the successful achievement of the objectives of any overshoot strategy hinges on a number of uncertain variables. These factors and the risks of failure should be explicitly identified. In the case of Garnaut's two-staged 550/450 ppm CO_2-e strategy, there is an assumption that a substantial drawdown in greenhouse gas concentrations is achievable on relatively short timescales. This strategy presumes that in the latter part of the 21st century there will be the technological options, political will and near universal compliance necessary to reduce emissions to levels close to zero. There is a significant risk that the necessary conditions may not exist. Indeed, the pressure applied to human systems from climate change could substantially reduce the prospects of achieving the required emissions reductions.

Garnaut's targets and trajectories report does not contain any detailed discussion of the inherent risks in overshoot strategies. Some analysis of

these issues is provided in the draft report, however, it is limited. For example, he notes in the context of 'peaking profiles' (where the objective is to prevent concentrations exceeding a prescribed peak and then they fall indefinitely) that:

> A disadvantage of a peaking profile is that if the climate is found to be more sensitive to increases in greenhouse gases than anticipated, the more of the mitigation task left until later by delaying emissions reductions, the less flexibility there is to adjust to a lower concentration target later and an increased risk that a threshold may be crossed.

He also states that:

> Bringing emissions below the natural rate of sequestration would require rigorous reduction of emissions from all sources, but might also require extraction of carbon dioxide from the air.[5]

Given the importance of overshoots in Garnaut's proposed strategy, it is arguable that a greater analysis of the inherent risks in this approach was warranted.

Conclusion

The Garnaut Review's targets and trajectories report has been widely criticised. The focus of this debate has been on Professor Garnaut's acceptance of 550 ppm CO_2-e as the most realistic and achievable target. However, arguably more troubling aspects of the analysis are the chain of reasoning that led Garnaut to conclude that abatement targets of 10 per cent for 2020 and 80 per cent for 2050 for Australia are consistent with 550 ppm CO_2-e and the failure to fully explain the risks associated with the proposed overshoot strategy.

The suggestion that the proposed national abatement targets for 2020 and 2050 are consistent with a global 550 ppm CO_2-e stabilisation objective is based on questionable emissions assumptions and an inequitable method for devising national abatement targets. In truth, Garnaut's proposal is more consistent with a 650 ppm CO_2-e outcome. The 'best guess' of global warming at equilibrium associated with 650 ppm CO_2-e is 3.6°C and the upper end of the 'likely range' stretches to 5.5°C. This compares to 2.9°C and 4.4°C respectively with a 550 ppm CO_2-e target.

If there is political agreement that 550 ppm CO_2-e is a desirable stabilisation objective, Australia will have to adopt abatement targets in excess of those proposed by Garnaut. The argument that these targets are consistent with 550 ppm CO_2-e is unsustainable unless the scientific uncertainty surrounding

[5] Garnaut's draft report contains analysis of the extent of uncertainty associated with climate science and its impacts on policy processes (see Sections 3.5 and 9). However, most of the analysis of uncertainty is not explicitly linked to overshoots.

the global emissions budget is ignored and one assumes a dramatic shift in the negotiating principles adopted by other countries. The final report from the Garnaut Review should also contain a detailed analysis of the risks associated with the proposed overshoot strategy. While overshoots may be necessary, decision makers and the public should be made aware of the inherent risks in this approach.