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The Intergenerational Report and Climate Change

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Key points

- The 2021 Intergenerational Report (IGR) provides a clear qualitative description of climate issues but does not provide any quantification or even orders of magnitude of the effects that it identifies.
- Because of the nature of the modelling that underlies the IGR—particularly the assumption that productivity growth returns to long-run values—it is not possible to judge whether the GDP scenarios in the IGR are consistent with the qualitative climate story.
- Indeed, the productivity assumption in effect assumes away any specific climate-related issues.
- This is a missed opportunity, as climate change is a genuine *intergenerational* problem—surely a convincing candidate for an IGR.
- A modest suggestion presented here is that, without requiring a full-blown modelling exercise, the IGR could significantly enhance its contribution to climate issues by using the social cost of carbon (SCC) as a framework.
- Just as the IGR has generated many useful insights through consistent use of a simple growth model (the so-called PPP or 'three Ps' model), with some analysis well within the scope of the IGR it could similarly provide useful insights on climate issues.

Climate change in the IGR

The 2021 Intergenerational Report (IGR) (Commonwealth of Australia 2021) contains a clear, qualitative discussion of climate change (in addition to other environmental challenges) along with a summary of key climate policy measures underway at the time the IGR was prepared.

It sets out some broad channels of climate impact, noting climate change could affect agriculture, the resources sector and the financial sector. It also notes the challenges from emissions mitigation.

Two quotes from the IGR serve to illustrate the broad tenor of the qualitative discussion:

> Rising global temperatures and other changes to the climate will impact locations, sectors and communities in diverse ways driving both structural adjustments and corresponding innovation. Connecting innovation and investment in climate-resilient development can significantly increase the adaptive capacity of our regions, towns and cities.
>
> …
>
> Mitigation efforts will require a step-change in innovation and global collaboration to make new energy technologies commercial and scalable. (Commonwealth of Australia 2021:57)

Importantly, the IGR distinguishes 'physical' effects (that is, the effects of climate change itself) from 'transitional' effects (that is, the effects of mitigation measures designed to reduce emissions). Transitional effects include costs of our own abatement, as well as the net effect of abatement in other countries. On these two effects, the IGR notes:

> A reduction in real GDP associated with climate change would have a fiscal impact through reducing taxation revenue, as well as increasing pressure on expenditure. Other revenue sources such as fuel excise and mining royalties could also be affected by changes in demand and consumption related to a global transition away from fossil fuel use. (Commonwealth of Australia 2021:59)
>
> Any reduction in GDP is likely to be unevenly distributed across sectors and regions. The agricultural sector is particularly vulnerable to the physical effects of climate change, the resources sector is particularly vulnerable to the transition effects, and the financial sector is vulnerable to both. (Commonwealth of Australia 2021:60).

The IGR implies a clear expectation that climate change (either in the physical or transitional aspects) is likely to reduce GDP (or at least to reduce GDP relative to where it might otherwise be, although the IGR is not clear on this).

Despite a large amount of information available from already existing studies, however, the IGR does not quantify or present orders of magnitude of the GDP effects of climate change through any of the channels it identifies.

Available information on transitional and physical costs

On the question of the costs of abatement (what the IGR calls transitional costs), the Centre for International Economics (CIE 2019) provides a detailed summary of a decade of detailed economic studies and what they imply for the cost of abatement (Figure 10.1 provides a summary of abatement cost from an ensemble of model results). A key point from the figure is that each plotted data point represents a different model outcome, with a large number of points representing a large number of studies (particularly for lower levels of abatement). Importantly, several of the studies reviewed were undertaken by the Commonwealth Treasury itself. Silence about the cost of abatement in the IGR is not a question of lack of readily available information.

Similarly, on the 'physical' cost of climate change, consider two impact examples (literally chosen at random for the purposes of the discussion here, and importantly studies that were available at the time the IGR was prepared. Since then, of course, more information is available from the most recent Intergovernmental Panel on Climate Change reports).

Kompas et al. (2018) use a large computable general equilibrium model to look at the overall economic impacts of climate change defined along a temperature dimension. Figure 10.2 illustrates the loss in GDP (relative to what would otherwise be the case) for different temperature increases over the long run (after 2067). For illustration, Australia's results are presented in comparison with Indonesia and China. The results show a significant loss for Australia (just under 2 per cent), but an even larger loss for neighbours and trading partners.

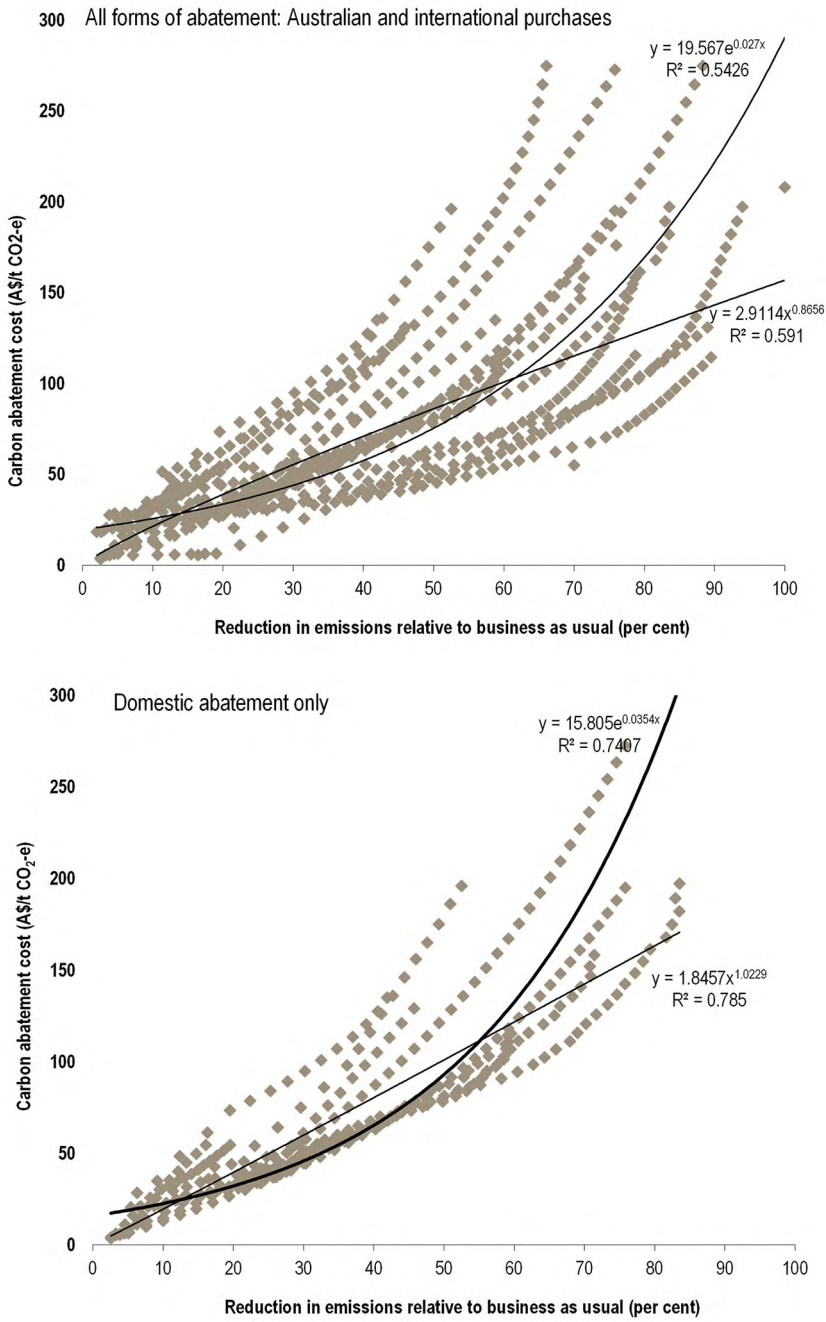

Figure 10.1: The marginal cost of abatement.

Source: CIE (2019).

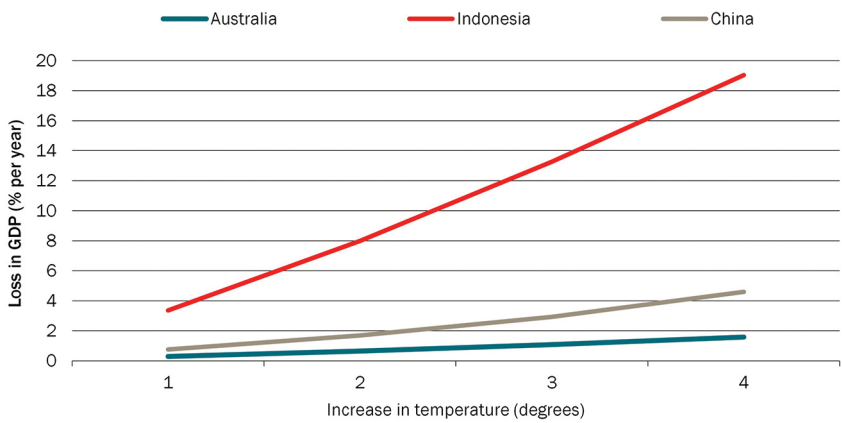

Figure 10.2: Loss in GDP for different temperature scenarios.
Source: Kompas et al. (2018).

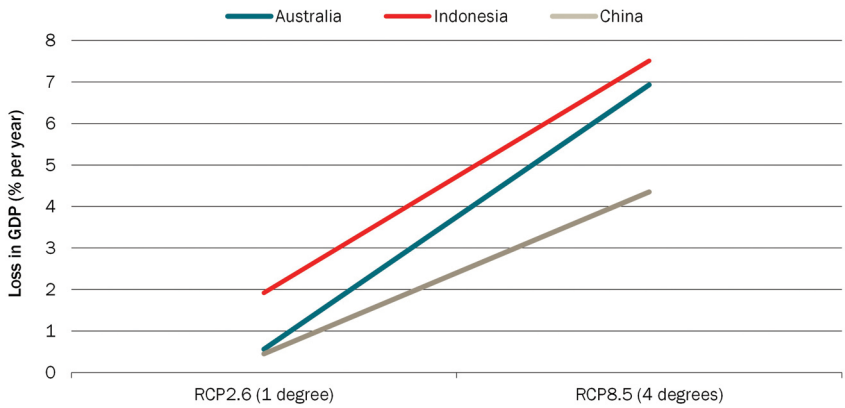

Figure 10.3: Loss in GDP for pathway scenarios.
Source: Kahn et al. (2019).

Along similar lines, Kahn et al. (2019), using a very different methodology (and defined against specific emissions pathway scenarios), look at the effects of climate change on a large panel of countries. Some key results are summarised in Figure 10.3. Again, there are significant potential losses in GDP for Australia and illustrative partners and trading countries.

Rather than explicitly using readily available information, the IGR implicitly assumes that despite climate change and the challenges it brings, (labour) productivity will converge to the long-run average under current policy settings. The modelling methodology used by the IGR does not allow us to assess whether this is reasonable or whether this is internally consistent with the qualitative story about climate change.

It's harder to go any further with the current IGR modelling framework

Put another way, it is hard to determine whether the qualitative discussion of climate change—and the clear expectation of structural changes and potential GDP loss—is, in any sense, consistent with the future pathway of GDP (and other aggregates) projected by the IGR.

This problem arises because of the very general nature of the methodology used by the IGR. Within the 'Population, Participation, Productivity' (PPP) framework the IGR uses, most of the impacts of climate change would appear in the 'productivity' component.

- For example, the net effect of unmitigated climate change could be to lower the productivity of agriculture (through reduced yields, more defensive expenditures on pests and diseases, higher infrastructure expenditure and so on).
- There are other effects of climate change such as sea level rise and tidal surges, which along with expectations of increased storms and flooding would either involve large recovery expenditures or defensive adaptation measures, all of which could appear as reduced economy-wide productivity.

In addition to these productivity effects, climate change and global climate mitigation policy are also likely to have a significant effect on Australia's trade composition and on Australia's terms of trade. Demand for Australian products is likely to shift away from fossil fuels, for example, and towards products that contribute to construction of renewable energy infrastructure.

In contrast to an approach of explicitly tracing through impacts that come along with mitigation and adaptation measures, a core assumption in the IGR (setting aside demographic considerations) is the expected pathway of productivity. The IGR states:

> This report, consistent with previous intergenerational reports, assumes that labour productivity growth converges to a historical average rate of growth. In this report underlying productivity growth converges to 1.5 per cent per year, the average growth rate in labour productivity over the 30 years to 2018–19. Given the current underlying productivity growth rate is below 1.5 per cent, it is

> assumed that the transition to the long-term growth rate of 1.5 per cent per year will take place over the next 10 years. (Commonwealth of Australia 2021:46)

How the return to long-run productivity growth—given that it is currently lower than the long-term average—comes about is not made explicit in the IGR.

Thus, rather than examining the future issues involved, this assumption has the effect of assuming any particular climate problems away. Productivity is assumed to return to the long-run average under current policy settings, so (by assumption) nothing in future climate outcomes will change this.[1]

The modelling framework used by the IGR essentially only allows this sort of very broad assumption. Explicitly linking climate change impacts to the IGR projections would require a much more detailed modelling framework.

Such frameworks, of course, already exist and have been extensively used by Treasury and others to consider macro-economic and structural implications of climate change.

A missed opportunity

The minimal treatment of climate change within the IGR is a missed opportunity. Climate change is a genuine *intergenerational* issue—a candidate for an IGR if there ever was one. Climate change extends well beyond the usual scope of government projections and the IGR is one of the few government documents that considers the longer term. Careful consideration of climate change is also consistent with the stated aims of the IGR:

> The role of the Intergenerational Report is to examine the long-term sustainability of current policies and how demographic, technological and other structural trends may affect economic growth and public finances. (Commonwealth of Australia 2021:xvi).

Climate policy is not set and forget: it will require ongoing attention and development at least until 2050 (for the current Paris Agreement commitments) and then well beyond that because, even with the Paris

1 This brings to mind the 'assume a can opener' economist joke, which is so prevalent that it now has its own Wikipedia page (en.wikipedia.org/wiki/Assume_a_can_opener).

Agreement, the issues are not 'fixed' in any sense—the implications of increased greenhouse gas concentrations will continue for many years even once annual emissions are reduced.

This leads to the question of how policy focus can be consistently maintained over time; in effect of how it can be coordinated over time. This is particularly challenging as the full scope of policy response is well beyond the tenure of individuals currently in government or in business (this is not just a government problem):

> Emissions pledges often have agreeably long deadlines. The tenures of bosses have been shortening. The revolving doors of most C-suites will have spun several times before chief executives of multinationals are expected to keep promises made by predecessors. (Financial Times 2021)

Even today, there is limited coordination between different elements of climate policy. It is not unusual for analysis of the benefits of mitigation to use different values for each ton of carbon abated, and different policies have very different implicit costs of carbon. And, as is well known, Australian policy has been notably unstable over the past decade or so.

Is it possible for the IGR to make some contribution to dealing with these issues?

A modest suggestion

In between the current treatment of climate in the IGR and a comprehensive modelling effort, there is a modest possibility—well within reach of the resources available for the IGR—to enhance the analysis of climate change within the IGR to provide a role in the intergenerational understanding of climate change.

The suggestion is that the IGR uses the concept of the social cost of carbon (SCC) to draw together the current (that is, at the time of each IGR) quantitative understanding of key elements of climate challenges. This is not a suggestion for a full revamped modelling exercise. While this would be good, and appropriate, there is a risk that it will be seen as well beyond the scope of the IGR as currently understood.

The suggestion here is much more modest and easily achievable. Essentially, it is that the IGR use the SCC as a tool and framework to consider broader issues around climate change.

This suggestion comes by making an analogy with how the IGR works for other issues. In the current and past editions, the IGR has successfully used a simple PPP growth framework as a means to discuss future issues. Rather than being a complete or comprehensive modelling approach, it is, instead, a way of thinking through issues to help frame future problems.

The PPP framework is a decomposition of elements of growth from one particular perspective. It essentially involves pulling apart an identity and considering each piece of that identity. To be blunt, no one perceives the PPP framework as a sophisticated forecasting model. But it is a powerful 'pedagogical' tool to work through important determinants of future growth.[2]

As illustrated below, the SCC can be used as a framework to expose and think through a range of issues that need to be confronted—in exactly the same way that demographic changes, or participation or broad productivity issues, need to be confronted.

The social cost of carbon

According to William Nordhaus (winner of the 2018 Nobel Prize in Economics):

> The most important single economic concept in the economics of climate change is the social cost of carbon (SCC). This term designates the economic cost caused by an additional ton of carbon dioxide emissions or its equivalent. In a more precise definition, it is the change in the discounted value of economic welfare from an additional unit of CO_2-equivalent emissions. (Nordhaus 2017:1518)

The SCC of carbon is well embedded in the economic literature of climate change and has received considerable attention in the United States, where it forms the basis of a number of regulatory measures (as discussed in Nordhaus 2017). The SCC is, in effect, a measure of the benefit of abatement and provides a benchmark for how much abatement should take

2 Here I'm using 'pedagogical' in a loose sense referring to teaching people how to think through a particular problem. Thus, several iterations of the IGR have 'taught' the audience to think about growth in terms of its PPP components.

place given a particular SCC. It is a number that can enter into benefit–cost calculations around particular climate policies or projects, showing the degree to which benefits offset the costs of mitigation. At the same time, the SCC is closely related to adaptation in that adaptation (at a cost) lowers the future SCC. The SCC creates a pivot to compare both mitigation and adaptation.

The SCC has received less attention in Australia for a variety of reasons; in part because the large modelling exercises undertaken by the Australian government over the past 10 years (see CIE 2019) focused mostly on the mitigation costs of achieving a particular target and not on whether that target had benefits greater than costs.

Further, there is no point pretending that issues around the practical measurement of the SCC have been resolved—they have not. Indeed, there is considerable disagreement about the appropriate values for the SCC. Some have suggested abandoning it altogether (see, for example, Pezzey 2018), while others have noted serious problems with the integrated assessment models (IAMs) typically used to derive the SCC.

For example, work by Robert Pindyck critiques the use of IAMs.[3] He argues that:

> These models have crucial flaws that make them close to useless as tools for policy analysis: certain inputs (e.g., the discount rate) are arbitrary, but have huge effects on the SCC estimates the models produce; the models' descriptions of the impact of climate change are completely ad hoc, with no theoretical or empirical foundation; and the models can tell us nothing about the most important driver of the SCC, the possibility of a catastrophic climate outcome. (Pindyck 2013:860)

Cass Sunstein (who headed the White House Office of Information and Regulatory Affairs in the Obama administration) recently reflected:

> Working on the social cost of carbon, to produce a concrete number, may have been the most difficult task of my professional life. It was difficult in part because of the known unknowns, and the unknown unknowns, and the challenge of deciding how to handle

3 See in particular his 'Climate change policy: What do the models tell us?' and 'The use and misuse of models for climate policy', both available at web.mit.edu/rpindyck/www/papers.htm. The same arguments appear is his book, *Climate Future: Averting and Adapting to Climate Change* (Oxford University Press, 2022).

> them. In some respects, we were flying blind. Dozens of people were involved; many of them were experts on science, economics, or both. They disagreed on fundamental issues. They disagreed vigorously about the magnitude of the harmful effects of greenhouse gas emissions. They disagreed about how much was known and how much was unknown. They disagreed about how to handle the possibility of catastrophe and whether to build in a large margin of error, which would produce a much higher number. We were able to reach agreement, but it took many months, and (to put it gently) not everyone who joined the agreement thought that the resulting number was the best choice. (Sunstein 2021:1–2)

Uncertainty (and disagreement) is the point

Despite these issues surrounding the SCC, for our purposes here—to propose a means by which the IGR can contribute to intergenerational climate issues—the SCC provides a useful framework to consider climate-related issues. Indeed, disagreements about the SCC tells us something fundamental about the nature of the climate problem. Examining the SCC and pulling apart its components provides a framework for thinking through the issues (directly analogous to the PPP framework).

Calculating and understanding the SCC requires:

- Modelling the link between emissions and greenhouse gas concentration levels (this is usually undertaken in large-scale climate models, and often summarised in IAMs).
- Establishing the link between greenhouse gas concentration and changes in temperature and other relevant 'physical' climate outcomes such as sea level rise, rainfall changes, frequency of storms and so on. (Again, this is usually undertaken in large-scale climate models, summarised in IAMs—although most IAMs focus on temperature change only.)
- Establishing a link between the climate outcomes above and relevant economic variables. This is often termed the 'damage function': for a given increase in temperature, how much is economic activity affected. These damages are usually measured in terms of GDP, but in principle there is no reason why any other relevant measure of economic wellbeing could not be used.

- Calculating future damages for each year, and then using an appropriate discount rate to bring these back to today's dollars.
- Confronting the uncertainty inherent in each of these steps and calculating how uncertainty itself affects the SCC.

It is true that every one of these linkages is uncertain. And it is precisely this uncertainty that provides the opportunity to confront a variety of perspectives and broaden the understanding within the IGR.

The argument put here is not that the IGR could, or should, resolve a single specific value for the SCC, but that the IGR could use the inherent structure of the SCC to further discuss the long-term implications of climate change. Subsequent analyses and tracking over time would institutionalise a substantive body of information that could extend well beyond any single report or administration. It would, over time, 'teach' readers how to think about quantitative elements of the climate issue (in the same way the IGR has already taught about the components of growth).

This suggestion would allow the IGR—within a constrained and manageable framework—to more explicitly confront trends that 'may affect economic growth and public finances' (Commonwealth of Australia 2021:xvi). It would allow, for example:

- **Explicit consideration of the 'damages function'.** This is an open area of research that is continually evolving. But being explicit about the damages function allows consideration of different views in policy development. A less steep damages function tends to lead to a lower SCC (all other things equal). Arguing for less (more) action on climate change is consistent with arguing for a less (more) steep damages function.
- **Explicit consideration of the discount rate.** This will help provide guidance on long-term coordination of climate policy. (As an aside, it is telling that the IGR does not mention the discount rate at all.) A lower discount rate tends to raise the SCC (all other things equal). Arguing for less (more) action on climate change is consistent with arguing for a higher (lower) discount rate. The discount rate is a central concept in all intertemporal policy, and explicit discussion in the context of the IGR would allow a lot more information to emerge than typically does in policy discussion.

- **Explicit consideration of uncertainty.** Uncertainty is often seen as something of a nuisance in climate policy. In contrast, *climate policy is actually about uncertainty*. Uncertainty is not a bug, but a feature. All other things equal, uncertainty tends to *increase* the SCC. That is, uncertainty implies doing more, rather than less (see, for example, Van den Bremmer and Van der Ploeg 2021).

Another perspective on lessons from the SCC

There is a final, slightly oblique take on the SCC that also helps clarify a question that currently confronts any analysis of mitigation measures. This question is whether any cost–benefit analysis looking to value mitigation should use a global SCC (that is, the cost to the whole world) or the Australian cost of carbon (cost to Australia only). These two provide very different answers. This is also related to the more primitive question of why we should worry about Australia's marginal abatement given that it has no effect on the climate.

This take comes from a remarkably useful article from the late Martin Weitzman. Published in *Economica*, Weitzman (2017) sets out a thought experiment (what he calls a parable) he had developed over time in a number of previous articles. He seemed to consider the *Economica* article a better presentation. The journal is probably not that widely read outside a circle of specialists, but the overall argument deserves much wider understanding.

The thought experiment is the idea of a World Climate Assembly (WCA), in which countries come together to vote on a binding global carbon price. This carbon price is imposed everywhere, and nations are allowed to keep the relevant revenue. The key element of Weitzman's paper is the analysis of the price that is likely to emerge from this process (under the conditions of the thought experiment, of course—Weitzman recognises the practical issues involved).

Consider thinking about what price to vote for from Australia's perspective. Australia might initially want to vote for a very low price, because every increase in the world carbon price imposes cost on us (as we reduce emissions in response), but with very little benefit because Australia's reduction in emissions are tiny compared with the world.

But at the same time, every increase in the world price also induces abatement everywhere else in the world, which compared with Australia's abatement is very large. From Australia's point of view, there is a large abatement 'multiplier' for every increment in the world price. Large global abatement is exactly what Australia wants as this reduces Australia's climate risk. Australia ends up with much more benefit from global abatement than our own abatement cost.

Thus Australia (and every other country) faces this interesting trade-off in choosing a price to vote for.

What Weitzman goes on to show—under simplifying but not unreasonable assumptions—is that the price chosen by a majority rule voting in the WCA is something very close to the global SCC.

The whole argument is subtle (typical of Weitzman's work) for it shows us that the *global* SCC is an appropriate metric for decisions within Australia because it is consistent in dealing with the global externality associated with climate change—the fact that Australia needs the whole world to abate in order to minimise our climate risk. Further, Australia should do at least the abatement consistent with that global SCC (despite our emissions being small) because that is again consistent with achieving global outcomes that are in Australia's interest.

In summary

The IGR currently has a minimal treatment of climate change; both in detail and in overall conception of how climate issues affect future outcomes.

One solution to this would be to fundamentally overhaul the modelling strategy underlying the IGR to include full modelled climate treatment. We know from past analyses that this is well within the capacity of Treasury (in combination with other Australian modellers).

If this seems too daunting, however, a minimalist suggestion is to upgrade the approach in the IGR by explicitly considering the social cost of carbon (SCC) as part of the analysis. Done properly, this could make a major contribution to long-term climate analysis.

As this chapter has tried to illustrate, this will bring both a means to reconcile diverse perspectives on climate issues as well as a way of confronting and managing issues to do with the climate damage function, the discount rate and uncertainty. Further, proper consideration of the SCC helps resolve some underlying policy disagreements as to the appropriate carbon price to use in benefit–cost analysis as well as the reasoning behind Australian action, even though Australia's emissions are globally small.

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This text is taken from *More Than Fiscal: The Intergenerational Report, Sustainability and Public Policy in Australia*, edited by Andrew Podger, Jane Hall and Mike Woods, published 2023 by ANU Press, The Australian National University, Canberra, Australia.

doi.org/10.22459/MF.2023.10