

Warwick McKibbin  
**Flaws in climate-change research need fixing**  
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#### WEEKEND ESSAY

It is common to read that temperatures are likely to rise by up to 7 degrees Celsius over the next 100 years. Where does this number come from? It is the most extreme temperature from a range of possible projections in the Special Report on Emissions Scenarios (SRES) published by the Intergovernmental Panel on Climate Change (IPCC). The IPCC was established by the World Meteorological Organisation and the UN Environmental Program to "assess the scientific, technical and socio-economic information relevant for the understanding of human-induced climate change". The SRES developed a range of emission scenarios to provide "input for evaluating climatic and environmental consequences of future greenhouse gas emissions and for assessing alternative mitigation adaptation strategies".

The temperature projections are generated by climate models that depend critically on projections of future greenhouse gas emissions from economic/energy models. Yet there is a vigorous debate about how these projections of greenhouse emissions should be undertaken. Many questions have been raised about the approach of the SRES, which forms the basis of almost all recent analyses of the impacts of climate change.

One criticism, by Ian Castles (a former chief Australian statistician) and David Henderson (a former chief economist at the OECD), examines the plausibility of assumptions underlying some of the SRES scenarios. A key assumption is the rate at which developing countries might grow over the next century. In some scenarios the IPCC assumes that countries with low per-capita incomes relative to the wealthiest country will grow faster so their incomes tend to catch up. The growth rate depends on how the initial income gaps are measured. These can be measured using market exchange rates. But it's more accurate to use the concept of purchasing power parity, which tries to exclude distortions in market exchange rates (which don't reflect underlying real incomes) by carefully adjusting for the value of a standard bundle of goods.

The differences in incomes calculated by these two methods are large, especially for developing countries. The ratio of incomes per capita in the OECD economies relative to those in the Asia region in 1990 is 33 times if measured at market exchange rates (as in the SRES) but only nine times larger at purchasing power parity exchange rates (as calculated by leading economist Angus Maddison).

This is an enormous difference. In theory this difference should matter for the growth rates in a convergence model. Using market exchange rates, faster economic growth would be required for incomes in developing countries to catch up to developed countries. With faster economic growth, carbon emissions would likely be higher when using market exchange rates than when using purchasing power parity. Since it is not clear in practice whether this result will hold because of potential offsetting factors, this can be run through models to find out.

In a recent study published by the Lowy Institute for International Policy together with David Pearce and Alison Stegman, we explore a range of methodological issues surrounding projecting greenhouse emissions over the next century. Understanding future-emission scenarios requires a framework that deals with the sources of economic growth and allows for endogenous structural change. One of the issues explored was the "convergence" of

incomes across countries and the Castles and Henderson critique of the use of market exchange rates instead of purchasing power parities to measure income differentials.

Using the G-Cubed multi-country model, one of the major global economic models used for climate-change policy evaluation, we show that emission projections based on convergence assumptions using market exchange rates can be 40 per cent higher by 2100 than emissions generated using purchasing power parities.

This supports the argument by Castles and Henderson that the use of market exchange rate assumptions relative to PPPs in an economic model like G-Cubed will likely overestimate emissions projections. This is because market exchange rates overestimate the initial income gaps and hence the amount of economic growth required for developing countries to "catch up" to incomes in industrial economies. With higher economic growth in developing countries, emissions of carbon are higher both in developing countries and industrial countries because of the increased demand for energy globally generated by higher wealth.

It is surprising that the IPCC has dismissed the Castles and Henderson critique. These results show this is a potentially important issue in at least one of the leading global climate models. It is true that we can't be sure what this result from the G-Cubed model actually means for the SRES projections, because it might be argued that in the models used in the SRES there could be substantially more endogenous changes in technology that will change the relationship between economic growth and carbon emissions. We do not have access to those models to explore this issue and can only show what this particular assumption implies in the G-Cubed model. It is also unclear exactly what the IPCC did in the SRES report about convergence assumptions in some scenarios.

Another problem with the SRES methodology is that it follows a "storyline approach" in which there is no assessment of the likelihood of alternative scenarios. For each scenario, a set of assumptions about economic, social and political conditions over the next century is created and emission outcomes projected from a range of models. This means users such as policymakers, and advocates for either the "take extreme action" or "do nothing" approaches, can choose from a range of possible futures to suit their own agenda.

All those who desire a serious debate on climate-change policy options should be concerned that some analyses of the impacts of future climate change are based on the extreme outliers (in both directions) from the SRES without any understanding of the probability of these outcomes. A probabilistic approach could be done using the economic approach proposed in the G-Cubed model, or with the existing range of SRES scenarios, to better inform the debate on future greenhouse scenarios.

It is unfortunate that the rather technical debate on methodology of climate projections is often used to argue that climate change does not exist. That is not what our results show. Our results reinforce the reality that there is a great deal of uncertainty about future climate projections and that this uncertainty needs to be reflected in the projections. The uncertainty also needs to be reflected in the types of policies implemented. For example, the McKibbin Wilcoxon Blueprint ( [www.sensiblepolicy.com](http://www.sensiblepolicy.com)), which distinguishes between the short- run cost of action and long-run targets for emissions, is an attempt to deal with this uncertainty in a much better way than the Kyoto Protocol. The blueprint implements firm policy actions that should reduce emissions but allows policymakers to collect information on climate and costs and flexibly adjust to this information. This approach is far better for handling uncertainty than the Kyoto approach of specifying rigid short- term targets and timetables irrespective of cost and information on the climate.

Climate change is a potentially important environmental problem. It is critical that the technical analyses used to inform policy decisions, and which drive other research on the impacts of climate change, be thoroughly understood, openly debated and, whenever possible, improved. The problems with the SRES that have been identified by many different people should be openly addressed before using this body of research as the basis for the next round of scientific assessment.

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