Beyond 2015 and the Paris Agreement: Projecting Future Global Warming & Information Conflicts

Carbon Budgets: A Decision-making Aid or the Decision Endpoint?

Dr Ted Christie, *27 September 2017*

Disclosure Statement

Ted Christie does not work for, consult to, own shares in or receive funding from any company or organisation that would benefit from this article, and has no relevant Carbon

TAGS: Carbon budgets; global temperature rise; science; models; uncertainty; decision-making; conflict; MIT; Nature Geoscience; Carbon Brief

A research study posted by ***NASA*** on 18 January 2017 titled, "*NASA, NOAA Data Show 2016 Warmest Year on Record Globally*", reported that the planet's average surface temperature increased by about 1.1°C from the late 19th century to 2016.

The temperature goals of the Paris Agreement are to keep global temperature rise this century well below 2°C above pre-industrial levels; and to pursue efforts to limit the temperature increase even further to 1.5°C.

The IPCC Fifth Assessment Report (2014) identified the key drivers of future climate and the basis on which projections are made. Beyond the 2015 Paris Agreement, cumulative emissions of CO_2 will ***largely determine global mean surface warming*** by the late 21st century and beyond.

Following the entry into force of the Paris Agreement,
scientific debate has ignited
an information conflict:
Whether the temperature goals of Paris resonate
with current NDC emission pledges and
warming of about 1.1 °C from the late 19th century to 2016.

The source of this information conflict is not simply the effective communication of complex climate science in a form that is understood.

Instead, the varying accuracy of simulation models, and the reliability of their projections for long-term global warming risk, under the Paris Agreement.

There would be no dispute that scientific information arising from modelling of future global warming, should facilitate informed decision-making by UNFCCC Parties to achieve the Paris Agreement's temperature goals.

But what is not clear is what role
science has in the decision-making process?

Pathways for Evaluating Global Warming Risk

One scientific pathway to determine if the Paris Agreement's temperature goals will be achieved is to assess the impact of the current NDCs on cumulative CO_2 emissions and ***global temperature rise,*** beyond 2015.

A recent example of this approach was a 2017 study undertaken by a research team from the *MIT Joint Program on the Science and Policy of Global Change*. Several scenarios based on different mitigation policies were evaluated.

The effects of these policies and the Paris Agreement pledges (NDCs) of 188 countries - *for the years 2020-2030* – on global temperature rise, were projected to 2100. The ***research study*** concluded that:

- *"By 2100, the Paris Agreement NDCs reduced the surface air temperature considerably, but still exceeded the 2°C goal by about 1°C";*
- *If the same level of commitment for the Paris Agreement's NDCs were to be retained after 2030, the study indicated a 95% probability that the world will warm by more than 2°C by 2100.*
- *The Paris Agreement was only a step - but certainly a step in the right direction - to the right path for keeping warming under 3°C.*

The concept of a ***carbon budget*** is an *alternative scientific pathway* to determine if the Paris Agreement's temperature goals will be achieved. Its origin was the *IPCC First Working Group Report of the Fifth Assessment Report (2013).*

A ***carbon budget*** is the maximum amount of carbon emissions that can be released into the atmosphere while keeping a reasonable chance of staying below a given temperature rise e.g. the temperature goals of the Paris Agreement.

The carbon budget requires emissions to move to zero. Zero emissions are required to ensure cumulative emissions do not continue increasing and result in the carbon budget being "blown".

The *IPCC Fifth Assessment Synthesis Report (2014)* used different scenarios for making projections, across a broad spectrum of CO_2 emission scenarios that could be emitted. Surface air temperature rise was to be limited to no more than 1.5°C, 2°C or 3°C above pre-industrial levels.

Each scenario presented the total carbon budget from the beginning of the industrial revolution, the amount used from 1870 to 2011 and so the amount remaining at the start of 2011.

The following carbon budget is an example for an IPCC scenario compatible with a 1.5°C goal:

- *Total Carbon Budget @ Pre-Industrial: 2250 Gt CO2*
- *Amount Remaining @ 2011: 400 Gt CO_2*

The challenge for climate science, in this example, would be to predict how many years of future emissions it would take to use up the remaining *400 Gt CO_2* of the carbon budget?

CASE STUDY: Time for a Carbon Budget to Reach Zero Emissions - 1.5°C goal

In 2016, ***Carbon Brief*** addressed this challenge: -

- Carbon Brief *used estimates for world-wide CO_2 emissions – fossil fuel use burning, cement production and land use change - between 2011-2015 from the* Global Carbon Project. *The conclusion? At the start of 2016, the carbon budget had almost halved to 205 Gt CO_2; and*
- *If the current rate of emissions continued, the 1.5°C budget would be used up in a little over 5 years, sometime in 2021.*

Next, the global climate models used in the *IPCC First Working Group Report of the Fifth Assessment Report (2013)* were the subject of research analysis by a research team led by Dr Richard Millar, University of Oxford. Their research was published on ***18 September 2017 in Nature Geoscience***[1] .

Significant finding of their analysis included: -

- *By taking a better account of past emissions and where we are today, in terms of human activities that have led to global warming, keeping surface average temperature rise to no more than 1.5°C above pre-industrial levels was still possible;*

- *That the IPCC global climate models tend to overestimate the extent of global warming that has already occurred;*
- *That, in order to keep temperatures below 1.5°C beyond 2015, the amount of carbon that could be emitted from human activities was almost three times greater than estimated by the IPCC.*
- *This study raises concern over the reliability of existing carbon budgets.*

F(Utility) of Carbon Budgets

There are several ways to construct carbon budgets. Whether to focus on cumulative emissions of CO_2 only, or all GHG emissions, is but one issue. So, it is not surprising that the article in *Nature Geoscience* galvanised reaction - both positive and negative – to add to the controversy over carbon budgets.

One response captured both sides of the controversy:

> The ***carbon budget concept*** has been described as "*a brilliant way to illustrate the importance of zero emissions, the need for rapid mitigation, and to compare different temperature targets. We need it for that*".
> "[But] *one thing this paper* [Nature Geoscience] *has convinced me, is that the carbon budget concept is just simply too uncertain to be of any practical use in policy*".

Notwithstanding the latter viewpoint, it is significant that the ***MIT (2017)*** and the ***Nature Geoscience (2017***) research articles shared ***common ground*** on one aspect of future action for global warming.

The research study acknowledged that
although global temperature rise was significantly reduced,
much more was needed if the Paris temperature goal
of limiting warming to 2°C or less was to be achieved. **[MIT, 2017]**

AND

Achieving the goal for a 1.5 °C rise is possible
if the current Paris Agreement pledges up to 2030
were subject to a modest strengthening,
followed by deep and rapid reduction in carbon emissions thereafter.
[Nature Geoscience, 2017]

Climate science has been thrust on to centre-stage of a global "forum", composed of UNFCC Parties, with a common goal: To achieve the aims of the Paris Agreement.

What is the role of science in this "forum"? **How can information conflicts over the accuracy of global warming projections be resolved?**

In this regard, the current controversy, as well as, any scepticism over climate science and the wide variations in projections for the long-term climate impacts of the Paris Agreement, parallels an "equivalent" global problem that confronted environmental science and law in the past.

Environmental Impact Assessment ("EIA"): The Role of Science in Informed Decision-making

The approval process for actions that may have a "significant" effect on the environment, required Federal Agencies in the USA to prepare an environmental impact statement ("EIS") as the first stage of the EIA process.

The origin of the EIS was the United States statute, the *National Environmental Policy Act of 1969* ("NEPA"), signed into law on 1 January 1970. NEPA has been referred to as possibly being "*the most successful legal export in history*" as it has been a model for over 100 countries.

Like the IPCC documents prepared for climate change, the EIS is a carefully researched report which identified the potential environmental consequences of a proposed development or activity or policy, alerting the government, developer and the community, as fully as possible, to any future environmental risks, and their extent, associated with the proposal.

Also, like the IPCC documents prepared for climate change, scientific information in the EIS is a cornerstone for decision-making. However, limitations in the scientific database *e.g. lack of reliable and relevant scientific data, misinformation, incomplete and inaccessible information*, made scientific certainty in the EIS problematic.

These limitations led to concerns for science over the accuracy of the EIS predictions. For example, in the 1990s an Australian research study that compared the predicted environmental impacts in an EIS, with the actual impacts following completion of the proposal development, concluded: -

"At present, in Australia at least, our predictions are less than 50% accurate on average and over two orders of magnitude out on occasions."

So, it is relevant to see how the legal process – legislation or judicial decision-making – then addressed this problem for science, the environment and law i.e. by defining the ***role of the EIS for decision-making*** by Government Agencies in deciding whether a proposal - that may have a "significant" effect on the environment - should be approved, with or without conditions, or rejected?

The approach taken in the United States was regulatory control and judicial application: ***"An EIS is to serve practically as an important contribution to the decision-making process and cannot be used to rationalise or to justify decisions already made".***

A judicial approach was taken in Australia by the Land and Environment Court of New South Wales: ***"An environmental impact statement is not a decision-making end in itself... its purpose is to assist the decision-maker."***

As was the case for Australia, a judicial approach was taken in England. A majority decision of the Court (*Privy Council*) adopted the observations of the above Australian court.

CONCLUSIONS

1.0 Contrary to a long-held misconception, science does not generate exact knowledge with logical certainty. The option taken by climate science, in this regard, is to project findings on future warming and cumulative CO_2 emissions at defined levels of probability for achieving the temperature goals of the Paris Agreement. It is also relevant that the Paris Agreement does not impose an obligation on UNFCC Parties to be bound by the findings arising from the IPCC scientific database.

2.0 Against the background of these features, climate science should adopt the approach taken for environmental management in circumstances when uncertainty exists in the accuracy of future projections. That is, modelling studies e.g. *carbon budgets and global temperature rise,* should be an aid for informed decision-making by policy-makers, not the decision end-point.

3.0 The information conflicts that have arisen for research on carbon budgets and global temperature rise could be offset using a ***data mediation using a scientific round-table***. The round-table would be convened by the *Task Force on National Greenhouse Gas Inventories*. The Task Force is responsible for assessing and developing inventory methods and practices which are scientifically sound and relevant for all countries.

The members of the round-table would be leaders of international modelling groups representing a broad spectrum of global climate interests. The outcome would be to agree, by consensus, on the accepted methodology – including all underlying assumptions – as well as the relevant and reliable scientific evidence to be applied; all in accord with the standards and criteria of science.

4.0 The common ground between the *MIT (2017) Global Temperature Rise study* and the *Nature Geoscience (2017) Carbon Budget study* on future action for global warming illustrates a significant element for informed decision-making. The two research approaches for studying a common climate change goal are essential complements.

Where common ground exists between these two different approaches, it increases the power of science and so the weight given to the findings for policy.

5.0 To achieve its long-term temperature goal, Article 4 of the Paris Agreement requires, amongst other things, for emission reductions to be in accordance with "*best available science*", and on the basis of "*equity*", and in the context of "*sustainable development*" and efforts to "*eradicate poverty*".

Future carbon budgets need to integrate equity and sustainable development in the model's framework. They are key elements for climate policy and ensure decisions lead to viable outcomes securing as much available value as possible.

---

[1] *NATURE* | NEWS Jeff Tollefson 18 September 2017 ***Nature*** **I doi:10.1038/nature.2017.22627**
"Limiting global warming to 1.5 °C may still be possible"
Analysis suggests that researchers have underestimated how much carbon humanity can emit before reaching this level of warming.