The WRE concentration stabilization profiles: History and application to the Paris Agreement

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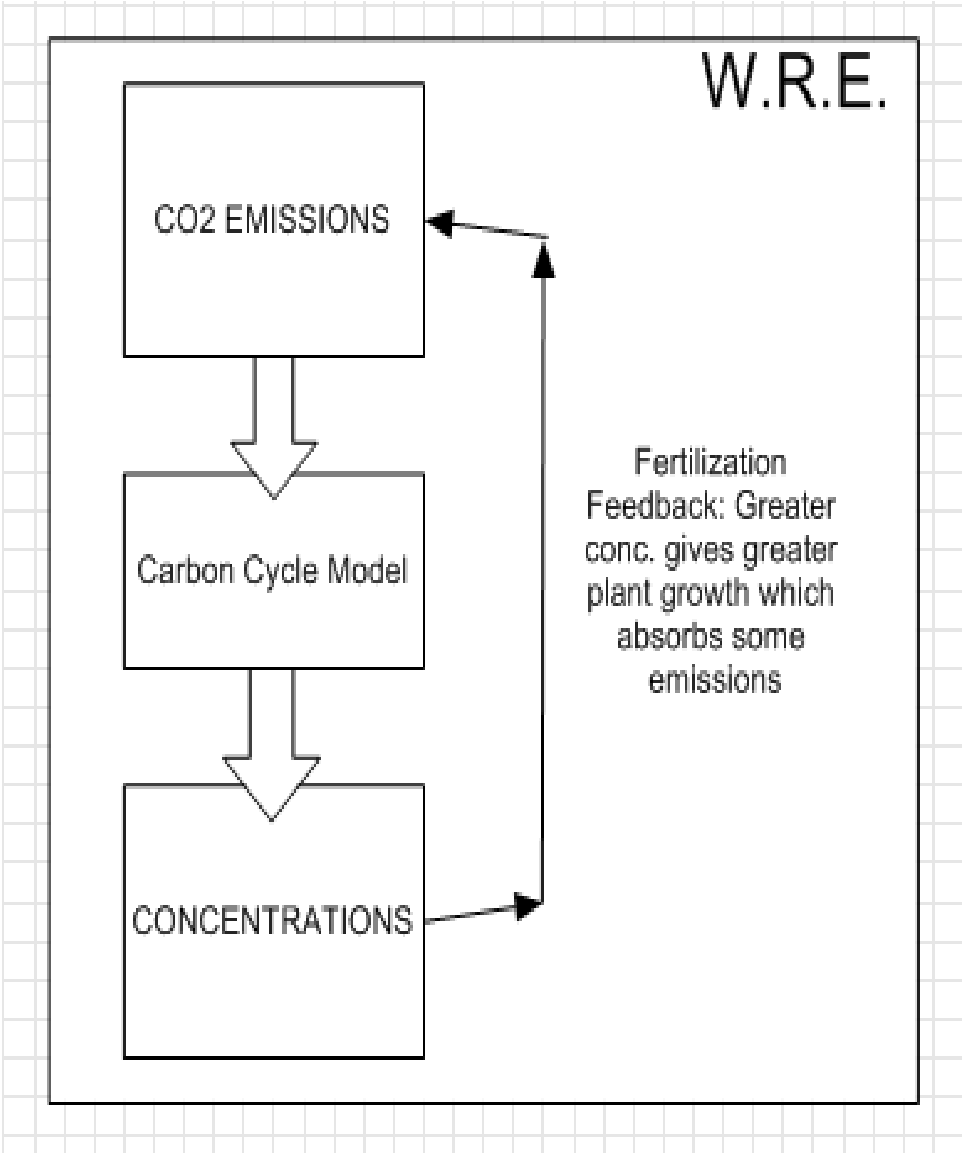
WRE philosophy.

In the 1990s there was renewed interest in the issue of CO2 concentration stabilization (and the attendant stabilization of climate).

We considered a range of concentration stabilization targets from 350ppm to 750ppm and used an inverse carbon cycle model to determine the emissions required to follow the specified concentration stabilization profiles.

MODELLING STRATEGY



The flowchart illustrates the normal forward calculation, CO2 emissions to implied concentrations. The WRE analyses employ an inverse calculation, from specified concentrations back to implied emissions.

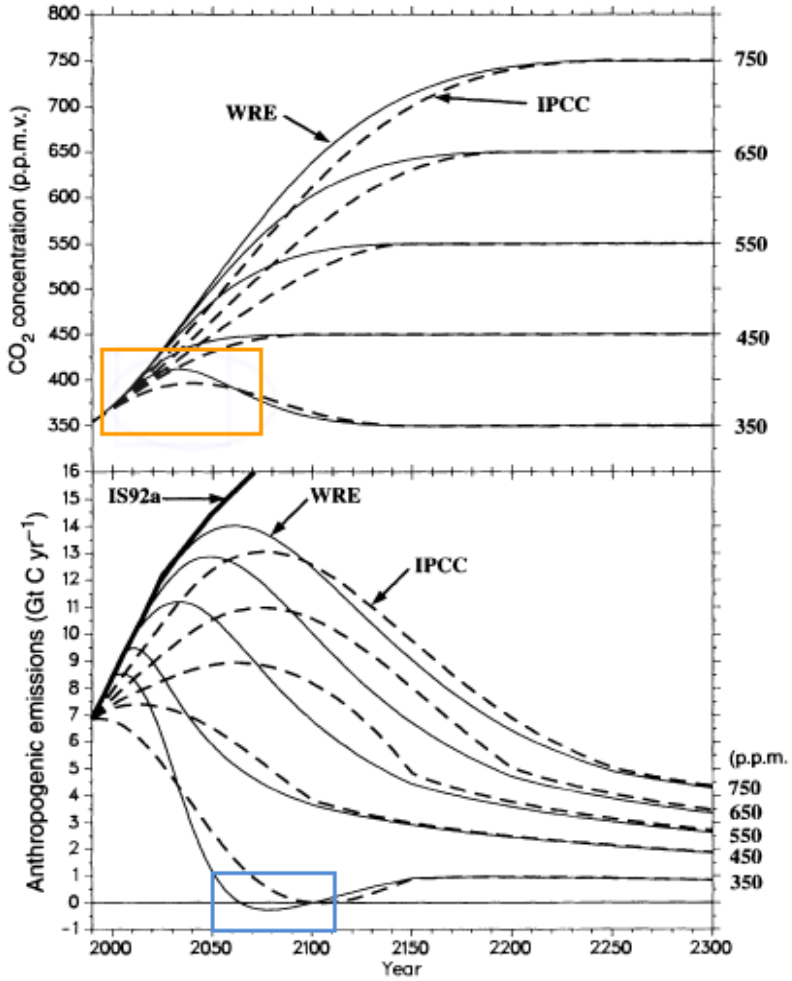


FIG. 1 Top, IPCC WGI[1,2] (dashed lines) and revised concentration profiles (WRE (this paper), solid lines) for stabilization of CO_2 at 350–750 p.p.m.v. Bottom, implied anthropogenic emissions using the model of Wigley[5]. IS92a is shown (thicker line) for comparison. Emissions were calculated following the procedure in ref. 1 in which the terrestrial biosphere sink is characterized solely by CO_2 fertilization of net primary productivity.

From Wigley, Richels, Edmonds, Nature 379, 240-243, 1996.

Original published WRE results.

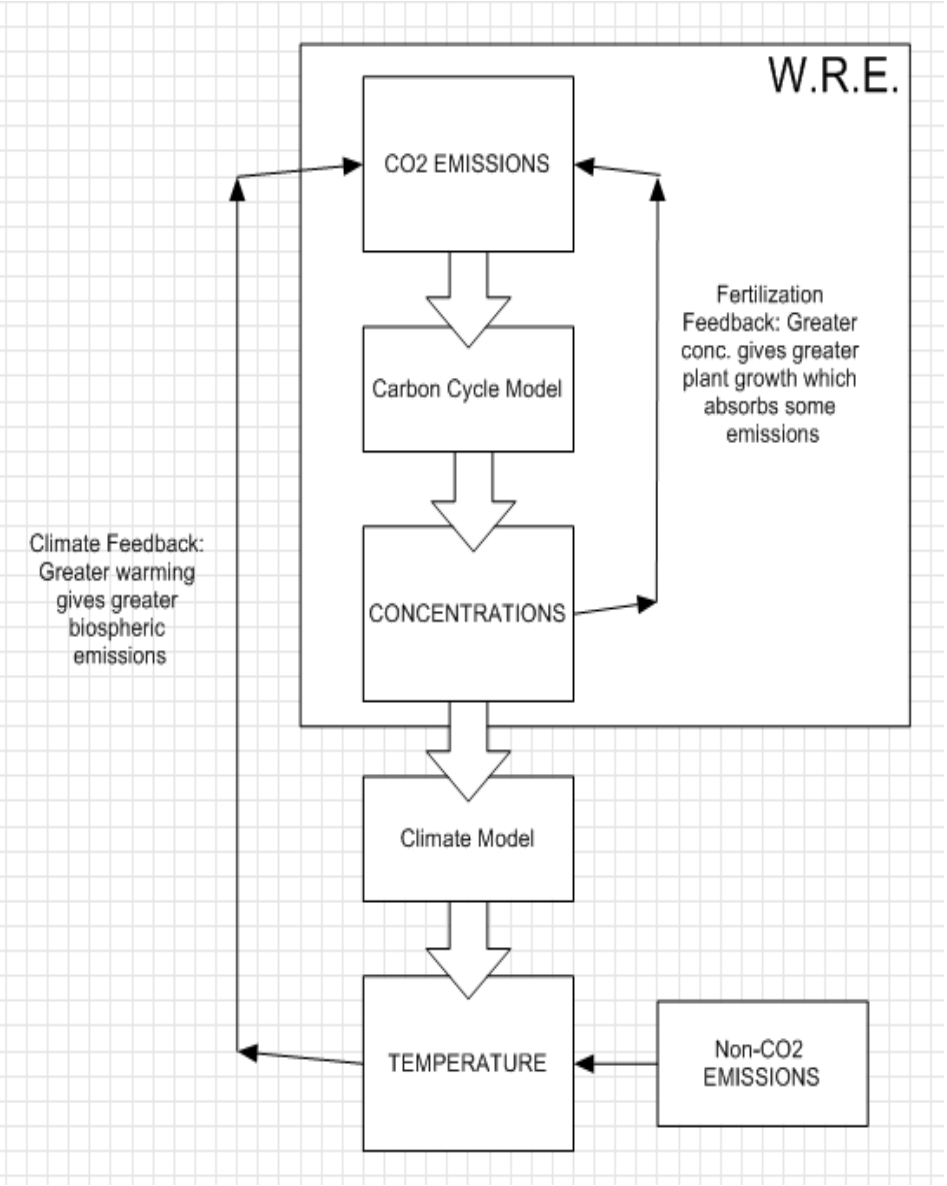
The higher the stabilization level, the longer can the no-policy baseline emissions trajectory (IS92a) be followed.

There are two things to note here.

First, the 350 ppm concentration profile necessarily **overshoots** the eventual concentration stabilization target**,** anticipating the likely need today for a temperature overshoot to meet the 1.5C Paris target.

Second, with the 350 ppm case, a short period of **negative emissions** is required**.** It is possible that negative emissions may be required to meet the 1.5C Paris temperature target, although this depends on the extent and duration of any assumed warming overshoot.

PARIS AGREEMENT EXTENSION



Extension of WRE procedure to determine the emissions required to match a specified temperature pathway consistent with the Paris Agreement targets.

The flowchart illustrates a normal forward calculation. The Paris analyses employ an inverse calculation from a specified temperature pathway back to the required emissions.

The Paris Agreement …

Mitigation efforts should be directed towards "Holding the increase in the global average temperature to well below 2C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5C"

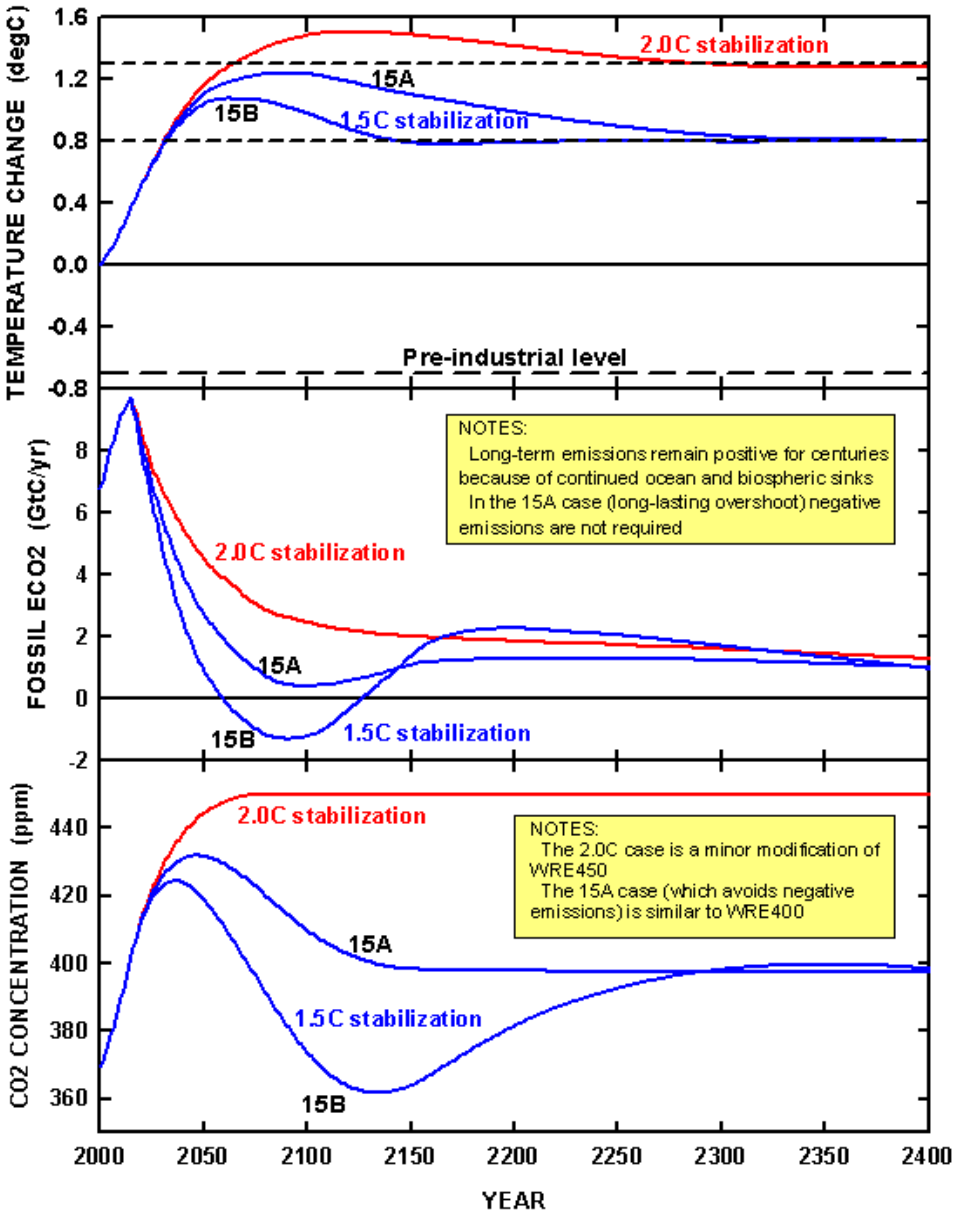
Question: What future CO2 emissions are required to meet these goals?

The way we answer this question is …

First define temperature pathways (top panel)

Then use an inverse carbon cycle/climate model to determine the emissions (middle panel)

From this we can calculate future CO2 concentrations (bottom panel).



CONCLUDING POINTS

(1) The WRE scenarios (and their Paris extensions) only consider **global** concentrations, temperatures and emissions.

(2) The two 1.5C Paris cases illustrate “when flexibility” (Richels presentation).

(3) “Where flexibility” (i.e., country-specific mitigation pathways) is a crucial issue (Edmonds presentation).