Agree to Disagree on 2°C Target

Recent debate on global warming is often premised on the assumption that the goal should be the "2°C target" of holding global average temperatures within 2°C compared to the pre-industrial level. **Professor Yamaguchi Mitsutsune** argues that this target is inappropriate and that attempting to achieve it would only falter midway, ironically worsening the environmental impact.

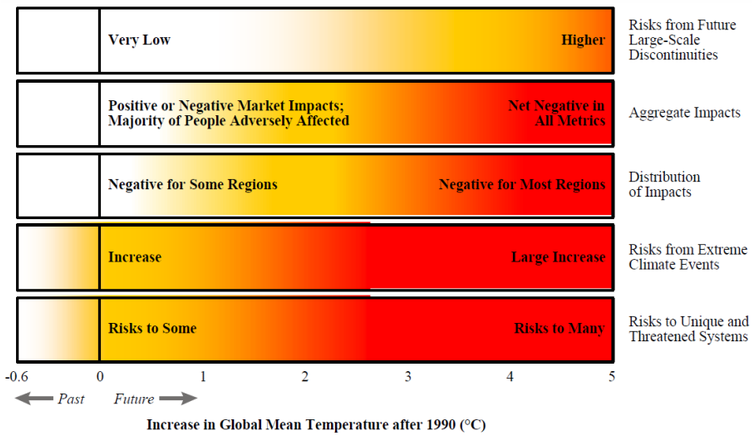
It was the European Union that first proposed the "2°C target" for global warming, in 1996. Section 6 of the agreement reached by the EU Environment Council that year noted: Given the serious risk of such an increase and particularly the very high rate of change, the Council believes that global average temperatures should not exceed 2°C above the pre-industrial level and that, therefore, atmospheric concentration levels lower than 550 ppm (parts per million) CO_2 should guide global limitation and reduction efforts. As seen from this view, the basis at that time was an abstract idea, namely that of a "serious risk of temperature increase." Scientific views have since moved forward, and the Third and Fourth Assessment Reports (2001 and 2007, respectively) of the Intergovernmental Panel on Climate Change graphically express the extent of damage associated with rises in temperature. For the sake of ease of understanding, I will use the figure from the Third Assessment Report.

In **Figure 1**, darker shades indicate greater degrees of damage. The IPCC's Fourth Assessment Report suggested that if temperatures rise greater than 2°C –3°C from 1990 levels, it is very likely that all regions will experience either declines in net benefits or increases in net costs (IPCC/AR4/WG2/TS p. 65).

The important point to note here is that the IPCC's base year for computing the increase in temperature increase is 1990. By 1990, temperatures had risen about 0.6°C from the pre-industrial level, so if the increase in temperature from the 1990 level is held within 2°C–3°C, the increase above the pre-industrial level works out to 2.6°C–3.6°C. From the IPCC's report, it does not follow that the temperature must be limited to within 2°C above the pre-industrial level.

Also, Figure 1 assumes that absolutely no adaptation is taken. But since it is inconceivable that nothing is done in the face of impending danger, the need for the 2°C target decreases even further if adaptation measures taken are considered.

Figure 1: Increase in Impact and Damage (no adaptation)



Source: IPCC/TAR/WG2/TS, p.71

Ultimate Objective of Countermeasures

Article 2 of the United Nations Framework Convention on Climate Change refers to the ultimate objective of measures to combat global warming, namely the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." However, there is no definition here of concentrations that are not dangerous (or the temperature increases involved). Figure 1 shows how the relationship between temperature increases and damage differs for five categories of risk. A person regarding the damage to ecosystems as a risk may consider a temperature increase of 2°C from 1990 levels to be "dangerous," and a person who regards significant and irreversible damage like the collapse of the West Antarctic Ice Sheet as a risk may not consider a rise of 3°C as dangerous. The question of what to regard as "dangerous" is not a question science can answer.

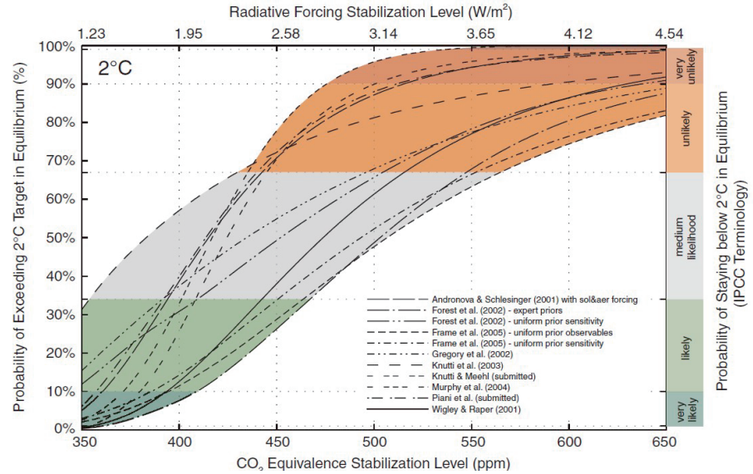
Costs and Benefits

An associated condition of Article 2 of the UNFCCC is that such a level of concentration which is not dangerous "should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner." The IPCC Fourth Assessment Report also notes, "The choice of a stabilization level implies the balancing of the risks of climate change (… including risks for food security, ecosystems and sustainable development) against the risk of response measures that may threaten economic sustainability" (IPCC/AR4/WG3/Ch.1 p. 97). This is to say that the costs of countermeasures and the benefits of avoiding the dangers of warming should be balanced. A number of difficult problems would be involved in the assessment of costs and benefits of global warming response measures, including discount rate (the rate at which the cost of future damage should be discounted to present value) and the possibility of measuring in monetary terms damage which has no market value, including damage to ecosystems. Based solely on a cost/benefit analysis, it is difficult to make a clearly delineated decision as to how far countermeasures should be pursued.

For example, according to the analysis of William Nordhaus, who used a traditional economics approach, a 2°C target would be excessive. However, an analysis by Nicholas Stern using a discount rate of 0.1% concluded that it would work adequately. The results are completely inconsistent. Still it does not justify ignoring costs and benefits when considering measures to combat warming.

Another dispute surrounds the treatment of major natural disasters with a very small likelihood of occurrence (the "fat tail" problem). I cannot discuss this here due to space limitations, but resolution of this issue is also problematic as it involves a kind of value judgment.

Figure 2: Probability of Increase Exceeding 2°C at Different CO_2 Equivalence Stabilization Levels



Source: M. Meinshausen, "What Does 2°C Target Mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Estimates," H-J. Schellnhuber ed., *Avoiding Dangerous Climate Change*, Chapter 28

Uncertainties

A major feature of the problem of climate change is the existence of uncertainties. Among these, climate sensitivity (the extent of temperature increase in the event concentration doubles) is estimated at 2°C to 4.5°C, which is very broad. **Figure 2** presents eleven different findings using a number of different climate sensitivities. It illustrates the relationship between the CO_2 equivalent (CO_2e) stabilization level (horizontal axis) and the probability of an increase in climate temperature exceeding 2°C above the pre-industrial level.

The stabilization level corresponding to a target of 2°C is generally put at 450 parts per million CO_2e, but as shown in Figure 2, the probability of an increase exceeding 2°C is about 25% to 75%. If temperatures are to be held absolutely within 2°C, even 350 ppm CO_2e would be inadequate. This concentration has already been exceeded at the present time, and considering the growth of developing countries, there is virtually no chance of it being achieved, unless dreamy technologies would appear with reasonable cost. From this perspective as well, it would be inappropriate to adhere to a 2°C target.

Feasibility

The IPCC Fourth Assessment Report states that holding the temperature rise to 2°C versus the pre-industrial level would require stabilization at around 450 ppm CO_2e and, toward that end, reduction of global CO_2 emissions by at least 50% versus 2000 levels by 2050. Since the global emissions total in 2000 was 22.7 billion tons, this means cutting emissions to not more than 11.3 billion tons by 2050 (excepting international marine and air transport). On the other hand, the UN predicts that the global population, mainly due to an increase in developing countries, will grow from 6.1 billion to 9.2 billion over this fifty-year period. This means that per-capita emissions must be cut from the level of 3.7 tons per year of 2000 to 1.2 tons per year by 2050.

Let us perform the calculations separately for advanced industrialized nations and developing nations. If the advanced nations cut their emissions by 80% by 2050 to 2.8 billion tons, the quota remaining for developing countries to achieve a reduction of half would be 8.5 billion tons. This works out to per capita emissions of 1.1 ton for developing countries, a reduction of half compared to the level of 2.3 tons for 2005. A reduction of 80% for advanced nations by 2050 is itself very severe, so is it really possible that developing nations, growing as fast as they are, can reduce their per capita emissions by half? (China would have to achieve a reduction of 70% since it is already at about 4 tons.) I have my doubts.

To summarize the foregoing, I believe any attempt to make it legally binding for the world's nations to achieve a target of 2°C would ultimately fail before it could be achieved. Given major uncertainties, it would be most realistic for each country to make the greatest effort it can, based on the Copenhagen accord and the Cancun agreement, and then to consider resetting targets after further knowledge becomes available. A strong weak agreement is better than a weak strong agreement that may collapse.

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