Making Plans for the Paris Climate Conference

What needs to be done to ensure the upcoming COP 21 conference in Paris is a success? **Yamaguchi Mitsutsune**, Visiting Professor at the University of Tokyo, comments.

On 12 November 2014, China, the world's largest greenhouse gas (GHG) emitter, and the United States, the world's second largest greenhouse gas emitter, agreed to combat global climate change (GHG reduction/control targets). This is the so-called U.S.-China Joint Announcement on Climate Change. According to this announcement, the United States intends to achieve an economy-wide target of reducing GHG emissions by 26% to 28% below its 2005 level by the year 2025. China intends to achieve the peaking of CO_2 emissions around 2030, and increase the share of non-fossil fuels in primary energy consumption to around 20% by 2030.

These two countries, which had no obligation until then to reduce/control GHG emissions, even announced their resolve to play a leading role in building a global agreement at the twenty-first session of the Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change (UNFCCC), which is scheduled to be held in Paris in December 2015.

Combined with the EU's resolution to reduce its GHG emissions by 40% below its 1990 level in 2030, the impact of this bilateral commitment is extremely significant, and there are some who are already optimistic that an ambitious agreement involving the participation of all countries will be reached at the conference in Paris. It is noteworthy that the U.S.-China Joint Announcement stipulated that the two nations are mindful of the 2 degree goal, which is the internationally agreed de facto target for limiting the increase of the temperature below two degrees above the pre-industrial level.

The top-down approach applied for the Kyoto Protocol set the upper limit of global GHG emissions and allocated emissions allowances to each country, though limited to industrialized countries, with the aim of achieving collective target. Unfortunately, this model did not work properly. Based on previous experience, many think it is certain that a new agreement, if any, in Paris will be based on a bottom-up approach in which each country pledges its own specific target. In this case, each country will make a pledge to achieve an ambitious target, while taking into consideration its individual situation. However, it is quite likely that even an aggregation of those targets will fall far short of the 2 degree target. If this gap is excessively large, it will become clear that the target will fail within a few short years, and a global awareness of climate change will suffer, potentially undermining the effectiveness of response measures. We must consider what needs to be done to make the Paris conference a success in these circumstances.

The Emergence of the Overshoot Scenario and the Disappearance of the 50% Global GHG Reduction Target

First and foremost, global leaders must recognize that scientific findings about climate change have changed. Global GHG emissions continued to increase even after 1997 when countries all around the world agreed on the Kyoto Protocol. The emissions ultimately reached 49 Gt in 2010, along with a significant increase in emissions in emerging economies. The IPCC Fourth Assessment Report (AR4), which was published in 2007, specified the range of temperature increases corresponding to multiple levels of GHG concentration, and the percentage of emissions reduction in 2050 to realize this range. The report states that the GHG concentration to achieve the 2 degree target will be about 450 ppm CO_2-equivalent. To realize this target, the report claims global emissions need to be reduced by 50–85% below 2000 levels by the year 2050. In response to this estimate by the IPCC, the international community has intended to reduce GHG emissions by 50% by 2050 (the "50% Global GHG Reduction Target toward 2050") to achieve the 2 degree target. For this target, it is necessary to note that the designated GHG concentration and the targeted upper limit for temperature increase were based on the assumption that they would eventually stabilize at these levels. However, as a result of a recent drastic rise in global emissions, it has become impossible to draw scenarios, especially for the ambitious 2 degree target, in which the GHG concentration and the temperature gradually increase toward stabilization. Subsequently, this simulation was replaced by the "overshoot scenario," which predicts that the GHG concentration (or possibly temperature) will have exceeded the targeted level by 2100 and then decline to a certain level (overshoot scenario). In fact, the IPCC Fifth Assessment Report (AR5), which was published in 2014, specified rigid targets based on this scenario. Consequently, in the AR5 the 2 degree target has been changed from the eventual 2 degree stabilization set in the AR4 to a target of preventing the temperature from rising more than two degrees by 2100.

In accordance with this estimate, **Table 1** shows the percentage of 2050 emissions reduction (relative to the base year of 2010) needed to achieve the 2 degree target based on the AR5 scenario, and the likelihood of achieving the respective targets. (The author edited the table based on Table SPM.1 and Table 6.3 in AR5 to make it simple for readers' convenience.) When the AR5 was announced, many media reports claimed it would be necessary to reduce GHG

emissions by 41–72% by the year 2050 to achieve the 2 degree target. This corresponds to a 28–66% reduction if compared with emissions of the year 2000 as was done in AR4 (see the parenthesized numbers in Table 1). In AR5, the above estimate was based on the assumption that the likelihood of achievement probability would be greater than 66%. If we allow to lower the likelihood of achieving the target to 33–66%, the target can be attained with emissions reductions of at least 8–47% below the 2000 levels. This is the amount of reductions required based on the latest scientific findings. It is essential for world leaders to understand that the 50% global GHG reduction by 2050 is unnecessary when assessing the pledges made by each country at the Paris conference.

Table 1: Concentration, Increase in Temperature, and the Percentage of Emissions Reduction Required to Achieve Targets

CO_2eq Concentrations in 2100 (CO_2-eq) Category label (Conc. Range)	Subcategories	Change in CO_2-eq emissions (in %)		Likelihood of staying below 2°C over the 21st century (relative to 1850–1900)
		2050 compared to 2010	2050 compared to 2000	
450 (430 – 530)	Total range	-72 to -41	(-66 to -28)	66 – 100%
500 (480 – 530)	No overshoot of 530 ppm CO_2eq.	-57 to -42	(-47 to -29)	> 50 – 100%
	Overshoot of 530 ppm CO_2eq.	-55 to -25	(-47 to -8)	33 – 66%

Note: The table above was edited on the basis of multiple charts drawn up by IPCC/AR5. The percentage of 2050 emissions reduction required to achieve targets compared to 2000 (the parenthesized numbers in the table) is based on the author's calculations.

Table 2: Changes in Climate Sensitivity and Best Estimate in IPCC Reports

IPCC Report	Published in	Climate sensitivity	Best estimate
1st Assessment R.	1990	1.5 – 4.5 °C	2.5 °C
2nd Assessment R.	1995	1.5 – 4.5 °C	2.5 °C
3rd Assessment R.	2001	1.5 – 4.5 °C	2.5 °C
4th Assessment R.	2007	2.0 – 4.5 °C	3.0 °C
5th Assessment R.	2014	1.5 – 4.5 °C	Not shown

Can the U.S.-China Joint Announcement on Climate Change Achieve the 2 Degree Target?

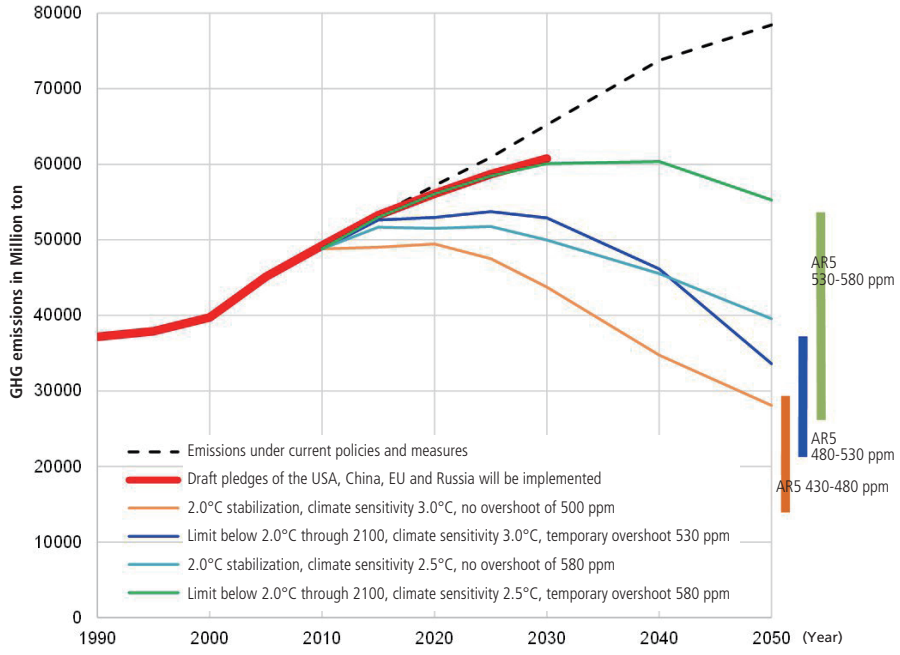
The biggest challenge in tackling climate change is uncertainty. Factors of uncertainty include the effect and cost of mitigation/adaptation and the damage caused by climate change. In addition, the uncertainty of climate sensitivity poses one of the greatest challenges. Climate sensitivity (strictly speaking, Equilibrium Climate Sensitivity) means an increase in global mean surface temperature caused by a doubling of the atmospheric CO_2 concentration. The AR4 specified the likely range of climate sensitivity is 2 to 4.5 degrees, but the AR5 lowered the figure to 1.5 to 4.5 degrees. For reference, **Table 2** shows the changes in climate sensitivity and the best estimates in IPCC Assessment Reports.

Considering the remarkable uncertainty that exists in the relationship between the CO_2 concentration and the increase in temperature, it is conceivable that there will be a huge range in the CO_2 concentration needed to achieve such as the 2 degree target, which in turn makes it more difficult for the entire world to implement measures. This is why the percentage of emissions reduction required to achieve targets is often calculated by using the best estimate of climate sensitivity. As shown in Table 2, the best estimate specified in the AR4 was 3 degrees. The percentage of emissions reduction required to achieve the 2 degree target was also calculated by applying this best estimate in AR4. On the other hand, the AR5 did not provide a best estimate because experts failed to reach a consensus. As a result, the AR5 did not present a specific figure for the best estimate to be used in similar calculations. However, the AR5 must have used a certain figure of climate sensitivity to calculate the figure in **Table 1**. The author will avoid giving a detailed explanation due to the limit on the length of this paper, but if we carefully read the AR5 and refer to its source materials, we find that the AR5 used 3 degrees for climate sensitivity. It is illogical, however, that while providing no best estimate in AR5 to use the best estimate of AR4, i.e. 3 degrees, without giving a clear-cut explanation. The question here is what level the best estimate will be now and how much influence does it have?

The IPCC has continued to rely upon the literatures of the Atmosphere-Ocean General Circulation Model (AOGCM) to estimate climate sensitivity. The application of this model shows that both climate sensitivity and the best estimate are the same as those specified in the AR4. However, this model cannot properly account for the hiatus in the temperature increase that has continued since 1998. In the meantime, an increasing number of literatures based on the observed warming since pre-industrialization show both climate sensitivity and its best estimate are rather lower. The AR5 reflects this estimate by presenting a lower figure for climate sensitivity. Although, as mentioned above, the AR5 did not provide a specific figure for the best estimate, it is logical to speculate that best estimate is lower than 3 degrees. [For example, a climate sensitivity of 1.25 to 2.45 degrees (17% to 83% range) and a median estimate of 1.64 degrees were presented in "The implications for climate sensitivity of the AR5 forcing and heat uptake estimates" (Lewis. N. and Curry. J., (2014), *Climate Dynamics*, DOI 10.1007/s00382-014-2342-y).]

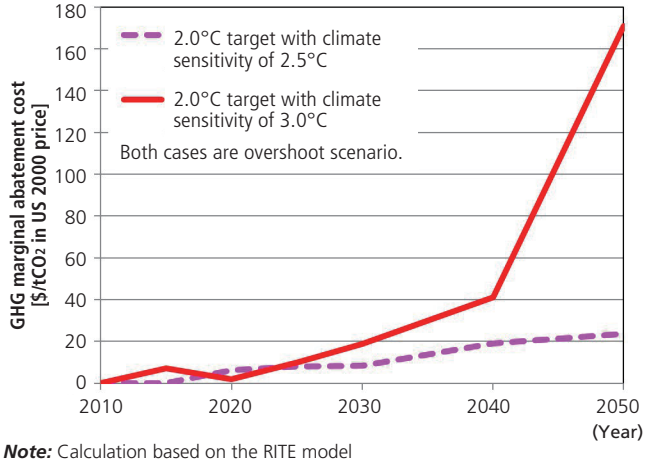
Given the uncertainty of climate sensitivity, is the U.S.-China Joint Announcement compatible with the 2 degree target? In addition to the United States and China, as of this time the EU (40% reduction below its 1990 level by the year 2030) and Russia (25–30% reduction below its 1990 level by the year 2030) have announced their pledges towards 2030 (the target year of 2025 is for the United States only). **Figure 1** illustrates the relationship between global GHG emissions in 2030

Figure 1: The U.S.-China Joint Announcement on Climate Change and the Likelihood of Achieving the 2 Degree Target



Source: RITE

Figure 2: Carbon Price to Achieve the 2 Degree Target (2010 to 2050)



Note: Calculation based on the RITE model

that takes into account the above four (provisional) emission pledges, the Global EmissionsTrajectory based on the four pledges — GET4Ps — and the achievement of the 2 degree target. The bold red line in the figure indicates the GET4Ps. Please note that China's peak GHG emissions in 2030 was estimated as 15 Gt.

Figure 1 also presents a total of four emission trajectories towards 2050 on the basis of the simulated climate sensitivity of 3 and 2.5 degrees, with a focus on the classification of the 2 degree stabilization scenario and the 2 degree overshoot scenario. The simulation shows that only the 2 degree overshoot scenario in which climate sensitivity is 2.5 degrees and the GHG concentration temporarily overshoots 580 ppm (green line), is compatible with the GET4Ps. This suggests that if climate sensitivity is 3 degrees, pledges in the U.S.-China Joint Announcement are completely inadequate for achieving the 2 degree target. However, if climate sensitivity is 2.5 degrees, the target might just be achievable if we overlook a considerable level of overshoot. It should be noted, however, that in this case we must reduce global emissions rather drastically after 2050.

According to an estimate presented by the Research Institute of Innovative Technology for the Earth (RITE), a Japanese think tank, if climate sensitivity merely changes from 3 to 2.5 degrees, the marginal abatement cost (carbon price) in 2050 in overshoot scenarios will fall from 171 to 24 dollars/tCO_2, a reduction of nearly 86% (see **Figure 2**). This demonstrates that, under the lower climate sensitivity, achieving the 2 degree target will become feasible and that international cooperation will be able to maintain momentum towards the aim of achieving reduction targets even after the conference in Paris.

Conclusion

To secure the participation of all countries by accepting their ambitious pledges will be of paramount importance in the negotiations at the conference in Paris. It is also necessary to secure compatibility with the 2 degree target in view of previous negotiation processes. To this end, the international community should share a common recognition of the latest scientific findings for achieving the 2 degree target (reducing GHG emissions by at least 8% to 28% below the 2000 level by the year 2050). Moreover, it is essential for experts to reexamine best estimate, including the post-AR5 literatures, on the basis of recognition that if the climate sensitivity is 2.5 degrees, it will be possible to achieve the 2 degree target.

In addition, the pledges each country makes need to be sufficiently ambitious and convincing in terms of efficacy and equity. In closing, the author would like to stress the significance of establishing various indexes for ex-ante and ex-post evaluation of pledges.

Note: This paper was written following my series of discussions with Dr. Kaya Yoichi, RITE President, and Dr. Akimoto Keigo, RITE System Analysis Group Leader. I would like to express my sincere gratitude to them for their helpful suggestions.

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