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Current trends of international assessments of greenhouse gas emission mitigation scenarios

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The IPCC 5th Assessment Report (AR5) are scheduled to be completed in 2014. The Working Group III assesses mitigation options and the report ”Climate Change 2014: Mitigation of Climate Change”, will be released in April 2014 after the approval in the 39th Session of IPCC. Scenario analysis and modeling exercise by the integrated assessment model (IAM) provide a key element in the AR5 report. A number of international inter-model comparison projects are formulated mainly in the United States and EU countries in an effort to make contribution to the IPCC AR5 report.

This paper introduces that the current trends of international assessments of greenhouse gas (GHG) emission mitigation scenarios with the key points which have been described in the AR5 and the key outcomes of the international IAM comparison projects. In addition, international research cooperation activities for harmonizing socioeconomic scenarios for the future IAM assessments, which is named SSPs (Shared Socioeconomic Pathways), will be introduced.

The Fourth Assessment Report (AR4) of IPCC WGIII which was published in 2007 provided six categories for broad ranges of several emission pathways provided by IAM estimations. The lowest level of GHG concentration stabilization is 445-490 ppm CO2eq and the emission pathways correspond to 85-50% reductions of global emission by 2050 relative to the 2000 level. The report summarized that the emission pathways will be expected to the equilibrium global mean surface temperature of 2.0-2.4C increase relative to pre-industrial level. The assessment had a strong impact on the international climate change negotiations and domestic measures of climate change response. Long-term target of 2C and halving global emissions by 2050 have been widely discussed in international negotiations such as UNCCC/COP and G8 after the release of AR4, while IPCC never recommends a specific target and policy.

A lot of assessments for emission reduction scenarios by IAMs particularly for deep emission reduction scenarios such as 450 ppm CO2eq, have been conducted after the AR4. The assessments also include many overshoot scenarios which are temporally over 450 ppm CO2eq and then achieve 450 ppm CO2eq in 2100 as well as 450 ppm stabilization scenarios, because current global emission increases are large due to the increases in developing countries, and it is difficult to develop emission reduction pathways with reality in near-term emissions for 450 ppm CO2eq stabilization without overshoot.

One of the inter-model comparison projects, AMPERE (Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates) project which was funded by the European Commission provided the feasibility of significant emissions reduction for a variety of mitigation technology portfolios. The project assessed that the feasibility for deep emission reductions such as 450 ppm CO2eq and the emission reduction costs under several conditions of technology unavailability and the near-term emissions locked into by the Cancun pledges. With significant emission reduction until 2030, the required annual emission reduction to meet 450 CO2eq target diverges from the historical rates of change. If the emissions pathways are locked into the low ambitious Cancun pledges to 2030, further improvement is required after 2030. There are many infeasible results to meet the stringent target in model calculation, if there are technological constraints in the availability of CCS, nuclear and renewable energy particularly under the near-term emissions locked in. The emission reduction costs are also very high and almost double or more compared with the idealistic conditions. These assessments which consider realistic conditions in IAMs are one of the progresses after the AR4.

The AR5 of IPCC will includes such new assessments will make impacts on international climate policies after the release.

Keywords: climate change, global warming mitigation, emissions scenarios, IPCC, integrated assessment model