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An Economic Aspect of the AVOID Programme: Analysis Using the AIM/CGE Model

Ken'ichi Matsumoto (1) and Toshihiko Masui (2)

(1) National Institute for Environmental Studies, Center for Global Environmental Research, Japan (matsumoto.kenichi@nies.go.jp), (2) National Institute for Environmental Studies, Social and Environmental Systems Division, Japan

This presentation purposes to show the results of the analysis that the AIM/CGE [Global] model contributed to Work Stream 1 of the AVOID programme. Three economic models participate in this WS to analyze the economic aspects of defined climate policies, and the AIM/CGE [Global] model is one of them.
The reference scenario is SRES A1B and five policy scenarios (2016.R2.H, 2016.R4.L, 2016.R5.L, 2030.R2.H, and 2030.R5.L) are considered. The climate policies are expressed as emissions pathways of several gases such as greenhouse gases and aerosols.

The AIM/CGE [Global] model is a recursive dynamic global CGE model with 21 industrial sectors and 24 world regions. These definitions are based on the GTAP6 database and it is used as the economic data of the base year. Some important characteristics of this model can be summarized as follows: power generation by various sources (from non-renewables to renewables) are considered; CCS technology is modeled; biomass energy (both traditional and purpose-grown) production and consumption are included; not only CO2 emissions but also other gases are considered; international markets are modeled for international trade of some fossil fuels; relationships between the costs and resource reserves of fossil fuels are modeled. The model is run with 10-year time steps until 2100.
For the reference case, there are no constraints and the model is run based on the drivers (assumptions on GDP and population for A1B) and AEEI. The reference case does not have the same emissions pathways as the prescribed emissions for A1B in AVOID. For scenario cases, the model is run under emissions constraints. In particular, for each policy scenario, the constraint on each gas in each 10-year step is derived. The percentage reduction in emissions that occurs between the AVOID A1B scenario and the particular policy scenario, for each gas in each 10-year period is first calculated, and then these percentage reductions are applied to the AIM reference case to derive the constraints for each gas over the 21st century.

The main results provided to AVOID were carbon prices and GDP for each scenario case. About the carbon prices, the results show that the higher the emissions reduction rate and the earlier the peak, the higher the carbon prices will be, and the prices tend to be higher over time ($536/tCO2 in 2100 for 2016.R5.L). These trends are quite different from those of the E3MG model which assumes constant carbon tax for each scenario ($232/tCO2 in 2100 for 2016.R5.L). In addition, the higher carbon prices are necessary in the AIM/CGE model than the E3MG model, especially in the latter half of the century. About the GDP trends, the results indicate that negative GDP changes occur for all scenarios cases, and higher GDP damage is observed as the reduction rate becomes higher and the peak comes earlier (-7.04% in 2100 for 2016.R5.L). These trends are extremely different from those of the E3MG model which shows positive GDP effects (+4.89% in 2100 for 2016.R5.L).
The differences of the results among the two models are caused by (1) technological change assumptions, (2) revenue recycling methodology, (3) timing of emissions cuts, and (4) modeling approaches. We expect to have a more detailed discussion at the session.