

## Climate Policy Analysis in the Context of Globalization

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Based on the resolution of the EU Council of Ministers to avoid a warming of the Earth's atmosphere by more than 2°C compared to the pre-industrial level, this study aims at identifying the magnitude of costs to attain such a climate protection target. The regional specification of investments and mitigation costs is highly important for the climate policy negotiations which has therefore been the central objective of the study. The specification of mitigation costs is analyzed in the context of globalization where regions are linked by different global markets.

The newly-developed Integrated Assessment model REMIND-R serves as the basic tool. REMIND-R is a multi-regional hybrid model which couples an economic growth model with a detailed energy system model and a simple climate model. The individual regions are coupled by means of a trade module. Each region is modeled as a representative household with a utility function that depends upon the per capita consumption. It is the target of REMIND-R to maximize a global welfare function that results as a weighted sum of the regional utility functions. Mitigation costs estimates are based on technological opportunities and constraints in the development of new energy technologies. Most essential, technological change in the energy sector is embedded in a macroeconomic environment that by means of investment and trade decisions governs regional development. REMIND-R combines the advantages of Bottom-up models (technical explicitness) and of Top-down models (macroeconomic completeness).

In a first step of model application, we run a baseline scenario and investigated in each region the simulated macro-economic development, trade, technological development, energy production and related CO<sub>2</sub> emissions. In a second step, we analyzed the same development parameters for a set of policy scenarios which differ from each other by the permit allocation schemes which follow either the contraction & convergence approach, an intensity target or the multi-stage approach. In all scenarios drastic emissions reduction are required. Industrial CO<sub>2</sub> emissions need to be reduced from today's level by 50% until 2035.

A detailed comparison of the three policy regimes focusing on the regional mitigation costs and the mitigation strategies in the energy sector is given in this paper. This is supplemented by investigating the contribution of different technological options (e.g. carbon capturing and sequestration) for climate change mitigation. From simulation experiments with REMIND-R, it turns out that the variance of mitigation costs is higher across regions than across policy regimes and that quite different strategies of restructuring the energy system are pursued by the regions. The 2°C climate target can most likely be reached with average mitigation costs of approx. 1.5% of the global GDP. Doing without the nuclear energy option is not costly, but forgoing the carbon capturing and sequestration option will increase the global mitigation costs by more than one percentage point.

This study analyzes ambitious climate protection scenarios. Immediate and multilateral action is needed. Given the rather small variance of mitigation costs in major regions like USA, Europe, Middle East and China, a policy regime should be chosen that provides high incentives to join an international agreement for the remaining regions. From this perspective either the contraction & convergence scenario (incentive for Russia) or the multi-stage approach (incentive for Africa and India) is preferable.