Economic implications of CO_2 emission reduction in Turkey

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Abstract

Turkey's CO_2 emissions have grown tremendously by 72.6% in the period 1990-2004; a growth rate that is by far the highest one among Annex I countries. There are no quantified emission reduction objectives in Turkey as the country has not yet ratified the Kyoto Protocol due to concern about economic implications. However, the ongoing EU accession process makes it increasingly likely that Turkey will access the Kyoto Protocol in the foreseeable future. It is therefore of vital importance to explore the underlying factors of emission growth in Turkey, and quantify economic impacts of reducing the growth of greenhouse gas emissions.

In this study, BU-MACRO, an integrated energy-economy-environment model, is used to generate Turkey's reference projections of energy use and economic growth, and explore the costs of CO_2 emission reduction. The model combines a Bottom-Up (BU) disaggregate activity analysis framework of the energy sector with an aggregate representation of the macroeconomy (MACRO) by means of a nested CES production function. The production function determines how aggregate economic output depends upon the inputs of capital, labor, fossil fuel based electric and non-electric, and renewable based electric and non-electric energy. In this way, the model allows for both price-induced and autonomous energy conservation, autonomous energy efficiency improvement and for interfuel substitution. The energy, economy and environment submodels are linked to produce equilibrium solutions through utility maximization over a planning horizon of twenty years. The endogenous demands in BU-MACRO feature to partly satisfy carbon abatement constraints via energy service demand reductions. Learning curve information, which indicates the exponential reduction in the cost of renewable energy technologies (RETs) under an increasing production volume, is explicitly incorporated into the model. BU-MACRO accounts for emission reductions additional to the reference projections implied by RET installations, thus featuring an evaluation of emission certificate trading as defined under the Kyoto flexibility mechanisms. Assuming market prices on emission certificates (VER, CER and ERU), the additional emission reductions are converted into monetary units and considered as an additional income item within the national accounts as well as a cost decline for RET investors.

The model is calibrated under a base case scenario as well as various other scenarios employing the same resource availability, macroeconomic and technology assumptions as in the base case, but considering different CO_2 emission targets. Results provide interesting insight for the case of Turkey. The impacts of carbon mitigation on GDP, investment and consumption are evaluated. The changes in both final and primary energy mix, changes in technology development, as well as marginal abatement costs are analyzed. The impact of emission certificate prices on the diffusion of new RET deployment is revealed, together with implications on carbon emissions and economic costs. The effects of autonomous energy conservation and efficiency improvement on macroeconomic and environmental indicators are explored under further scenario definitions.