Potential reduction in mitigation costs from multi-gas abatement: a meta-analysis based on EMF21 and other literature on GDP costs

Topic: 28 - Climate Change and Air Pollution Role of non-CO2

Abstract:

We have carried out a meta-analysis of the costs of mitigating global GHG emissions over the period to 2100, with and without the effects of
non-CO2 GHG abatement, relying mainly on the set of Stanford University's Energy Modelling Forum (EMF-21) studies published as a Special Issue #3 of the Energy Journal in November 2006 (EMF, 2005; Weyant et al., 2006, Van Vuuren et al., 2006).. The dataset, which was created with the help of 19 global energy-economic modelling teams, included the mitigation analysis of multiple gases under specific stabilization targets. One of the main elements of the EMF-21 study was data development of non-CO2 GHGs, sink emissions and mitigation costs.
The modelling teams used data provided by a special data development group. The results of these studies have been already reviewed and assessed by the editors of the Journal. This paper goes beyond these reviews by providing a quantitative meta-analysis of the effects that multigas abatement has on the published estimates of the costs, taking into account the many different approaches and assumptions, including the different baselines, adopted in the different EMF-21 studies. The meta-analysis uses regression and related techniques to assess the costs measured as changes in gross world product, and of the CO2-eq tax rates and/or emission permit prices required to reduce the emissions at a global level. We study what effect the different model assumptions and modelling approaches have on the published estimates of costs with and without multigas abatement.

We report the results in terms of two sets of equations (one for the
EMF-21 results, the other incorporating these into a wider study of costs that includes other effects that can be identified in the literature). The EMF21 data provides differences between reference cases and standardised mitigation cases (4.5w/m-2 with and without multigas abatement) and these can be interpreted as effects of mitigation for different overall levels of GHG stabilisation. The wider study explains most of the variance in the published results on GDP costs of mitigation for different stabilisation targets, covering the Innovation Modelling Comparison Project's 2006 study and the earlier meta-analyses done by the World Resources Institute for the US economy, 1997, and the IPCC post-SRES models for the global economy, 2002. In the full study covering some 2050 observations, the major influences on the results for world product and growth (besides the extent of the reduction in CO2
required) are found to be assumptions made for (1) the treatment of technological change, (2) the use of revenues from taxes and permit auctions and (3) multigas gas scenarios. When the models allow for induced technological change, when revenues are recycled, e.g. via investment incentives, or when the other GHG are mitigated, growth is higher. Allowance for the Kyoto Mechanisms, climate and non-climate benefits, and a backstop technology all further reduce costs. The level of tax rates and permit prices is found to depend on the stringency of the CO2 stabilization target (raising prices), and the modelling of induced technological change and disaggregation of sectors (reducing prices).

The overall conclusion from the meta-analysis of the modelling literature is that even stringent stabilisation targets can be met without materially affecting world GDP growth, at low carbon tax rates or permit prices, at least by 2030 (in $US(2000), less than $15/tCO2 for 550ppmv and $50/tCO2 for 450ppmv for CO2). In addition, a multi-gas strategy can achieve the same stabilization target at significantly lower costs than a CO2-only strategy. However multi-gas abatement is a relatively new topic in economic modelling and results are often experimental and controversial.