

POEM – an integrated energy-economy modelling methodology

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Introduction

In order to restrict global warming to 2 °C, major greenhouse gas (GHG) emission reductions are needed by 2050. While most of the accumulated anthropogenic atmospheric carbon dioxide can be attributed to industrialized countries, the greater share of future emissions will come from the developing world, and India and China will contribute to a substantial part of this. Thus, participation by India and China in climate change abatement is essential. However, developing countries, including India and China, are reluctant to enter into any binding commitment due to the possible interference of climate and development objectives. Despite a large number of studies, the estimations of the economic consequences of mitigation are still marred by large uncertainties.

Different ways of distributing the commitments of climate mitigation have been proposed but there are large disagreements between nations on this, and there is clear division of standpoints between developed and developing countries. Several proposals on burden-sharing regimes have been proposed. One of these, taking different standpoints into consideration, is the so-called common but differentiated convergence (CDC) which has received considerable attention recently (Höhne et al 2006).

Any climate policy has spill-over effects across several societal sectors and, thus, carefully chosen national policies coupled with international cooperation may offset some of the possibly negative effects on development (e.g. Halsnæs & Shukla 2008; Halsnæs & Garg 2011). Another of the spill-over effect is the strong interaction between climate goals and other environmental objectives, which has been covered in a number of papers (e.g. Elkins 1996; Burtraw et al 2003; v Vuuren et al 2006; Das & Ahlgren 2010; Krook-Riekkola et al 2011). Further, mitigation options will have an impact on the demand for different types of energy sources and carriers and thus on energy security issues.

Objectives

There are dual objectives of the study. The first objective is to develop a methodology that through integration of a number of existing models can provide new insights on the effect of different burden-sharing regimes with regards to development, environment and energy security. The second objective is, by applying the integrated modeling framework, to explore possible multiple pathways which may exist for India and China to contribute to international climate initiatives while not compromising national development priorities. This paper reports findings in both these areas.

Methodology

The presented study builds upon the still on-going so-called POEM project (www.chalmers.se/ee/poem-en), a European Commission funded project involving European, Indian and Chinese partners.

The models being applied in the project are global and national models, and bottom-up as well as top-down models. The models are first compared in a number of rounds of comparison concerning basic macro parameters (population assumptions and GDP assumptions (output in some models), fuel price parameters (global fossil fuel prices (exogenous assumptions in some models while endogenous in other), marginal abatement cost curves, and responses to simple carbon tax models. Then the models are harmonized to a certain extent. The harmonisation is only carried out as far as to enable meaningful model integration while leaving most assumptions un-harmonised. Finally, the models are run using a soft-linking procedure.

The modelling outcomes in terms of development, welfare distribution, energy system structure, environmental impact and demand for different kinds of energy sources and carriers are compared for different climate regimes using the CDC as the reference.

Expected results

The expected results of the study is a selection of policy options (macro-socio-economic, energy and environment) for India and China assumed to facilitate their engagement in climate change protection measures under a post-2012 regime. The implications of these targets should be tested in the POEM modelling framework in terms of burden distribution and socio-economic impacts. This implies a combination of international climate on reduction targets and allocations, and a quantification of the impact of these policy options in terms of socio-economic development on India and China. This paper will be focusing on the related energy demand and energy security issues.

Further, the project is expected to deliver an integrated modelling framework which can be used to analyse, formulate and improve international climate policies and cooperation mechanisms, and an example of how this modelling framework (combining top-down and bottom-up models, and global and national models) can contribute in supporting decision making on energy-environmental-economic matters.

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