Multi-model assessment of impact of climate policy on the energy systems of India and China – results from the POEM project

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Introduction

In order to restrict global warming to 2 ^{o}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). Further, mitigation options will have an impact on the demand for different types of energy sources and carriers and thus on energy security issues.

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 recently finalized 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 energy system as well as computable general equilibrium (CGE) 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 analysed for the CDC climate regime (and a number of sensitivity cases) compared to baseline developments.

Results

The multi-model analysis shows the need for significant emission reductions in both China and India, implying huge changes in their energy systems. Due to the lower per capita emissions and GDP per capita in India compared to China, the economic impacts of international climate policy are generally smaller in India than in China, and while India can gain from international emissions trading over a long time period China is likely to become a buyer on the long-term. Some models are also showing a strong welfare impact in both India and China due to decreasing global fossil fuel prices due to climate policies since both countries are oil importers.

The type of model applied (energy system or CGE) has a strong impact on the energy system outcome. While the CGE models depend primarily on energy intensity improvements, carbon intensity improvements are the most important mitigation option in the energy system models. With regards to the impact of different primary energy supply there are large differences between the model results but also some robust results. In China, in models with a detailed representation of the transport sector, the oil demand is considerably reduced under climate policies while there is hardly any oil use reduction in models lacking this detailed transport representation. In India, there is more general reduction of oil use due to climate policies. Coal use is considerably reduced, as expected, in all models under climate policies, while most models hardly show any change of gas use in the climate scenarios compared to the base case.

The use of renewables is increasing also in the base case but more strongly in the climate scenarios but the difference is not very large compared to the outcomes of different model types. In the energy system models the contribution of renewables is important while renewables in the CGE models only show a slow growth. These results are generally similar for India and China except for the base case where all models show a slow growth for India.

References

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