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EMISSION STANDARDS VS. RENEWABLE ENERGY TECHNOLOGY PROMOTION FOR GHG CONTROL IN THE EUROPEAN UNION – EFFECTIVENESS, ECONOMIC COSTS, AND SECURITY OF SUPPLY

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Overview

Anthropogenic climate change largely stems from the combustion of fossil fuels in the energy system. In Europe (EU-25) approx. 80 % of green house gas (GHG) emissions are energy related and approx. one third originates from electricity generation. Hence, the electricity system's technological design strongly affects both the environmental outcome as well as the economic impact of GHG control.Policy instruments for GHG control may follow different strategies. For this paper, we identify two distinct strategies. The first strategy draws upon administrative emission standards, which may be coupled with an allowance trading scheme. The second strategy is a technology oriented approach which aims at an increasing application of GHG emission free electricity generation technologies using Renewable Energy Sources (RES). Using a CGE model, the paper to be presented compares the effectiveness, the efficiency, and the security of supply impacts of the two different strategies. Additional emphasis is laid on the effect of a cohesive EU-25 approach in contrast to a single EU-15 RES policy.

Methods

In applied economic research, CGE modeling has been shown to provide a well established instrument for the quantification of the direct and indirect economic impacts of climate and energy policy measures. A CGE analysis of the implications of policy induced changes in the electricity system needs to incorporate explicitly generation technology specifications. To meet this requirement the paper at hand modifies and uses the CGE model NEWAGE-W as developed in Zürn et al. (2005) and in Küster (2006). The NEWAGE-W version applied here is a recursive dynamic, technology rich, multi-sectoral world economy model with ten regions, including Germany, the EU-15, and the EU-25. The model is calibrated towards the GTAP database Version 6 from 2005.

NEWAGE-W considers generation technologies in bottom-up detail, with technology specific physical capacity data, cost shares and energy and emission intensities. Thirteen technologies are considered in three load segments putting special emphasis on technologies using renewable energy sources. The modeling of technology oriented policies in the bottom-up approach allows for analyzing technology oriented climate policy strategies. In this respect, a novel aspect of this paper is the implementation of specific RES shares in electricity generation through endogenously computed subsidies. Moreover, the nuclear phase out in Germany as well as general technical potentials for RES application are implemented.

The model is applied for the analysis of four scenarios which reflect specific instruments of one and of both of the strategies respectively. The fist scenario considers an emission standard including allowance trade between countries involved in emission reduction, i.e. EU-25 and effective other Annex-B countries. The emission caps reflect national goals of the Kyoto protocol which are considered to be constant and effective even after the first commitment period. The second scenario is technology oriented. It implements an endogenously specified subsidy on technologies using renewable energy sources in a way that a share of RES in the EU-15 electricity mix correspondent to EU targets as given in EU (2001) and in BEE (2006) is achieved. These targets are set as 22 % starting in 2010 and 35 % from 2020 onwards. Taking into account subsidies necessary to reach the targets makes allowance for the additional electricity system costs through the application of the more cost intensive RES technologies that have to be borne by the economy. The third scenario combines both promotion of RES technologies as well as emission caps and allowance trade. The fourth scenario widens the scope of the technology strategy onto the EU-25 so that all EU countries are obliged to fulfill the RES target shares. This highlights the role of harmonization and unification in EU climate and energy policy.

Exemplary results

Results to be presented for the effectiveness and efficiency assessment incorporate the impacts on the EU electricity mix, CO_2 emissions, GDP, and welfare. For the aspect of security of supply fossil energy input and international trade flows are balanced. In this context, international macroeconomic feedback effects can be traced back by assessing changes in bilateral trade flows between the regions modeled.Preliminary model results indicate that implementing RES targets in the EU-15 leads to an increase of overall electricity produced by approx. 18 % in 2030 compared to the cap and trade scenario. CO_2 emissions are most effectively reduced by an emission standard. Restricting climate policy on the promotion of RES in this setting cannot yield adequate emission control. Combining emission standards with technology promotion yields lowest emission.Macroeconomic effects are significant but rather small. The introduction of RES technologies as demanded by the quota decreases GDP in the EU-15 by approx. 0.75 % in 2030 compared to the mere cap and trade case. Combining cap and trade with technology promotion alleviates this negative effect, mainly because allowance prices decrease in this case. Despite accounting for income and budget effects, model results only detect a slight negative welfare effect through the technology promotion. Increasing the EU-15 goals onto the entire EU-25 without providing nationally differentiated goals yields significant negative macroeconomic impacts in all European countries. This is because the increase of RES share from a considerably low base year fraction to a share of 22 % respectively 35 % is accompanied by significant structural effects that depress economic growth.

Conclusions

The preliminary model results suggest that for reasons of effectiveness and efficiency an effective GHG control strategy should not merely rely on technology oriented policies. Combining a technology oriented strategy with a cap and trade strategy may further decrease emissions. However, this reduction is accompanied by negative growth impacts. The necessary changes in technology application in the electricity mix are best achieved through the implementation of emission standards and emission permits tradable on perfect allowance markets. An important result is that harmonization of RES technology oriented EU policy as analyzed in the fourth scenario has negative economic implications. This suggests that a cohesive strategy should provide differentiated goals also for the new member states, as in EU (2001). In addition to this paper, regarding the emission standard strategy, further options for the design of a Post-Kyoto protocol need to be considered. Regarding the electricity technology oriented strategy a further step would be to also assess and compare the impacts of other technology options for GHG control such as nuclear energy, CO_2 capture and storage, and energy saving through efficiency in production and consumption.

References

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