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Applications of the Pan-European TIMES model

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OVERVIEW

The model and results presented in this paper are the outcome of a number of projects over the last years, that have developed and used the PanEuropean TIMES model.
TIMES (an acronym for The Integrated MARKAL EFOM System) is one of the tools developed and used by the Energy Technology Systems Analysis Programme an Implementing Agreement of the International Energy Agency. Using TIMES, in the framework of the NEEDS project which was funded by the 6th Framework Programme [1], a model for EU-27, Iceland Norway and Switzerland was developed. In this model the energy systems of each one of the thirty countries are modelled separately in detail. The Pan European Model was then synthesized by allowing trade of energy commodities among the countries. This model has been used as a starting point for building the RES2020 Pan-European TIMES (PET) model [2], and the models in the REACCESS [3] project and REALISEGRID [4] projects.

METHODS

The level of analysis per sector of economic activity in each country, in the Pan European model, is rather detailed [5]. On the energy demand side the useful energy demand per use in the residential, commercial, agricultural, industrial, and transport sectors is analysed in detail. On the energy supply side, the electricity and heat production is analysed in detail, the refineries are modelled using a generic refinery structure and the mining and extraction of primary energy resources are modelled using a cost-supply curve. The high, medium and low voltage electricity grids are included in the model, with different type of technologies being able to produce at different voltage, modelling distributed generation in this way.. The model uses endogenous trading of electricity between the countries, natural gas, biomass and biofuels. The trading of GreenHouse Gases (GHG) emission permits is flexible and can model a “closed” or an “open” European market.
The RES2020 application of the model focused on the analysis of the renewable energy targets in EU27. This led to a more detailed representation of renewable energy sources and four alternative scenarios for achieving the targets for renewables and green house gasses emissions in 2020. In the REACCESS project the model was recalibrated in detail to reproduce the 2005 statistics as a base year. In the framework of this project the PET model run together with the global multi-regional TIMES Integrated Assessement model and the REACCESS Corridor Model (RECOR), in order to study the effects on the energy system of EU competing with the Rest of the World for scarce and uncertain supplies of energy sources [6]
The REALISEGRID FP7 project [7], focussed on developing methodologies for improving decision making in the electric power sector, and used the extended PanEuropean TIMES model, which includes EU27 and the Western Balkan region. The representation of the high voltage electricity grid was improved in the framework of this project, by including more

precise information on the efficiency and costs of grid and trade infrastructure and on other points.

RESULTS

In the framework of the RES2020 project, it was decided to run four alternative scenarios in order to examine the achievement of the renewable targets set by the European Union for 2020. The scenarios that were elaborated are: Reference Scenario: where there is no enforcement of the targets for renewable energy sources in 2020. RES Reference Scenario: where the target for renewable energy sources per Member State and the corresponding targets for CO_2 emission in 2020 are enforced. RES Statistical Transfer Scenario: where the target for renewable energy sources per Member State and the corresponding targets for CO_2 emission in 2020 are enforced as in the RES Reference scenario, and the statistical transfer mechanism proposed in the Directive is also modelled. RES-30 Scenario: with the same assumptions as the RES Reference Scenario, but enforcing a 30% reduction target for CO_2 emissions over the whole of the European Union. According to the model results the mix of renewable technologies in power production is mainly based on wind, hydro and biomass. Renewable electricity generation increases across the scenarios and the structure of this production across the different energy sources changes considerably by 2020. In all scenarios, wind power is the main renewable electricity source by 2020, covering about 45% of total renewable electricity generation in all scenarios. In the RES scenarios, policies further increase renewable electricity generation, and especially generation from wind. Also the use of biomass for power generation becomes more important. Other non-hydro sources play a small role. Overall, more than 35% of the net electricity should come from renewable energy, the highest share of which is due to wind and hydro power plants [8].

In the REACCESS project the PET model runs with a time horizon up to 2050. In REALISEGRID four scenarios were selected, with a time horizon up to 2030. The scenarios differ by the degree of technological development and are: the Optimistic, in which most key drivers develop at their most positive configurations, the Competing, the EU-Centered in which Europe makes steps in integrating the energy systems, and the Pessimistic where all key drivers develop at their most adverse configurations [9]. The results of the scenarios are at the stage of being analyzed in detail.

CONCLUSIONS

The PanEuropean model and has been developed and used in a number of projects, in order to model the medium to long term development of the European energy system under a number of different assumptions. The model was extended to focus on specific issues (like renewables, electricity grid development etc) that are important in the European energy policy. The least cost optimisation approach that is used, offers a tool for impact assessment of energy policies on the EU27 level, and can be extended to include neighbouring regions that

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