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REPORT

Additional information on the long term energy scenarios for Belgium with the PRIMES model

Addendum to the FPB report "Long term energy and emission's projections for Belgium with the PRIMES model", addressed to the Commission Energy 2030

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Executive Summary

In September 2006, the Federal Planning Bureau forwarded to the Commission Energy 2030 a study report entitled "Long term energy and emissions' projections for Belgium with the PRIMES model". On the basis of these scenario analyses and other relevant inputs, the Commission Energy 2030 released a draft report on "Belgium's energy challenges towards 2030" in November 2006. This report was then being reviewed by several panels. This review process ended up in a series of formal advices combining comments, proposals and demand for clarification or deepening. A certain number of remarks are directly related to the study performed by the Federal Planning Bureau. The objective of this report is to provide the review panels with further explanation on data and methodological issues raised in the advices.

Contents

1. Additional information

1.1. Rationale behind the baseline or reference projection

The purpose of the baseline is by no means to provide the most likely or most realistic picture of the Belgian energy system by 2030. The baseline rather simulates the impacts on the energy system and related CO_2 emissions of current trends and policies as implemented in Belgium up until the end of 2004[1]. The baseline reflects current knowledge on policies on energy efficiency, renewables[2] or climate change without assuming that specific targets are necessarily met. The possible gaps between the results of the baseline and policy targets (indicative or binding) show the challenges policy makers will be facing in the years to come as well as the need to go one step further if the target is to be met[3].

In addition to its role as reference projection, the baseline also serves as a benchmark for the assessment of alternative policy scenarios, as it allows to determine quantitatively the impact of alternative policies and measures.

The definition of the baseline summarised above is standard and similar to the one used in other long term energy outlooks like the World Energy Outlook of the International Energy Agency, the World Energy and Technology Outlook of DG Research of the European Commission or the European Energy and Transport: Trends to 2030 of DG TREN of the European Commission.

1.2. Transport activity

Energy demand in the transport sector is driven by several factors one of which is the level and modal allocation of transport activity. Passenger transport activity is given in passenger-kilometres (pkm) whereas freight transport activity is given in ton-kilometres (tkm). Both indicators are disaggregated according to the mode of transport, namely public road transport, private cars (and motorcycles), rail (including tram and metro) and aviation for passenger transport and trucks, rail and inland navigation for freight transport.

In the baseline, the evolution and modal allocation of transport activity are exogenous. Figures come from a European study[4] carried out in the framework of the mid-term implementation of

1 See for instance, European Commission, *European Energy and Transport: Trends to 2030-update 2005*, DG TREN, May 2006.
2 Policies aiming at promoting renewable energy sources include for instance subsidies on capital costs and preferential electricity selling prices.
3 Examples of targets are: the -7.5% reduction of GHG emissions specified in the Kyoto Protocol, the 6% target for renewables in electricity supply, the National Emission Ceiling (NEC) for acid pollutants…
4 See http://ec.europa.eu/transport/white_paper/mid_term_revision/assess_en.htm

the European Commission White Paper "European Transport Policy for 2010: time to decide", end of 2005. This study examines four policy scenarios for the transport sector in the European Union. In the PRIMES scenario analysis, the results of the "Partial Implementation scenario" (or P-scenario) are used for the baseline.

However, in the alternative scenarios where a high carbon price is introduced (i.e. with a constraint on energy-related CO_2 emissions), transport activity reacts to price increases and shows lower levels than in the baseline (see Table 31 p.85 of the report of the FPB). The decreases in the transport activity levels depend on the mode of transport.

1.3. Natural gas supply in 2030

The availability of natural gas supply in 2030 is implicitly ensured in the PRIMES modelling via the assumptions on the evolution of international gas prices. The latter are determined upstream by the POLES model[5] and result from the equilibrium between demand and supply (reserves, production …) at global level (see also p.89 of the report of the FPB)

1.4. Modelling of renewables penetration in the power sector

In the baseline scenario, the development of renewable energy sources reflects improvements of energy technologies on the one hand and policies in place on the other hand. In the model data base, the effects of improvements of renewable energy technologies are a reduction in capital and fixed costs over time and an increase in efficiency rates. These improvements reflect both "autonomous" technical progress (as a result of for example long term research effort) and "endogenous" progress (through learning curves). The endogenous progress is driven by anticipations about an increasing volume of new installations (under baseline trends)[6].

In the carbon constraint cases, renewable energy technologies deploy further as compared to the baseline because they emit no CO_2 emissions. One can then expect that a higher deployment of RES may enable faster technology progress than the one considered in the baseline, and therefore a more rapid decrease in capital costs. This effect is taken into account in the post-Kyoto scenarios (i.e. the contribution of the "endogenous" progress term described above is amplified). This leads to lower overall costs of meeting the CO_2 targets as compared to a situation where the costs of renewable technologies remain equal to their values in the baseline.

As regards the policies in place, the supporting mechanisms of the Regions aimed at promoting the renewable energy sources for electricity production are simulated by the model via the introduction of a subsidy on capital costs (irrespective of the scenario). This subsidy improves the

[5] See for instance chapter 1 of the report: European Commission, World Energy and Technology Outlook-2050, WETO-H2, DG Research, 2006.

[6] For more details, see for instance the description of the PRIMES model on http://www.e3mlab.ntua.gr/downloads.php

competitiveness of RES relative to other power generation technologies. However, the subsidies decrease over time to account for the steady reduction in capital costs and in order to maintain the budget devoted to subsidies within reasonable ranges. Finally, the cost of subsidies is recovered in the electricity tariffs.

The application of both methodologies is illustrated below on two (generic) renewables' power technologies:
- On-shore wind power: the rate of subsidy to capital cost is set equal to 14% and 7% respectively in 2010 and 2020, leading to "actual" production costs close to 50 euros/MWh in both years.
- Off-shore wind power: the rate of subsidy to capital cost is set equal to 26% and 13% respectively in 2010 and 2020, resulting in net costs for the producers of the order of 60 euros/MWh in both years.

In the period up until 2020, the subsidies range from 5 to 50 euros/MWh, according to the technology. It is worth noting that these figures are below the present values of the green certificates in the Regions which are close to the total production costs of the technologies (i.e. 100% subsidy).

1.5. Modelling of biomass supply and uses

Biomass energy uses can be allocated in three groups each of them being modelled differently in PRIMES: (1) biomass for power and steam production (i.e. power plants (including co-combustion), CHP plants and industrial boilers), (2) biomass for the production of biofuels, and (3) biomass for space heating in the residential and tertiary sectors. According to the energy statistics for the year 2000, the first group represents about three quarters of total biomass consumption in Belgium and the third one, the remaining quarter. Of course the allocation between these 3 groups should evolve over time notably due to the development of biofuels in the transport sector and the promotion of renewable energy sources for electricity production[7]. Therefore, the first two types of biomass uses are likely to become the most significant.

In the baseline scenario as well as in all alternative scenarios, no upper bound was put on biomass supply on the Belgian territory (total supply combines domestic production and imports). The penetration of biomass in the Belgian energy system results from different mechanisms and assumptions according to the type of use.

For electricity and steam production, the PRIMES model uses biomass supply curves that are calibrated to data provided by ECN (Energy Research Centre of the Netherlands)[8]. A fuel supply curve relates the price or unit cost of a fuel to the required fuel quantity. Fuel supply curves

7 In the baseline, the respective shares become 55%, 40% and 5% in 2030.

8 Similar cost curves are used for other renewable power technologies (wind, solar PV…). The ECN study is confidential.

have a steep slope beyond a certain quantity of demand reflecting cost increases when moving to less favourable production sites or to more expensive fuel supplies.

As far as the production of biofuels is concerned, the demand for biomass is determined by the share of biofuels in the transport sector, share that is fixed exogenously in the model[9]. In the scenario analysis for the Commission Energy 2030, the share of biofuels is assumed to follow a similar trend in all scenarios, namely 2.1% in 2010, 6.4% in 2020 and 8% in 2030.

Biomass consumption for heating in the residential and tertiary sectors is essentially determined on the basis of the boiler costs (investment, operating…) and the biomass costs, relative to other heating technologies.

The total demand of biomass is computed as the sum of the demand for the three types of uses. In all scenarios studied, the total demand never exceeds the biomass supply estimated in De Ruyck, 2006.

1.6. Electricity imports

In the baseline (or reference projection), electricity imports and exports between European countries are determined endogenously by running the European interconnected version of the PRIMES model. Consequently, the evolution of the net electricity imports of Belgium takes into account the evolution of capacity surplus abroad (especially in France), the evolving level of interconnection capacities, the power price differentials between EU countries and differences in load curve patterns.

Due to time constraints[10], only the Belgian PRIMES model was run for the alternative scenarios. In this simplified picture, the net electricity imports of Belgium are exogenous and set equal to the levels of the baseline. Consequently, the scenario analysis performed with the PRIMES model for the Commission Energy 2030 does not deal with the possibilities of reducing CO_2 emissions in Belgium by increasing the imports of (CO_2 free) electricity. This policy option is to be analysed downstream of the modelling results.

9 This parameter is determined in collaboration with DG TREN on the basis of available information from the Member States on the development of this energy option.

10 Running the European version of the PRIMES model for each alternative scenario was unthinkable within the framework of this study. Indeed, doing so would have required not only more time (due to the more complex structure of the European model) but also the definition of alternative policy contexts in the other EU countries.

2. Bibliography

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