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ASSESSING CARBON VALUES TO ACHIEVE STRONG POST KYOTO CO2 REDUCTION TARGETS FOR FRANCE

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Overview

Ambitious post Kyoto targets to reduce greenhouse gases emissions are needed to effectively address climate change and maintain the overall temperature increase within acceptable ranges. The last UNFCC summit helped to stress this point, but no reduction objectives were agreed upon. As next rounds of negotiations, envisaged in the final roadmap, may help to specify such targets, an important element is that, the EU as a whole and several member countries individually, have already announced strong unilateral commitments to reduce their emissions. France, for instance, has decided on a 75% reduction of its GHG emissions by 2050. Yet, understanding what such targets mean in terms of carbon values (and the evolution of those values) in the long run is an important element for a complete analysis of the reduction strategy.

This paper addresses the question of carbon value for France in the long term in two ways:

- as abatement levels achieved over the period under different structures of CO_2 taxes specified exogenously
- as the marginal cost of CO_2 given by the dual value of an explicitly specified carbon constraint.

In the following, energy related CO_2 emissions, corresponding carbon values and energy system costs are compared for eight different scenarios. The study is based on the technology rich TIMES-France model developed for France and the modelling horizon reaches from 2000 to 2050.

Methods

The proposed approach is based on TIMES-France, a bottom-up optimisation model of the MARKAL family of energy models. The basic principle of the model is a large linear optimisation of substitutions possibilities in the energy system for commodity flows and explicit technologies under constraints of end-use demands satisfaction. The model is used to calculate the responses of the French energy system for eight alternative scenarios. For the different scenarios the responses analysed here include the total primary energy consumption, the total CO2 emissions, the related carbon value and the supplementary discounted cost in comparison with the baseline scenario.

- **The baseline scenario :** (scenario *base_line*)

This scenario describes energy choices when the goal is to satisfy the demand for services without any supplementary policy. Since the system cost is optimised, negative costs improvements are included.

- **The low useful demand scenario :** (scenario *Low demand*)

The second scenario considers that voluntary policies to reduce the demands for final services are applied in all sectors. Those low demands levels are used for the next four scenarios.

- **CO_2 taxes applied to the low demand case :** (scenarios *TX_25€, TX_100€_3%, TX_100€_5%, TX_100€_8%*)

Four taxation levels are considered: a constant tax at 25€/tCO_2 for all period and a tax value of 100€/tCO_2 in 2010 further increased at 3 different rates (3%, 5% and 8%) over the modelling horizon.

- **Explicit emission bound :** (scenarios *Factor 2 or F263GW, F292GW*)

In that scenario an upper limit is put on CO_2 emissions to achieve a division by two by 2050. The reduction profile on the modelling horizon is defined by a "-20%" step in 2020 and a decrease at a constant rate towards "-50%" in 2050. A second scenario tests the sensitivity on the total installed nuclear capacity.

Results

The comparison of CO_2 emissions levels for the different scenarios show that:

- Even with negative cost options, energy related CO_2 emissions increase by more than 25% in the baseline;
- Voluntary actions on the final service demands stabilize CO_2 emissions at 2000 levels and reduce the cumulative emissions over the period by 10% compared to the baseline;

- Higher growth rates for the CO_2 tax yields more reduction but tend to evolve toward an asymptote around -60% in 2050 compared to 2000 levels (and for much higher cost on the energy system).

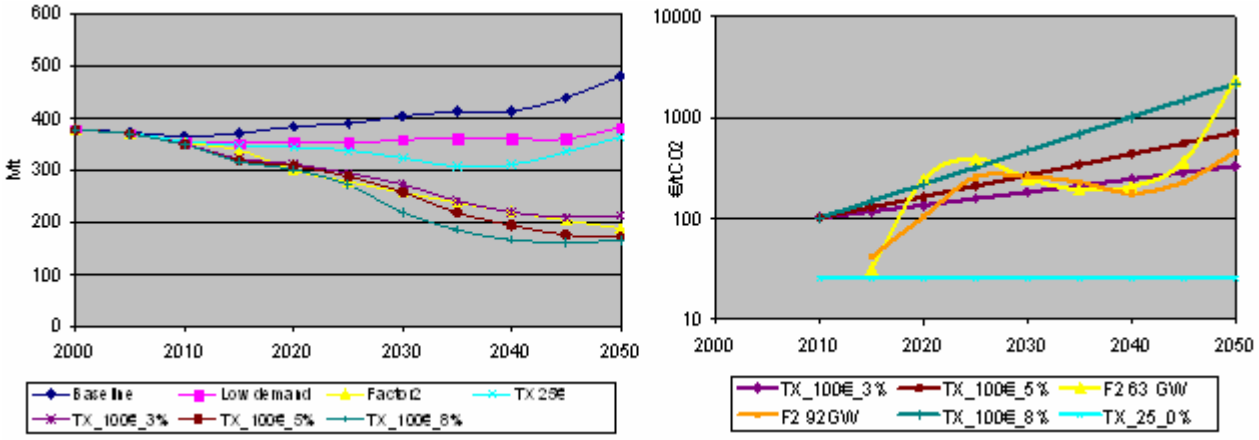

Fig1. CO2 emission levels and calculated carbon values

The corresponding carbon values show more discrepancy between the "prices" (taxes) approach and the "quantities" (factor 2) one. With the "quantities" approach, the carbon values reflect the saturation level of the emission constraint. While the tax profiles give a totally predictable evolution of the carbon value, the constraint on quantities reveals a peak between 2020 and 2030, followed by a local minimum around 2040, and again a strong increase when more efforts are required.

Conclusions

Once emitted in the atmosphere, CO_2 will remain there for more than a century. The simulated emissions levels enlighten the fact that if a long term target is important the emission pathways should also be cautiously assessed. The different scenarios explored a large range of final emission levels in 2050, from stabilization to a reduction by 60% compared to 2000. The cumulative abatement potential ranges between 10% and 37% compared to the baseline.

The simulated tax profiles appeared to be efficient for a factor 2 target. This structure proposed in Boiteux (2001) as an extension of Hotelling's rule, gives an interesting theoretical interpretation in terms of inter-period climate change valuation.

Finally the carbon values comparison showed that the dual value of the CO_2 constraint better captures the time-dependent difficulty to reach the target.

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