

## Overview

Since the past couple of years the climate change debate has been marked by increased scientific evidences reported in the fourth IPCC assessment report, the release of the EU climate package and its approval by the EU parliament in December 2008, and the political transition in US with greener positions expressed by the new administration. That is the reason why there were great expectations for an international agreement at the last United Nations Framework Climate Change Conference (UNFCCC – COP 15) which was held at Copenhagen in December 2009. COP 15 should also be the final step of the two-year negotiation process set by the Bali conference in 2007. For the long term, a noticeable convergence seems exist as regard the will of regions to reduce their CO<sub>2</sub> emissions. But, as the result of the Climate Change Conference confirms, the deal on medium term targets is far from being sealed.

Nevertheless, even if an international coordination is difficult to be established, the global carbon stakes stay the same and continue to be crucial.

The aim of this paper is to discuss, through scenario analysis, the outcomes of different coordination schemes for intermediate mitigation targets. Therefore different commitments are investigated, involving Annex 1 regions and China.

## Methods

Analyses carried out in this paper are based on the ETSAP-TIAM model which offers a technology-rich representation in 15 regions of the world energy system. This model performs a minimization under constraints of the total discounted cost of the energy system over the long-term and in a partial equilibrium framework. We cover the period 2000-2050 and assess the evolutions of primary energy consumption and regional emission levels for different scenarios:

- (1) World reference scenario without any explicit policy measures concerning CO<sub>2</sub> mitigation (BASE);
- (2) COP 15 scenario expressing the last pledges announced by China, Japan, USA and European countries before COP 15;
- (3) Post COP 15 scenario, a more optimistic scenario, with a CO<sub>2</sub> emission reduction commitment for China, Japan, USA, European countries, Canada and Australia.

Regions	Reference year	% of mitigation COP 15	% of mitigation Post COP 15
China	2005	40 (of carbon intensity)	60 (of carbon intensity)
European countries	1990	30	30
USA	2005	17	34
Japan	1990	25	25
Australia	2005	No constraint	34
Canada	2005	No constraint	34

The international community appears to converge on its long-term objectives; in this context, in our model, we consider a CO<sub>2</sub> mitigation target of 80% by 2050 compared to the year reference levels of each region.

For each scenario, we also test the introduction of an additional constraint regarding technologies of carbon capture and sequestration, in the sense of the introduction of an upper limit for carbon constrained regions.

## Results

The analysis of the scenario results focuses on the one hand, on the evolution of primary energy consumption and the energy mix, and on the other hand, on regional CO<sub>2</sub> emission levels and costs of the climate policy. Particularly, we compare global efforts of CO<sub>2</sub> mitigation and carbon cost that constrained regions had to assume in climate policies, and, we assess the impact of the carbon constraints on the energy mix in 2020 and 2050.

A first result inherent to the specification of the scenario, and more precisely to the commitment of regions consisting on what represent these different pledges, in term of emission levels on the period [2005-2050] at the world and regional levels, considering that the reference year are different and that for China, the objective is on the reduction of his carbon intensity.

An other result concern the importance of fossil fuels, in spite of the improvement of renewables. More, nuclear increase but less that renewables. What is also interesting is the importance of coals, to the detriment of gas, if we don't constraint the level of carbon capture and sequestration, and, indeed, how the limitation of CCS impacts on the total primary energy supply.

## Conclusions

These scenarios allow us to compare effects of international coordination on three main environmental and economic indicators. The model shows CO<sub>2</sub> emissions levels by regions and the impact of international climate change strategies on energy system.

Scenario analysis also provides a comparison of the total discounted cost of these CO<sub>2</sub> mitigation policies according to international coordination on mid-term targets and so permits us to discuss impact of different commitment levels under post-Kyoto negotiations. Through these total discounted costs, the level of ambition of the CO<sub>2</sub> reduction targets could be analyzed. Other focus consists on the long-term development of carbon price.

Finally, these scenario analyses allow us to discuss the evolution of the energy mix in different regions and particularly the improvement of renewables, compared to the fossil fuels evolution.

## References

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