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## **EMF24 Global Scenario Modeler Presentation : Insights from the IMACLIM model**

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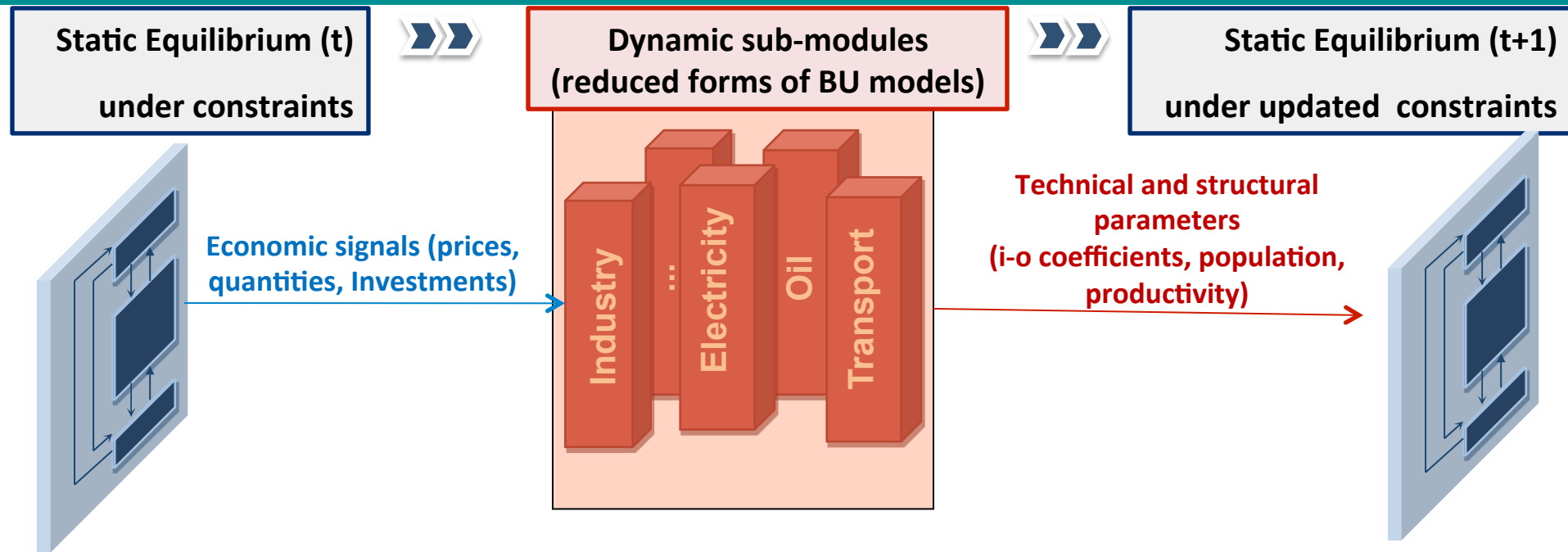
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# EMF24 Global Scenario Modeler Presentation Insights from the IMACLIM model

**Henri Waisman**, Céline Guivarch, Adrien Vogt-Schilb & Jean-Charles Hourcade  
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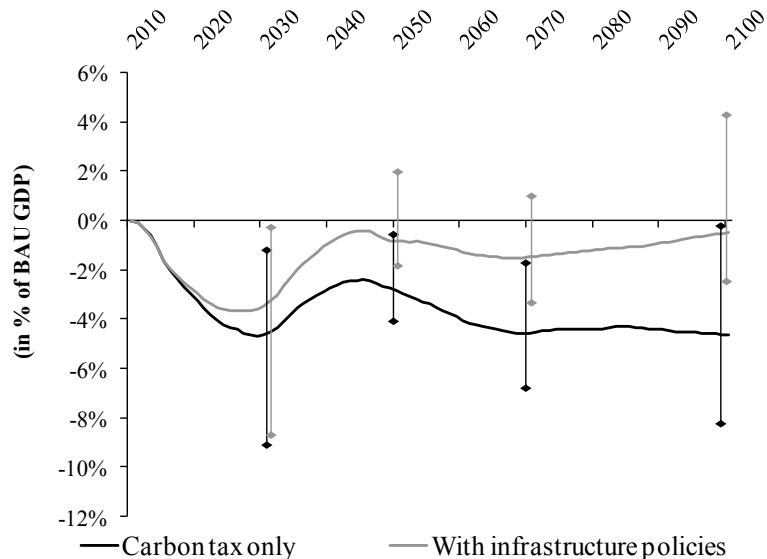
# IMACLIM, an attempt to model 2<sup>nd</sup> best economies in a GE framework



- ❑ *Hybrid matrixes in values, energy and « physical » content*
  - Secure the consistency of the engineering based and economic analyses
  - Explicit accounting of inertias on equipment stocks
  - Technical asymptotes, basic needs
- ❑ *Solowian growth engine in the long run but transitory disequilibrium*
  - Unemployment, excess capacities
  - Investments under imperfect foresight (informed by sectoral models)
  - Trade and capital flows under exogenous assumption about debts

# Why was it so hard to run EMF24 scenarios with IMACLIM?

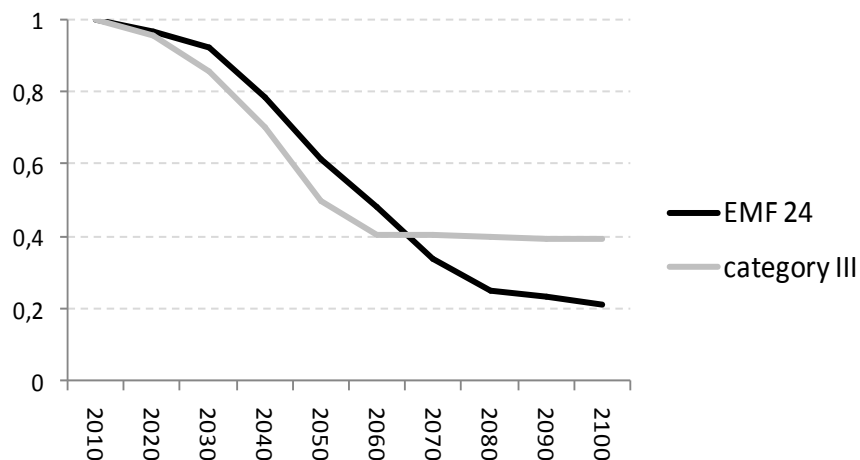
Typical cost profile in a category II scenario



➤ For a category II scenario (-50% in 2050), typical cost profile of IMACLIM scenarios : high transition costs with moderate LT losses and possible benefits

➤ Emission trajectories differ in EMF 24 = far stronger reductions in the LT  
- only the most optimistic of the abatement scenarios could be run with our current (conservative?) technological assumptions  
- in other scenarios the technical asymptotes and basic needs were constraining

CO2 emissions

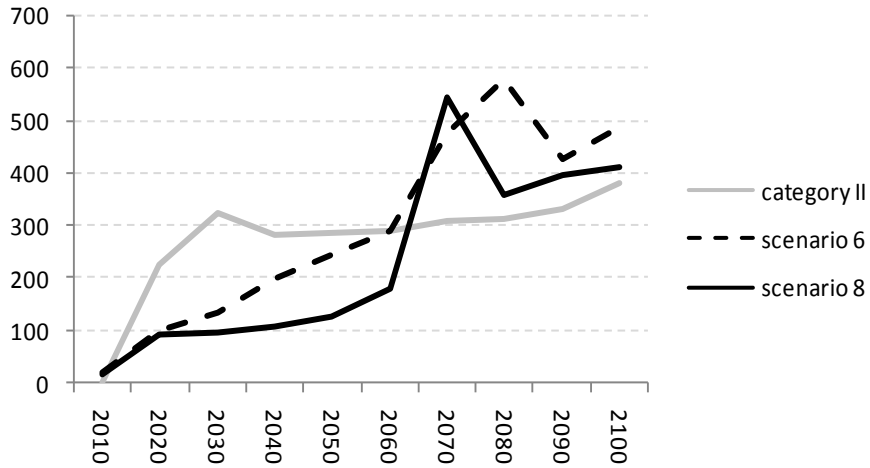


➤ Three changes to run the abatement scenarios

- low basic needs and technical asymptotes  
- non-price induced policies in transportation (automobile, air)  
- sequestration in degraded lands to relax CO<sub>2</sub> constraint

# Why so high carbon prices?

Carbon price (\$/tCO<sub>2</sub>)

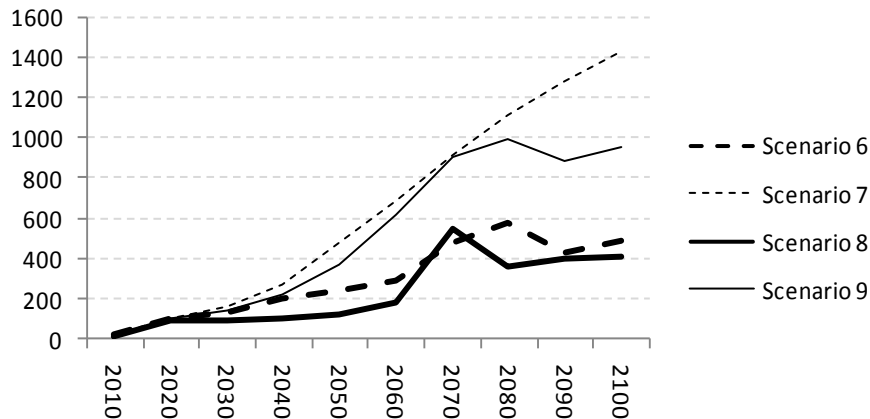


*In category II scenarios, carbon prices*  
 -- increase fastly over the first decades  
 (strong signals needed to wake up the half deaf),  
 -- then stagnate or even decline after 2030 (LBD)

*In EMF scenarios, the long run constraints govern the LT increase of carbon price*

- Decreasing efficiency of the carbon price when the asymptotes are approached
- Decreasing GDP losses per unit of tax increase (tax revenues returned to the economy) = only 'frictional' GDP losses

Carbon price (\$/tCO<sub>2</sub>)  
 under different technology assumptions



## The role of technologies

- CCS crucial over the LT
- with CCS, energy efficiency matters for the transition but CCS becomes some form of substitute in the long term

# From carbon price profiles to GDP losses, the mechanisms at play

## - *Causal chain of GDP losses:*

higher energy prices, higher production costs, lower terms of trade for the most impacted economies, lower purchasing power of households (higher energy bills and higher prices of imported goods + lower wages), lower domestic demand

- A catchy way of representing the mechanisms at play (prior to trade effect and technical change)

**The rigidity of labor markets**

small wage-curve elasticity means high cost

$$\frac{\Delta Q}{Q_0} \approx -\frac{1}{\alpha} \cdot \frac{z_0}{1-z_0} \cdot \frac{e \cdot CI_E}{\omega_0 \cdot l} \cdot \Delta \tau_E$$

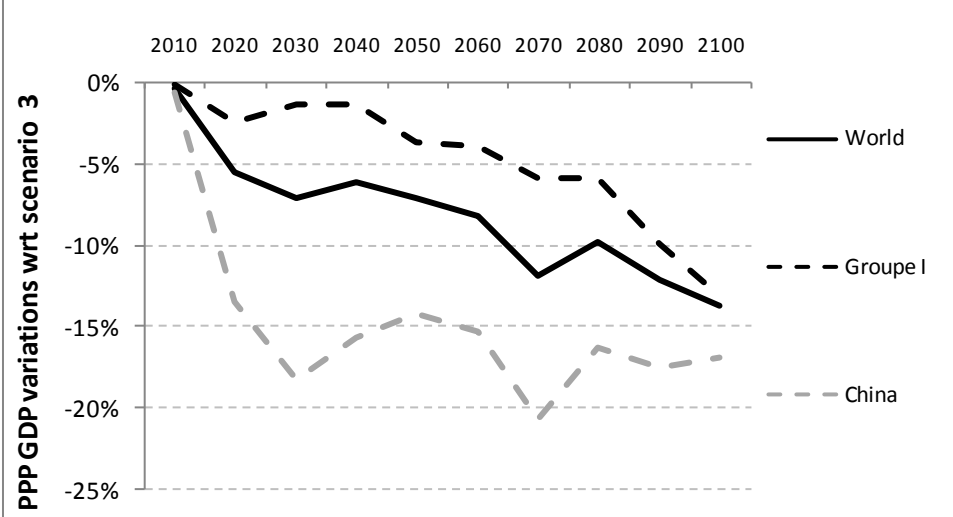
**The ratio “energy (carbon) vs. salaries”.**

High energy intensity means high cost

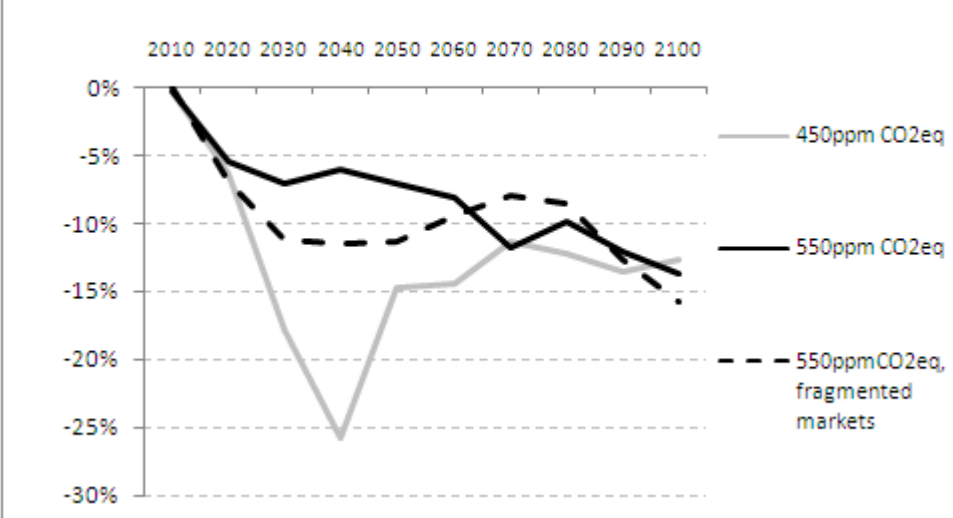
- Over the long run, GDP losses may decrease over time depending on a tradeoff
  - Benefits from ITC that decrease energy intensity and correct sub-optimalities of baseline scenarios (peak oil)
  - Necessity to increase carbon tax rates

# From carbon prices to GDP losses

Regional differentiation of losses



PPP GDP variations wrt scenario 3



## Regional distribution of GDP losses

- in the transition: moderate in OECD countries, high in China (energy-intensive)
- in the long term: continuous increase of GDP losses

## *Without:*

- Compensatory transfers to dev. countries
- Local fiscal policies
- « deus ex machina » technology (alternative tech. availability changes LT costs)

## Climate objective and coordination:

- 450ppm needs a fast decarbonization which comes at a very high transitory cost (inertia and imperfect foresight)
- G8: very high transitory cost (OECD) but recovery after 2050 (dev. countries)
- Long term: similar efforts in all scenarios

## Pending questions for further analyses

- The role of the emission time profile (RCP emissions) : when flexibility and transition costs
- Sensitivity tests about technological assumptions (cost-potential after 2050) because they determine the nature of the constraint over the long term
- Tests of the role of non price induced policies (in transportation and infrastructures) and of alternative assumptions about consumption patterns