



## **Domestic and international drivers of urban dynamics**

## **Urbanization and low-carbon growth pathways Modeling the interactions between energy and real estate prices**

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## 20 years of a surprising absence in energy-economy modeling

- ❑ *What was “obvious” in the early nineties*
  - Large competitive advantage of oil-based motor and fuels over substitutes (biofuels, electricity, hydrogen)
  - Apparent low price elasticity of mobility and energy demand for transportation
  - Mobility and transportation are driven by other “signals” than energy prices
  
- ❑ *What should have been done*

A strong collaboration between energy, transportation and urban economists  
(Hourcade ,1993)
  
- ❑ *What happened :*

A methodological lock-in due to three converging intellectual dynamics:

  - The ‘Elephant and rabbit stew metaphor’ legitimates to treat the energy sector independently from the rest of the economy (Hogan & Manne 1977)
  - The TD/BU controversy about the energy efficiency gap focused the debate on technological efficiency
  - Extrapolating electricity optimization models to the entire energy system
  
- ➔ ***The overwhelming majority of energy-economy models adopt carbon price as the only driver of decarbonizing economies.***

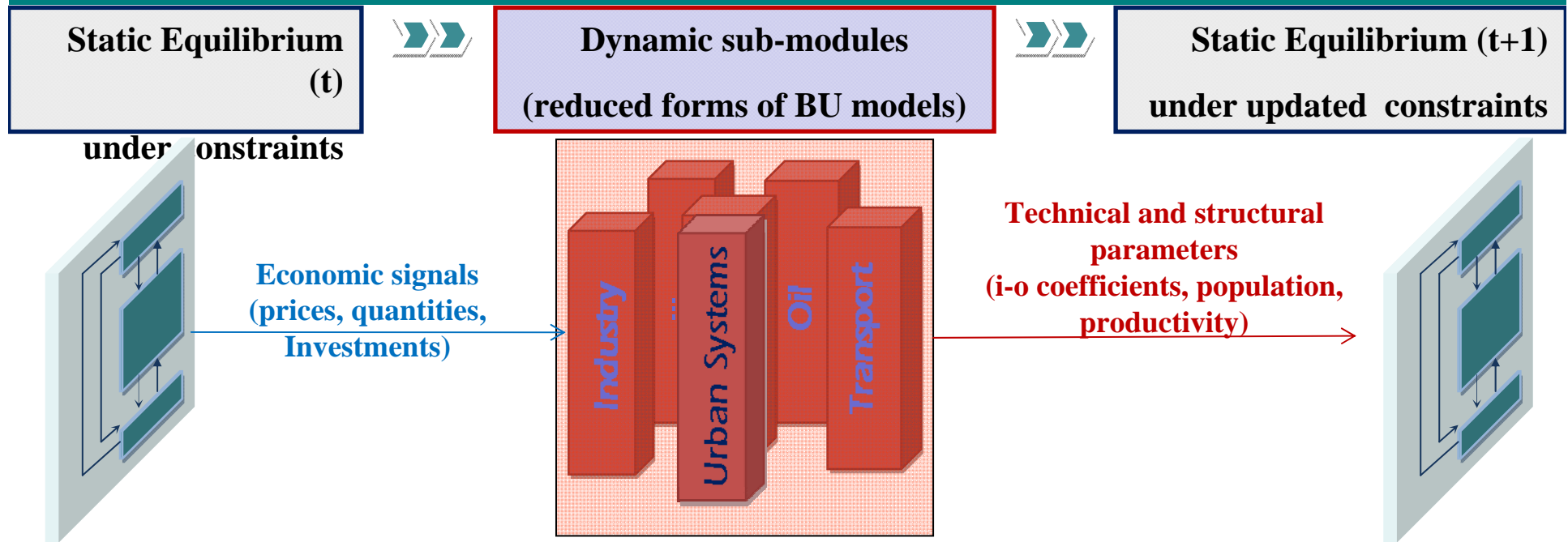
# The Impasse of the « carbon price only » frameworks

- ❑ A carbon price at 50\$/tCO<sub>2</sub>
  - doubles the cost of cement in India and hurts segments of the steel industry in the EU
  - ...but hardly affects mobility demand (low price-elasticity)
  
- ❑ Consequences for cost assessment of climate policies
  - **Underestimated** : an often ignored caveat of energy-economy modeling
    - « Most models use a global **least cost** approach to mitigation portfolios with **universal emissions trading**, assuming **transparent** markets, **no transaction cost**, and thus **perfect implementation** of mitigation measures throughout the 21st century. » (IPCC, AR4, WGIII )
  
  - **Overestimated** : in absence of complementary policies in the transport sector
    - very high carbon prices are needed to curve down transport emissions  
(low elasticity of mobility demand to energy prices)
    - other determinants : non-energy prices and non price signals  
(real estate prices, risk-adjusted capital cost, infrastructure policies)
  
- Economic rationale behind the difficulties in making a deal around policy architectures built around a “pure” pricing of carbon

# Intertwined methodological issues to be solved

- ❑ Modeling second- best economies with
  - Imperfect foresight
  - Inertia of capital stocks
  - Market imperfections (underutilization of production factors)
  
- ❑ Representing structural change driving the decoupling between growth and energy
  - Beyond pure energy efficiency, the fundamentals of the material content of the economy C-T-L (Hourcade 1993):
    - Consumption styles (preferences)
    - Technical potentials (resource and technology availability, asymptotes)
    - Location patterns
  
- ❑ Capturing the interplay between energy prices, land prices and the growth engine (productivity, demography, savings) in an opened economy
  
- ❑ Endogenizing the urbanization process and location decisions in urban/rural areas

# IMACLIM, a tool to investigate the interplay between Systems of Cities in Interaction and growth patterns



## ❑ Long term growth drivers vs. transitory disequilibrium

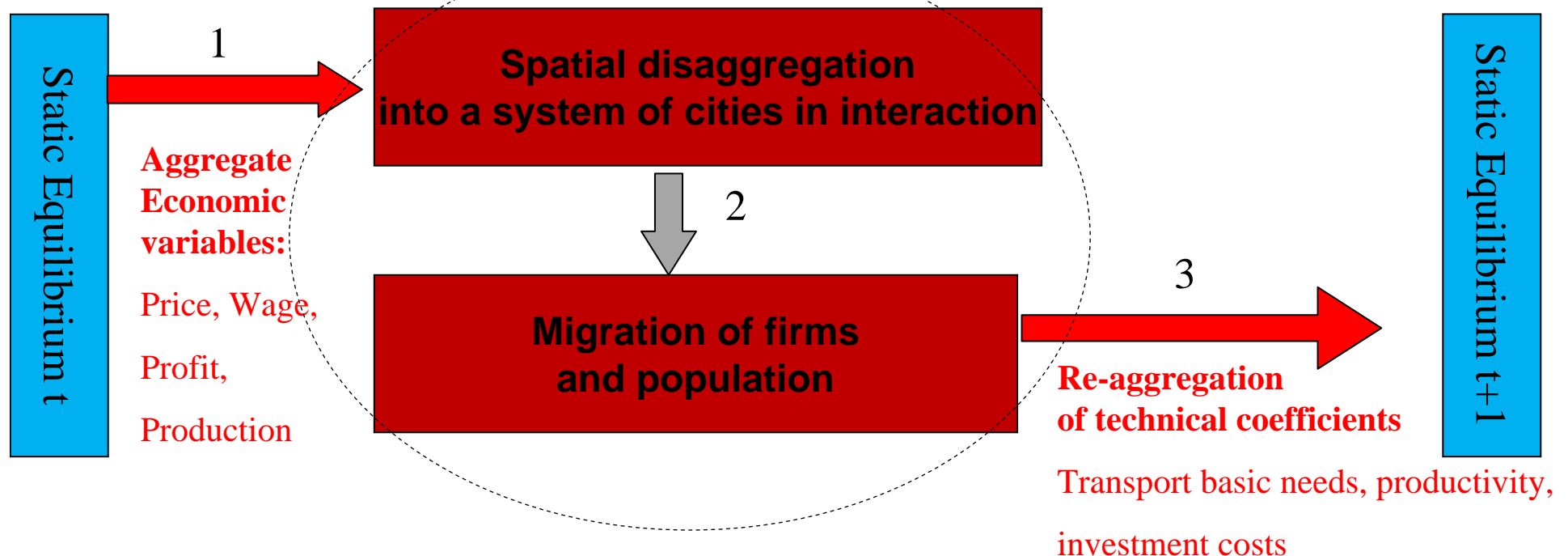
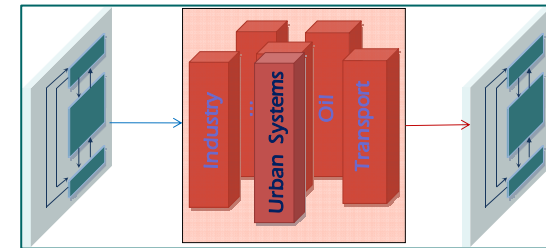
- Demography + Labor productivity growth
- Imperfect markets & Partial use of production factors (unemployment, idle capacities)
- Investments under imperfect foresight
- Trade and capital flows under exogenous assumption about debts

## ❑ A dialogue between engineering-based and economic analyses

- Hybrid matrixes in values, energy and « physical » content (Mtoe, pkm)
- Explicit accounting of inertias on equipments, technical asymptotes and basic needs

# IMACLIM, a tool to investigate the interplay between Systems of Cities in Interaction and growth patterns

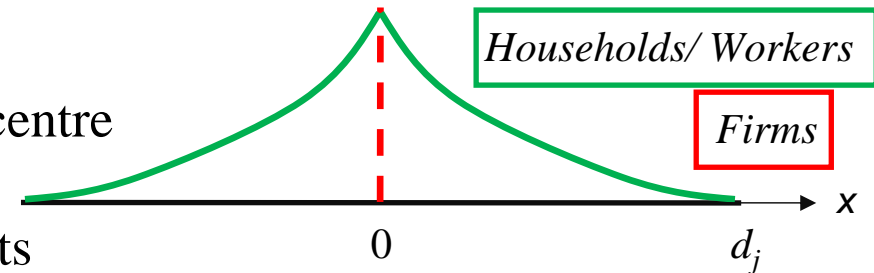
1. Disaggregate the national economy into a System of Cities in Interaction
2. Represent the spatial dynamics among a number of urban agglomerations
3. Capture the feedbacks on growth patterns



# The system of cities in interaction

## □ *Spatial structure of cities*

- Monocentric and axisymmetrical
- Firms clustered into the adimensionnal centre
- Spatial distribution of households
  - tradeoff on housing/commuting costs



- Calibration in 2001: 74 OECD agglomerations
  - « Empirical data » : Population, Density, Production, Wage

## □ *Multi-level interactions*

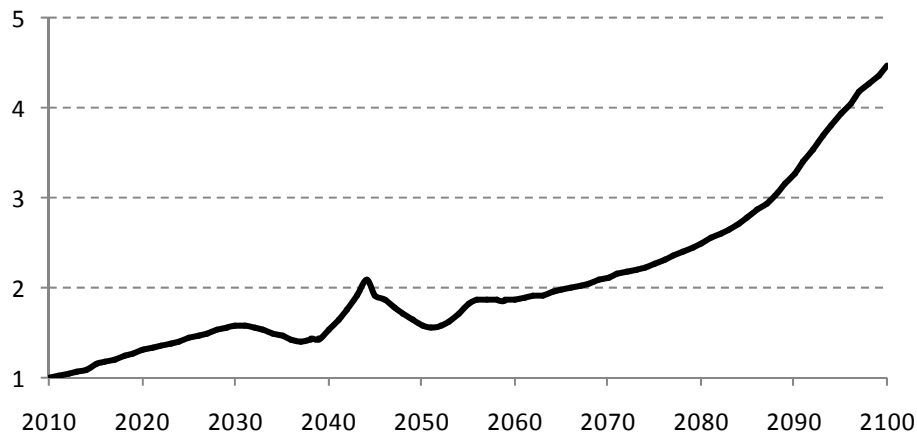
- Inter-city trade (iceberg structure)
- Monopolistic competition & imperfect substitution among varieties
- Agglomeration effect on production

## □ *Spatial dynamics*

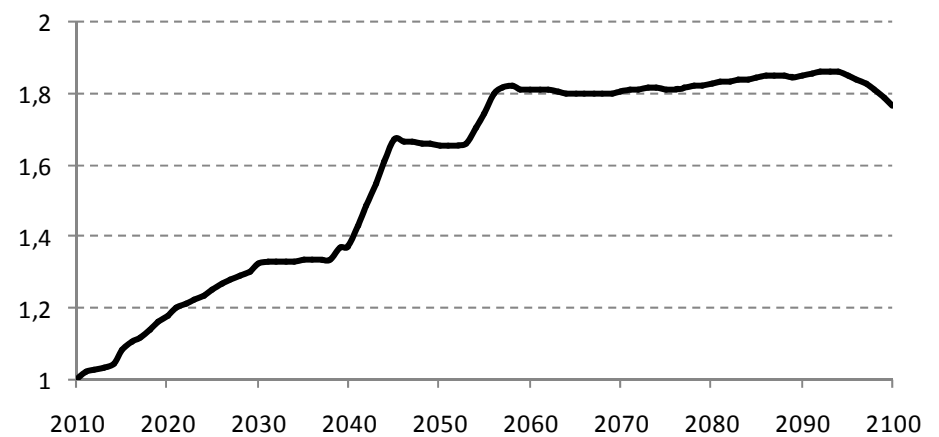
- Differentiated attractiveness of cities (investment profitability)
- Migration of investments towards the most attractive cities
- Migration of firms and associated labor force

# A consistent view of macroeconomic and urban dynamics

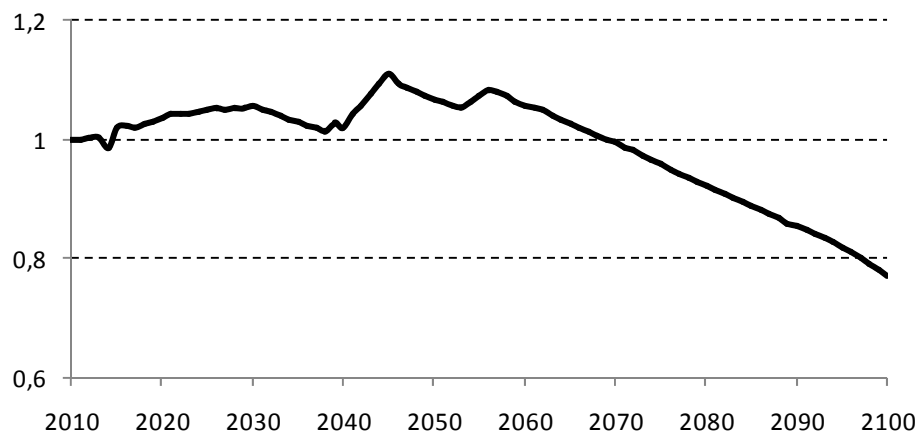
**World oil price  
(index 1= 2010)**



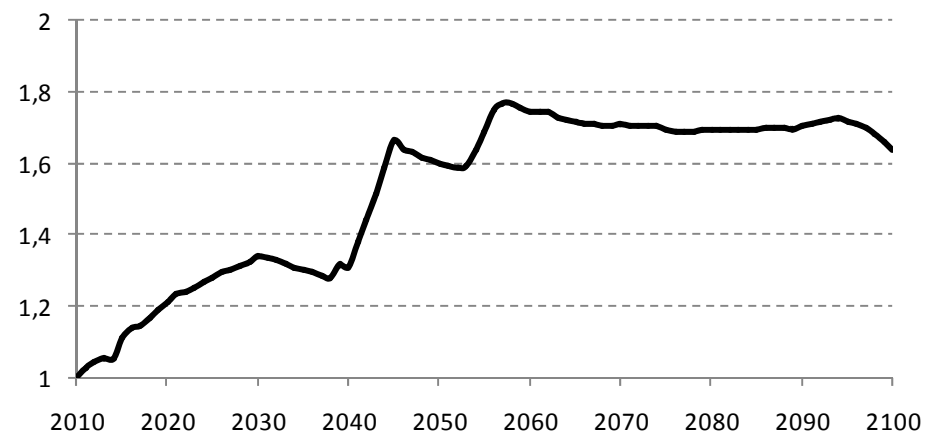
**Unitary urban commuting cost  
(index 1=2010)**



**Average urban density  
(index 1= 2010)**



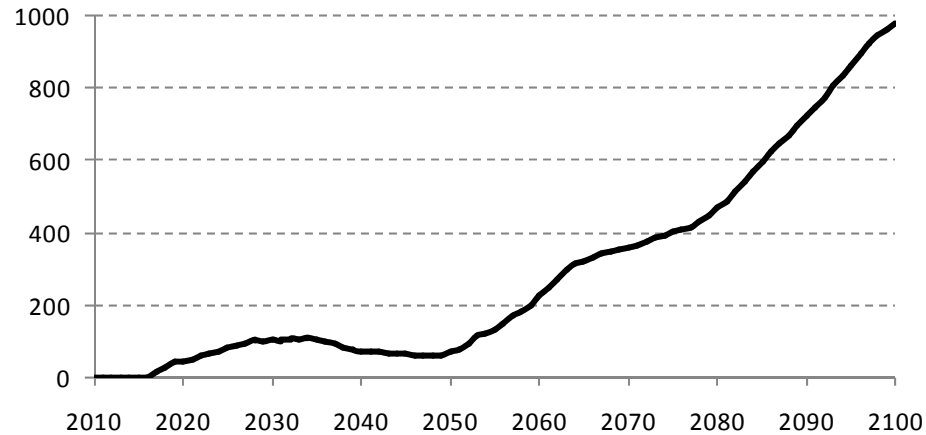
**Urban land price  
(index 1=2010)**



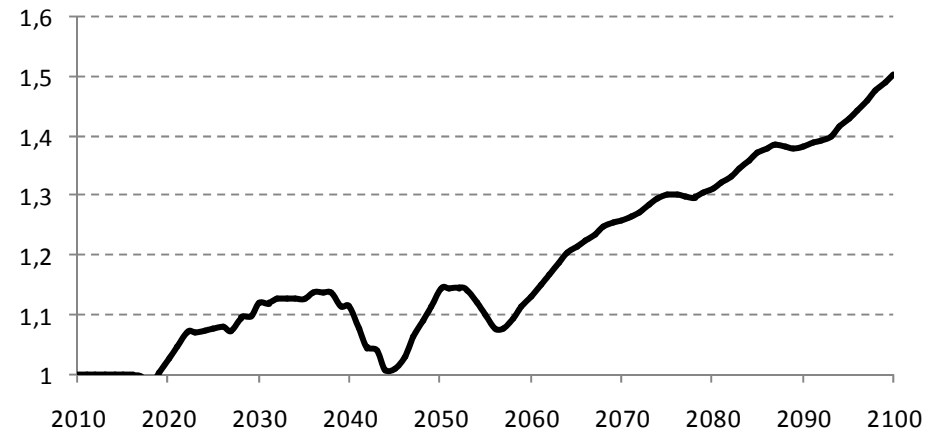


# Climate policy (450ppm-CO<sub>2</sub>) and urban dynamics

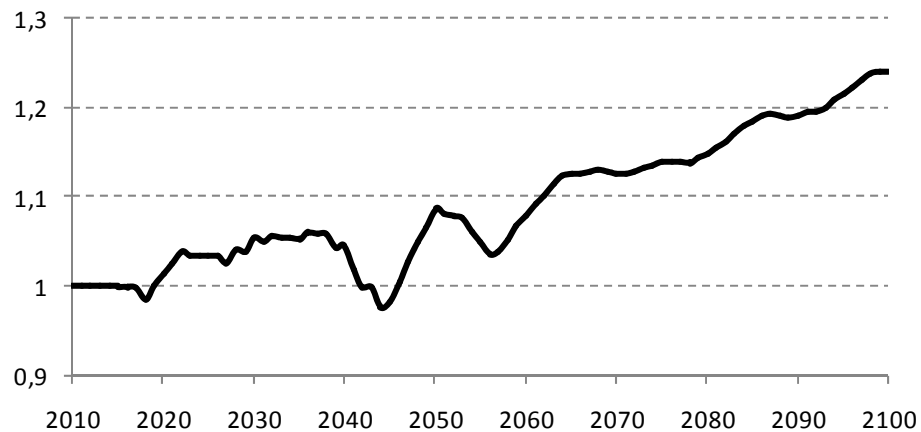
**Carbon price  
(\$/tCO<sub>2</sub>)**



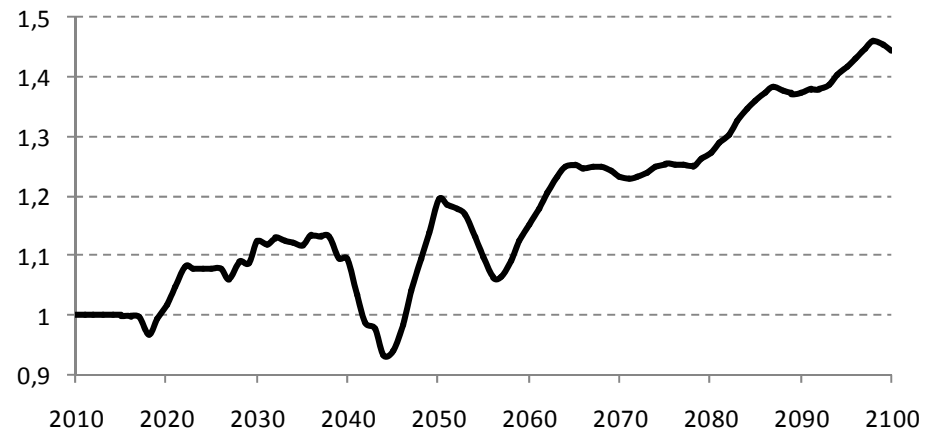
**Relative variation of unitary commuting cost  
under climate policy (index 1= baseline)**



**Relative variation of urban density  
under climate policy (index 1= baseline)**

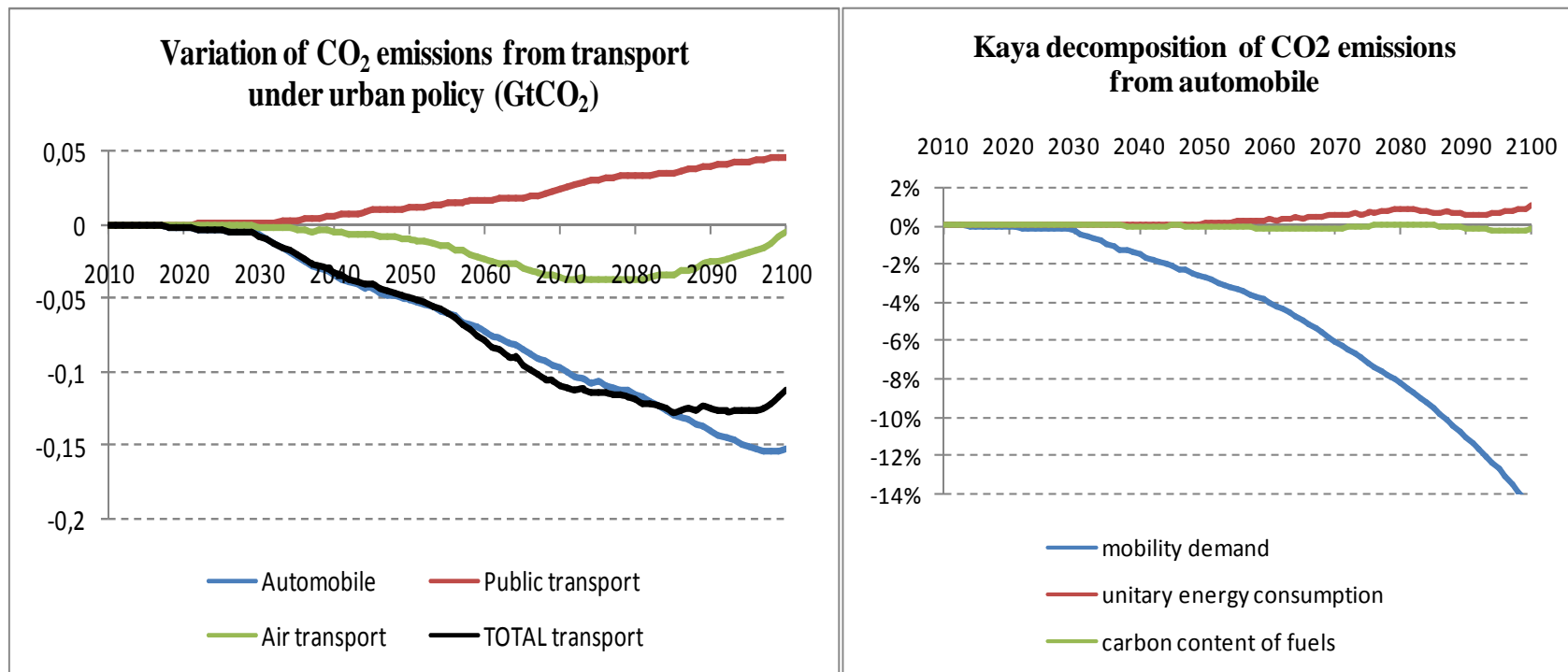


**Relative variation of urban land price  
under climate policy (index 1= baseline)**



# Urban policy and CO<sub>2</sub> emissions

Spatial policy at the city level to limit urban sprawl and constrained mobility  
= 0.1% of OECD GDP



# Urban densification policy and costs of climate policies

	discount rate = 7%		discount rate = 1%	
	carbon price only	carbon price & urban policy	carbon price only	carbon price & urban policy
Carbon price (\$/tCO <sub>2</sub> )	56.2	55.8	225.0	219.8
Oil price (\$/Barrel)	69.4	69.2	61.2	60.0
Land price (index 1 =baseline)	1.31	1.37	1.70	1.93
Total surplus variations (Billion \$)	-4.30	-4.27	-4.08	-3.46

# Conclusion

IMACLIM, a methodological tool for consistency checks between expertises

- material content of economic growth
- transport, infrastructure policies and mitigation
- endogenizing urban systems in a global energy-economy model

Quantification of the impact of urban policies on carbon and real estate prices

- important complement to carbon pricing for ambitious mitigation objectives
- not only for carbon mitigation : political implementation, social dimensions (welfare effects, distributional issues)

On-going research:

- real estate markets and scarcity rents
- interplay between transport infrastructure, modal choice and the dynamics of real estate at the local level
- linkages between labor productivity and agglomeration effects