



*Downscaling results from  
a representative household to  
urban and rural households  
in Latin America*

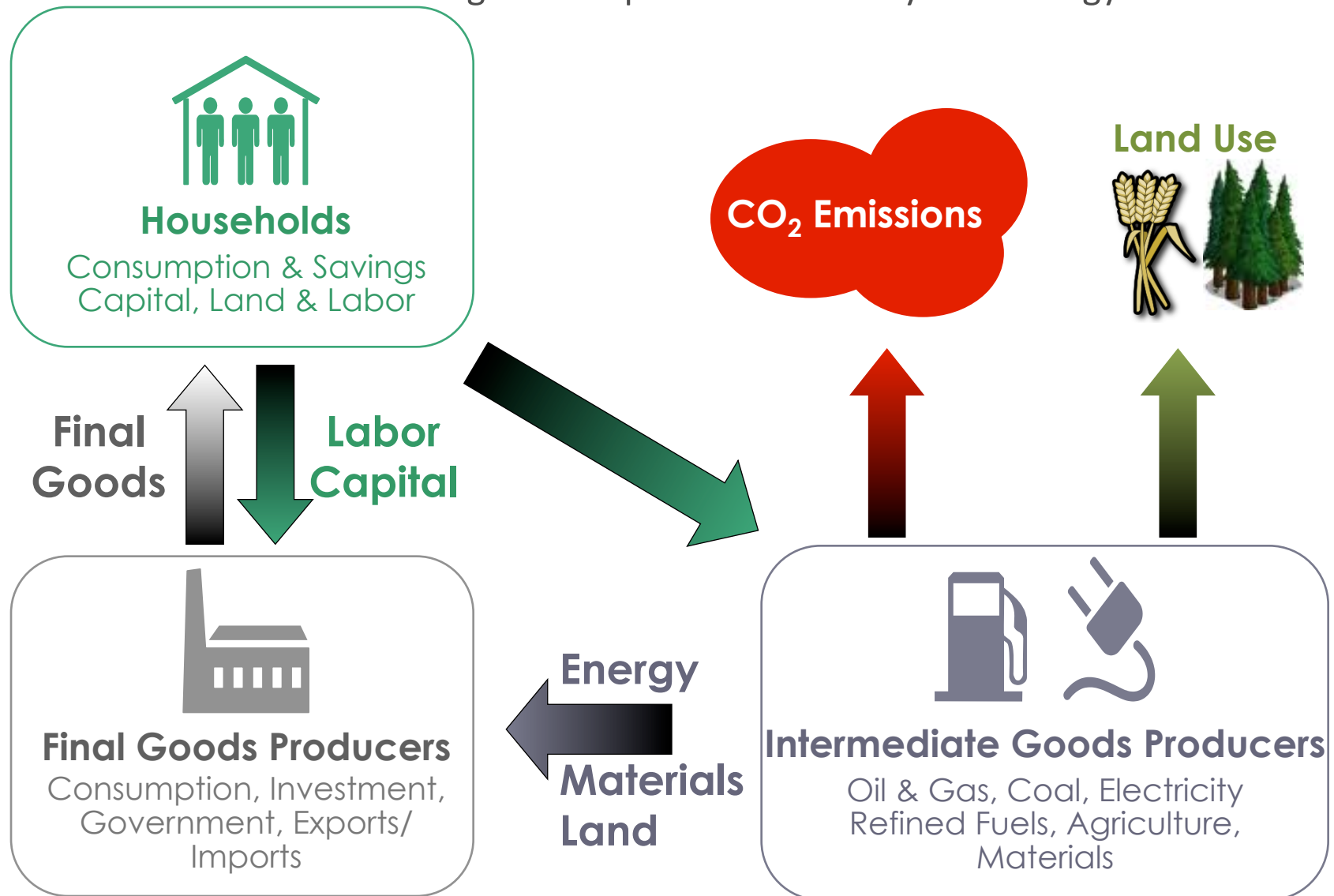
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# Background

- RH results overlook impacts for household types
- iPETS includes heterogeneity
- Method should capture demographic trends
- Differences in income, consumption, savings
- Analyze heterogeneous impacts
  - Climate policy & climate impacts

# iPETS

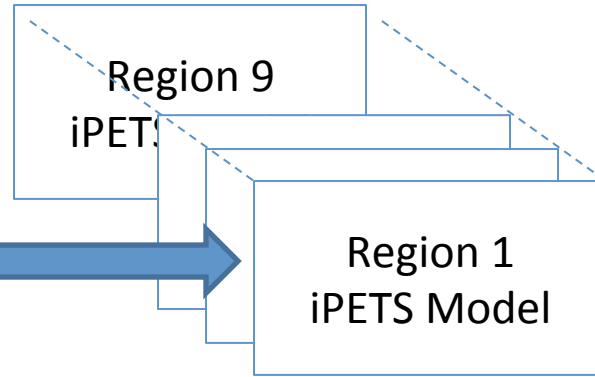
Integrated Population-Economy-Technology Science Model



# iPETS model setup

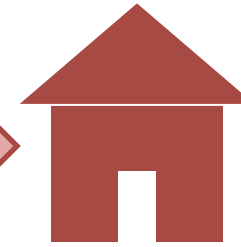
## HH Characteristics

Labor supply  
Preferences  
etc.

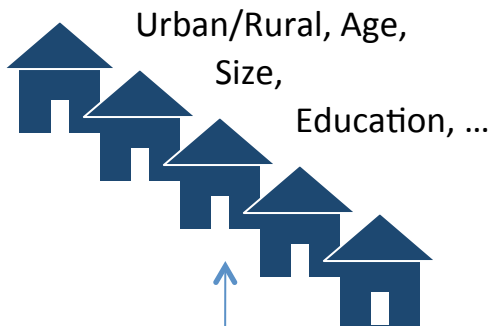


## HH Outcomes

Consumption  
Income  
Savings  
etc.



## Characteristics by Type



Population  
Projection

Household  
Survey Data

China, India, Indonesia,  
EU, Russia, USA, Japan,  
Mexico, Brazil

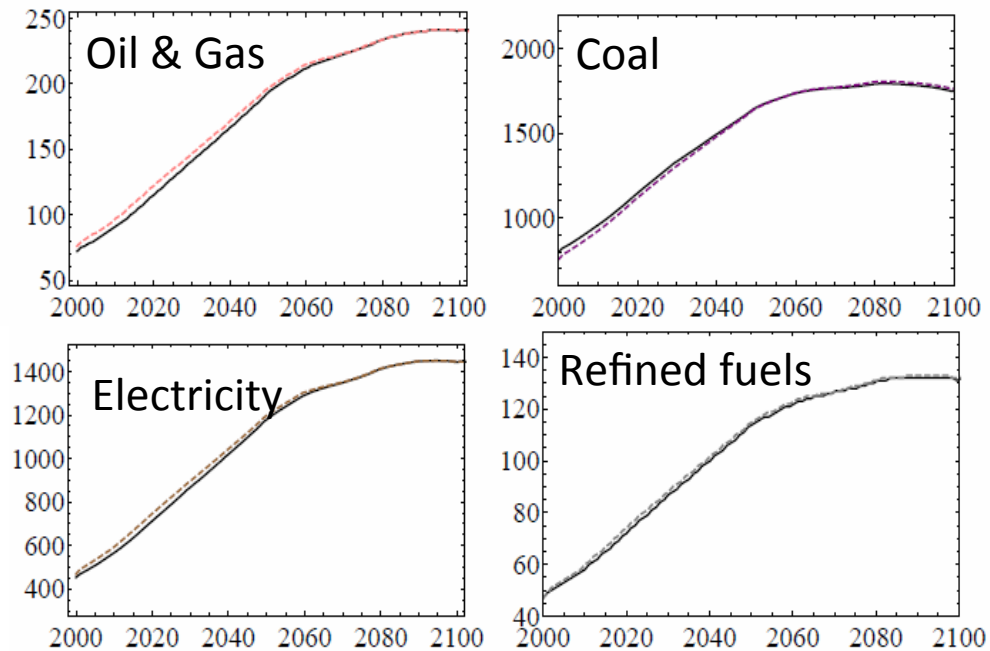
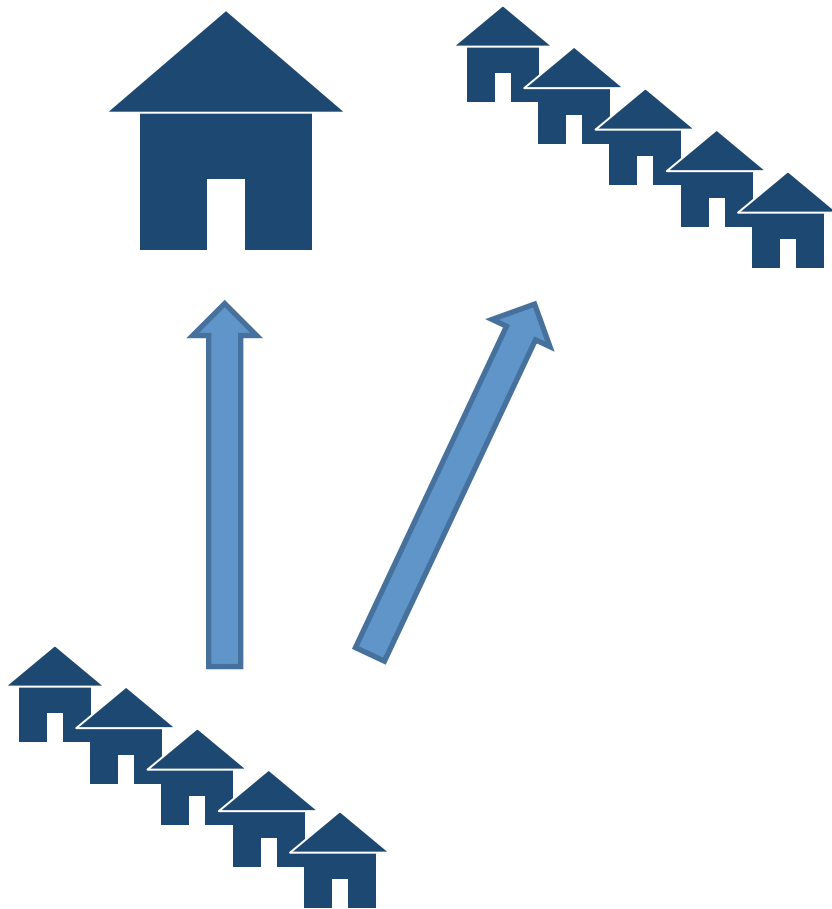
## Outcomes by Type



*Upscaling*

*Downscaling*

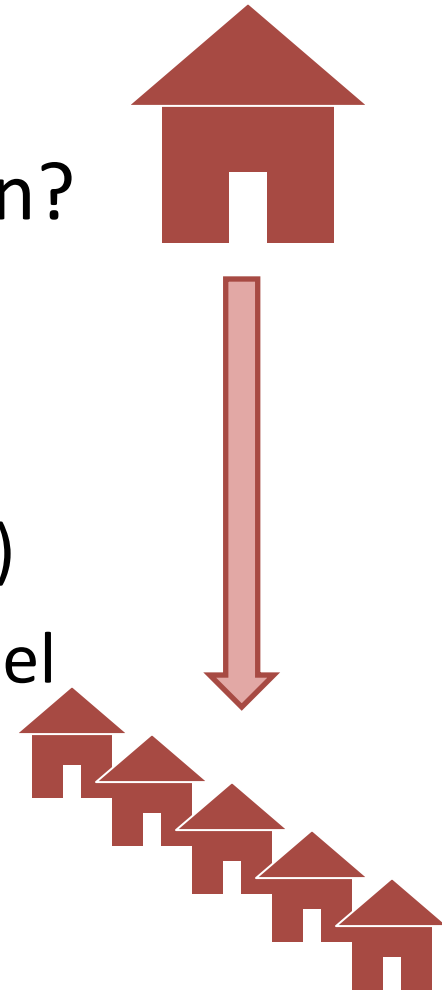
# Aggregate households -> same total results



— Representative HH  
 - - Heterogeneous HHs

# Disaggregate household outcomes

- Possible to obtain same results from downscaling as multiple household run?
- Methods:
  - Multiple household in iPETS (benchmark)
  - Recursive-dynamic microsimulation model
  - Forward looking microsimulation model



# Approaches

	Exogenous variables	Endogenous variables
General Equilibrium (benchmark)	Labor supply	Prices Savings Incomes Consumption
Forward looking micro simulation model	Prices Labor supply	Savings Incomes Consumption
<del>Recursive-dynamic micro simulation model</del>	<del>Prices Savings Labor supply</del>	<del>Incomes Consumption</del>

# 2-period dynamic model

maximize  $\log C_{it} + \beta \log C_{it+1}$

s.t.  $\{ \begin{aligned} C_{it} + X_{it} &= L_{it} + r_t K_{it} \\ C_{it+1} &= K_{it+1} \\ K_{it+1} &= (1 - \delta) K_{it} + X_{it} \end{aligned} \}$

Simple OLG model, capital income in first period

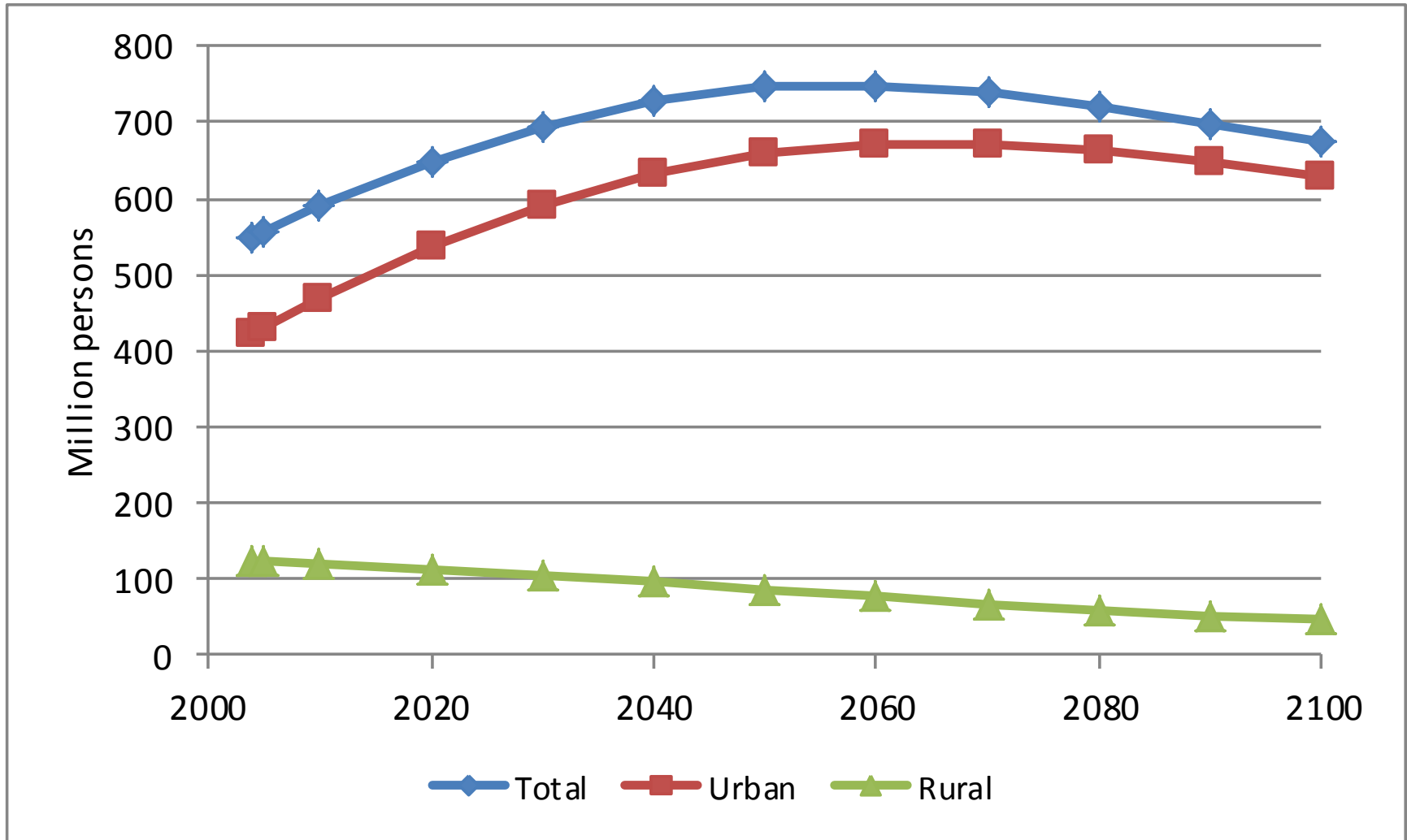
Estimate  $\beta$  from benchmark run or RH



# Application

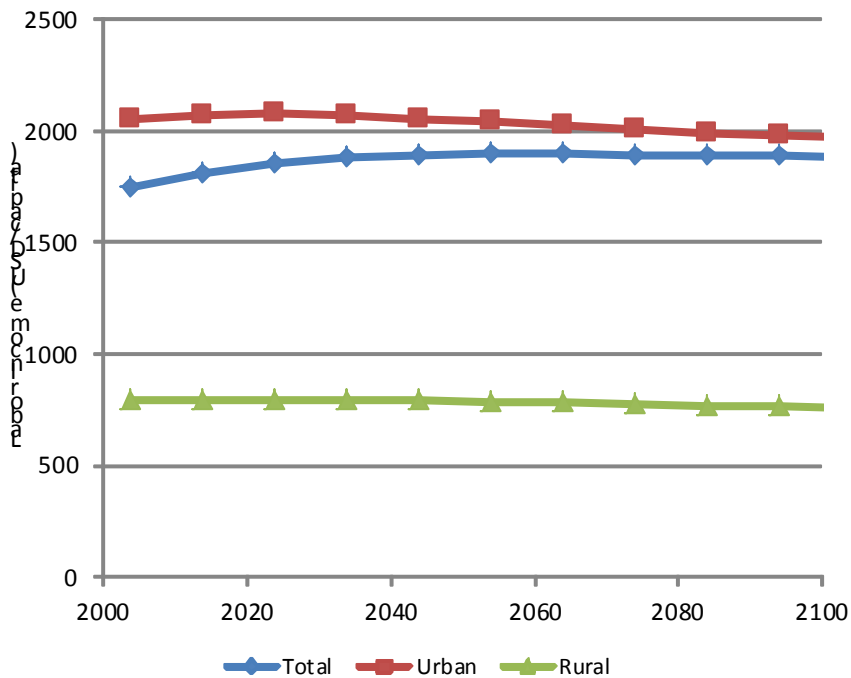
- Latin America
  - Economic data: GTAP7
  - Household data: HH surveys for Mexico and Brazil
- SSP2 baseline scenario
- Downscale to 2 household types:
  - Urban & Rural

# Population

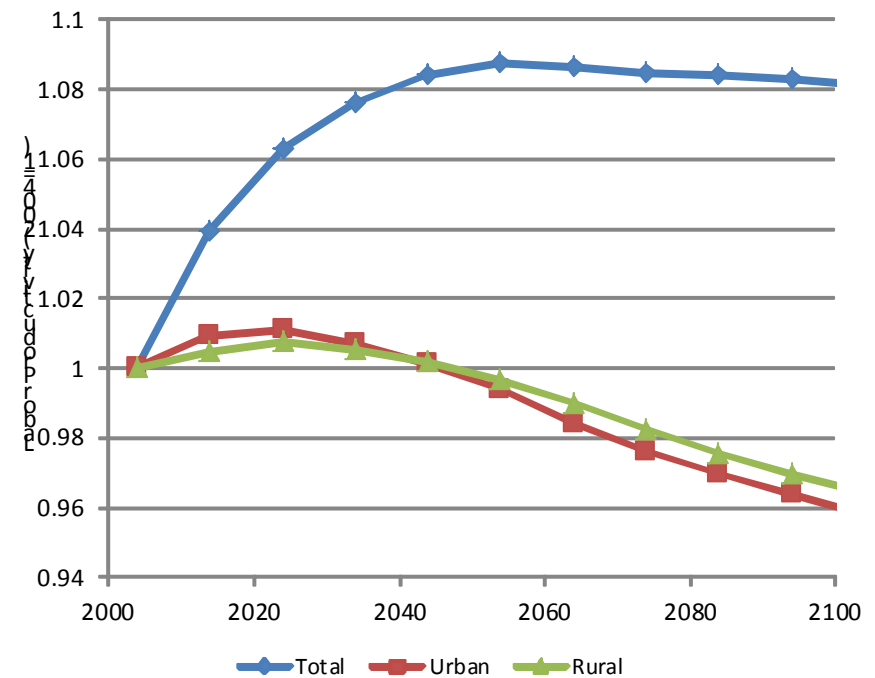


# Labor income assumptions

Per capita labor income (survey)

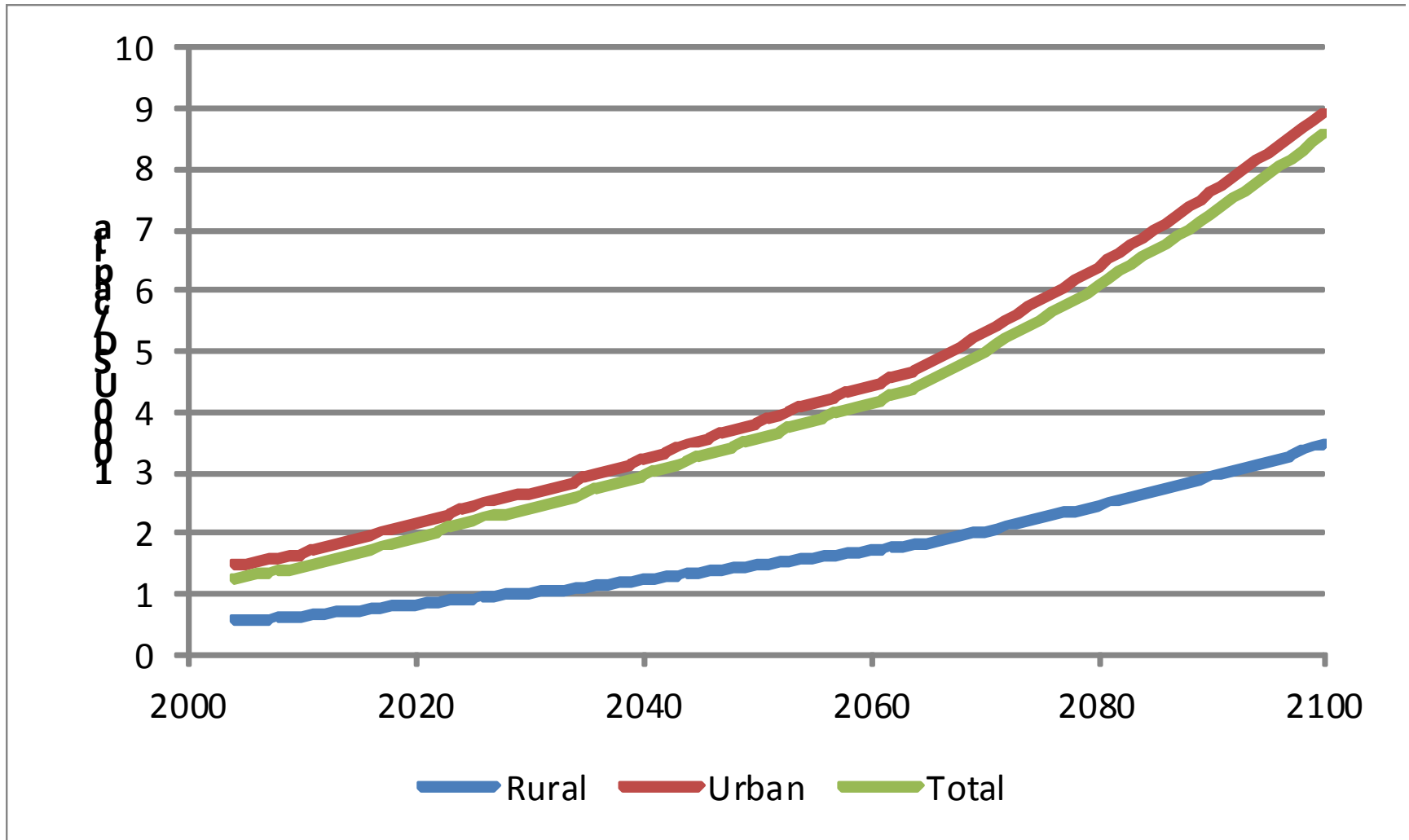


Per capita labor productivity from demographic change



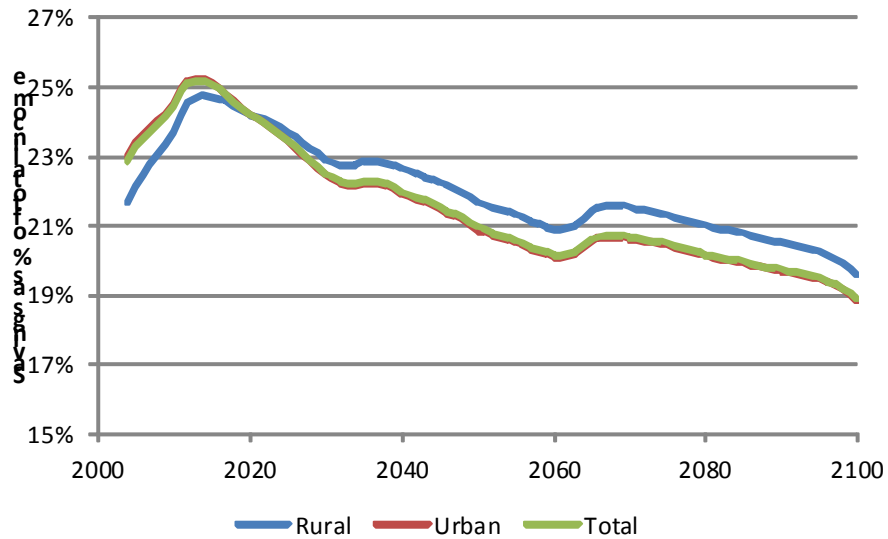
Demographic changes:  
 Urbanization  
 Ageing  
 Household size

# Downscaled labor income

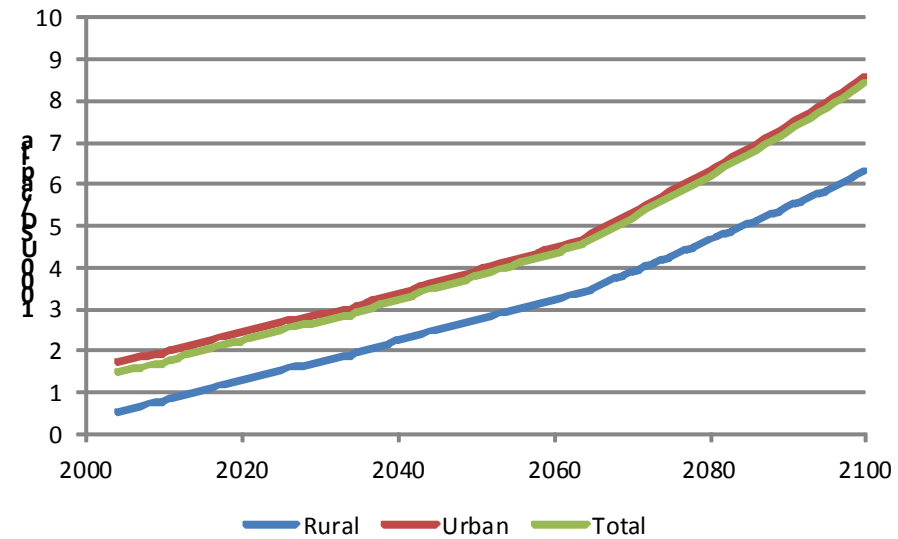


# Savings & capital income

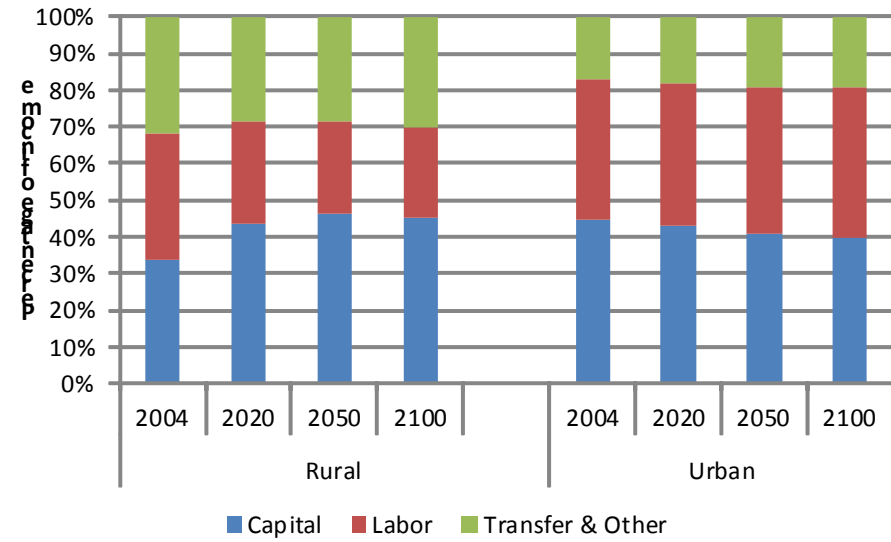
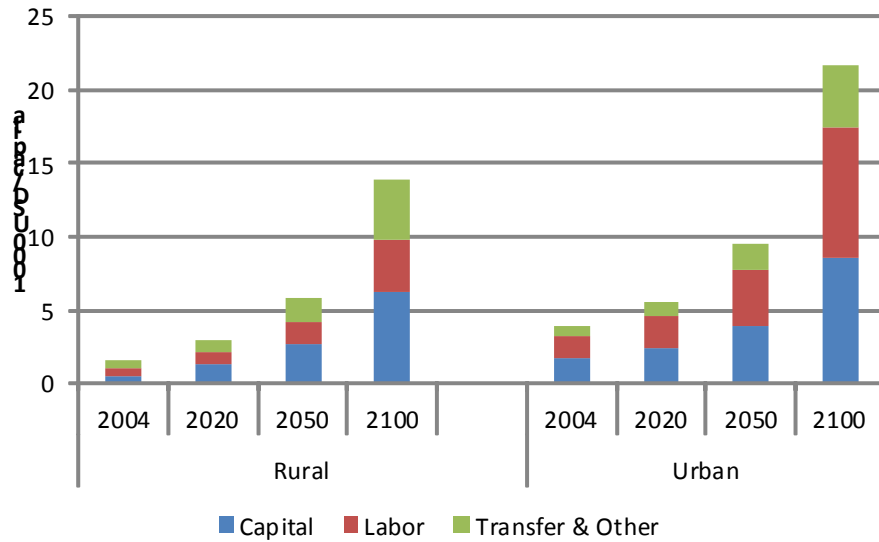
## Savings rate



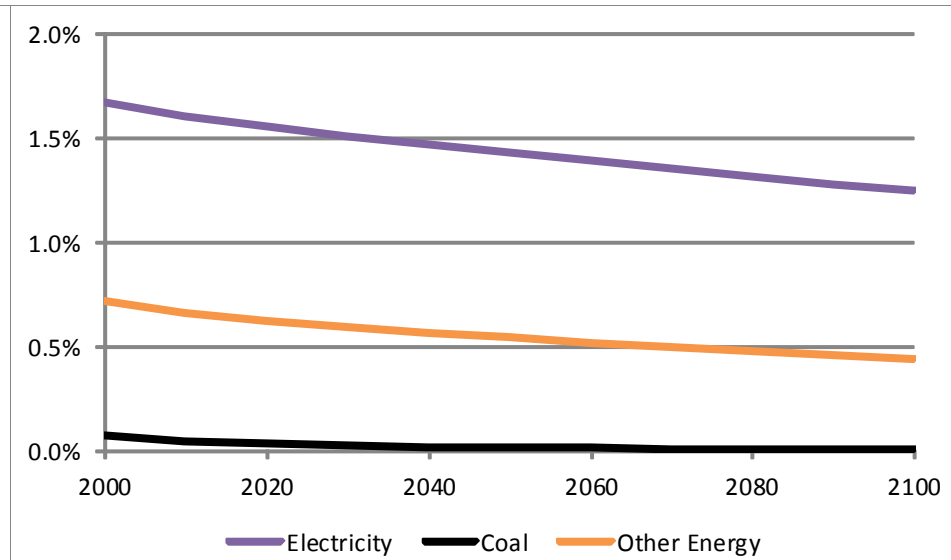
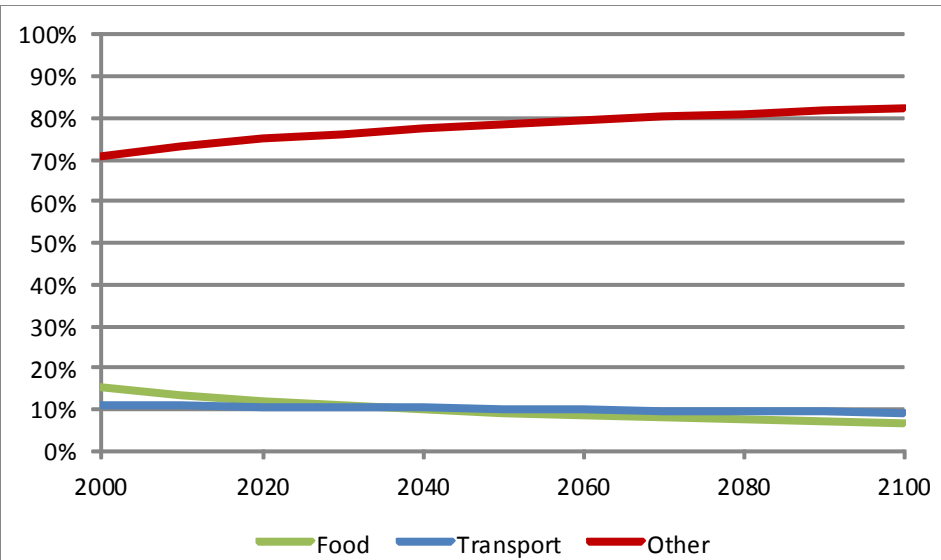
## Per capita capital income



# Total income

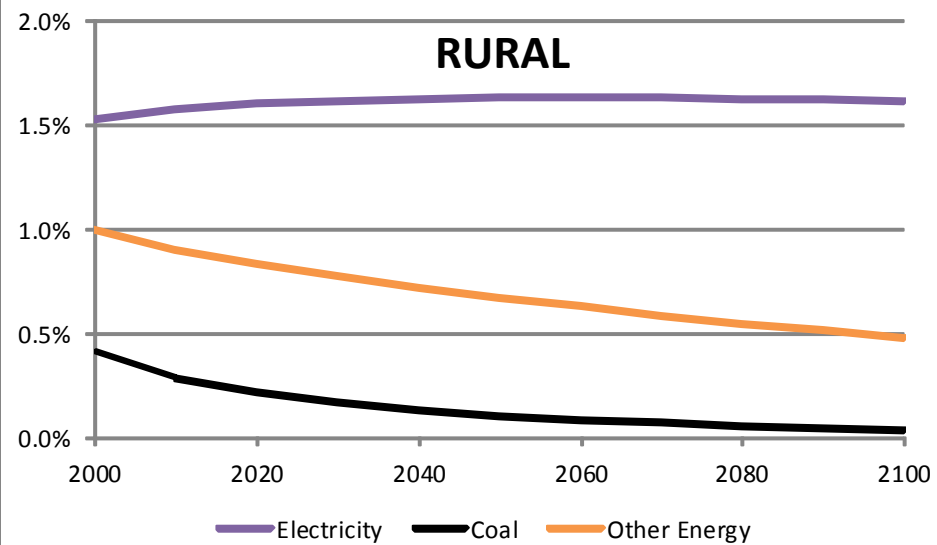
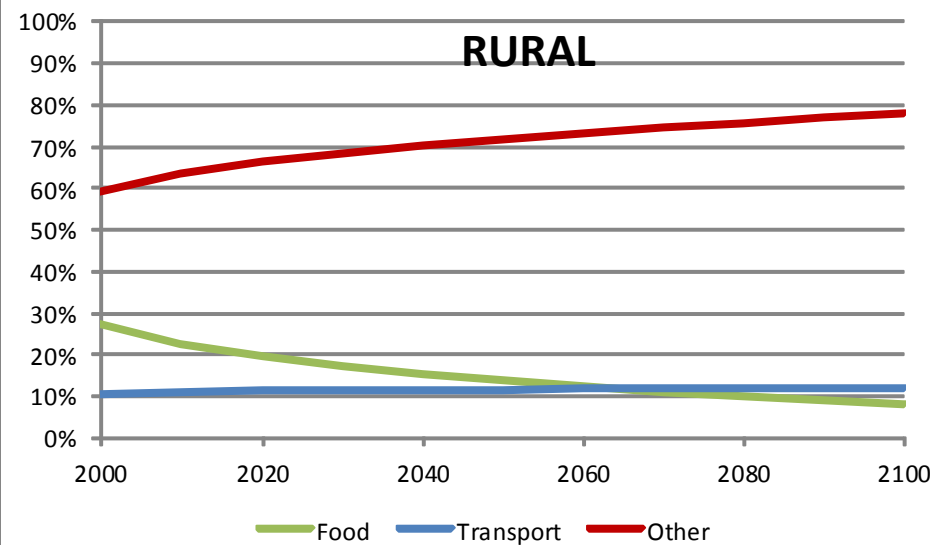
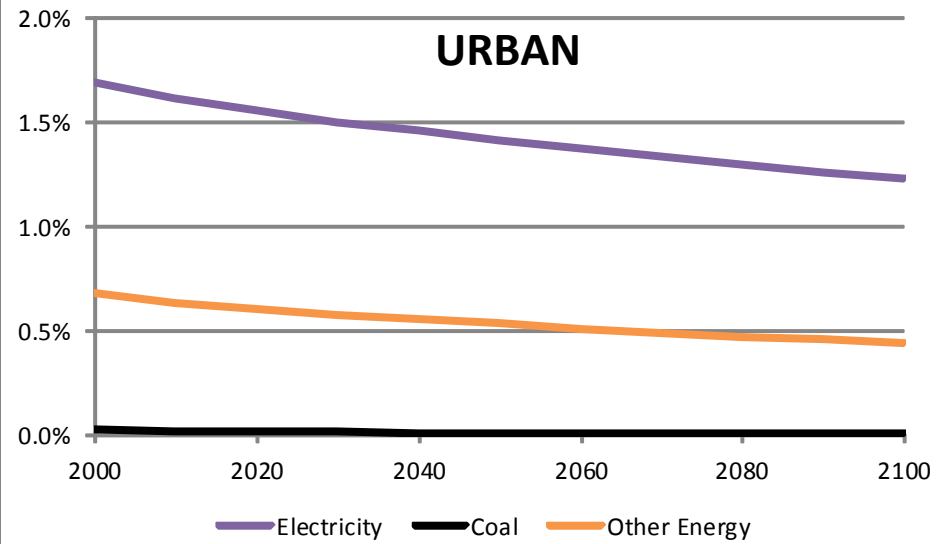
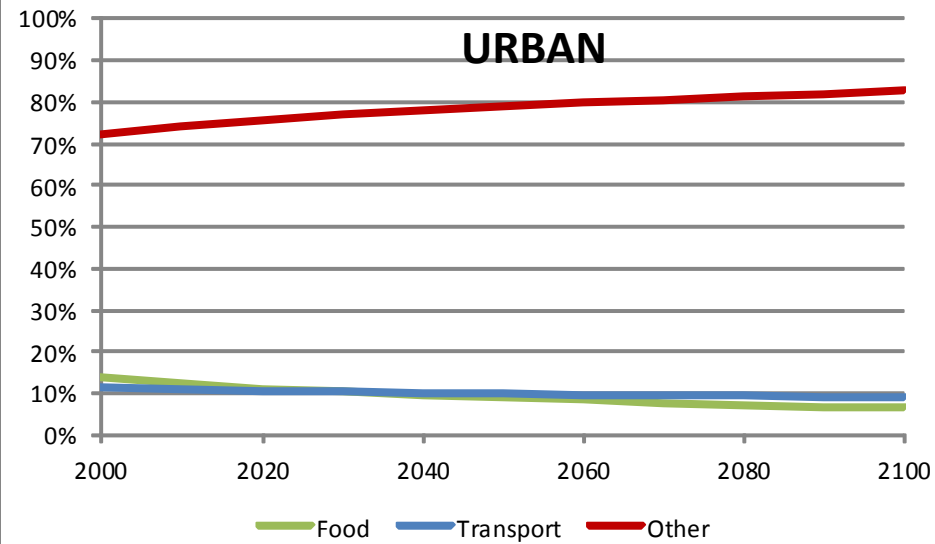


# Consumption preferences



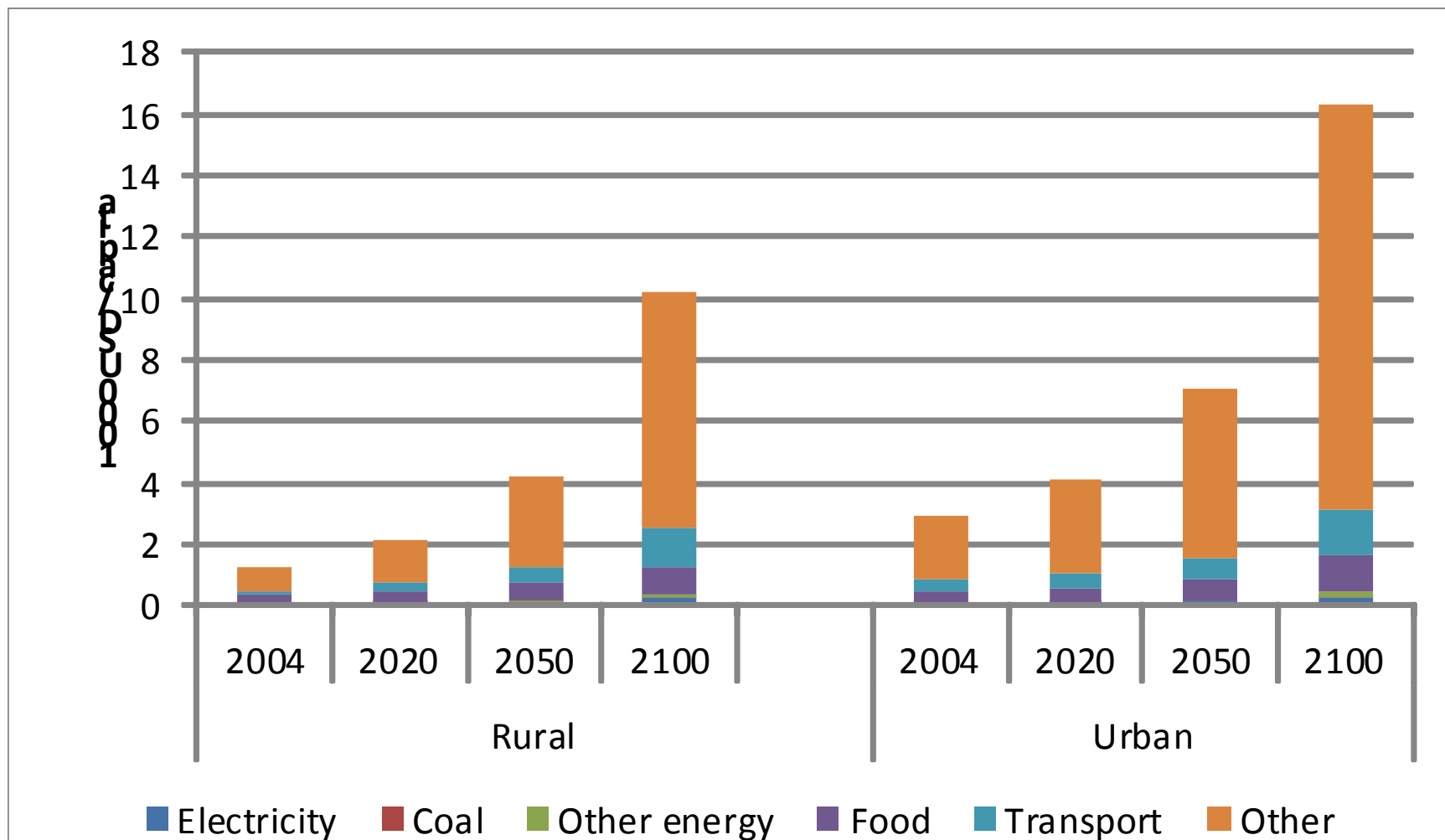
**Changes over time due to:  
Income change, Urbanization, Household composition change**

# Consumption preferences

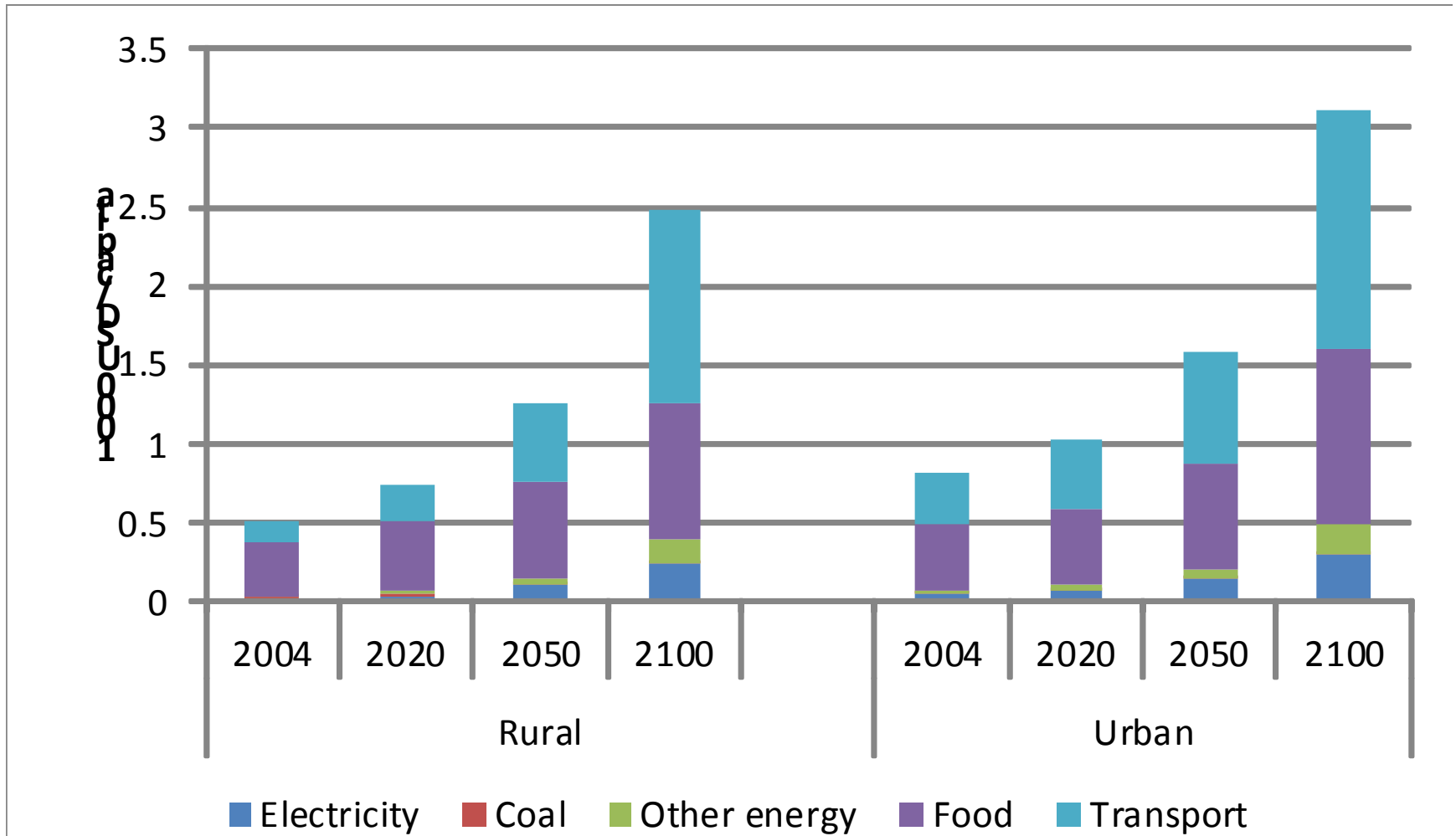




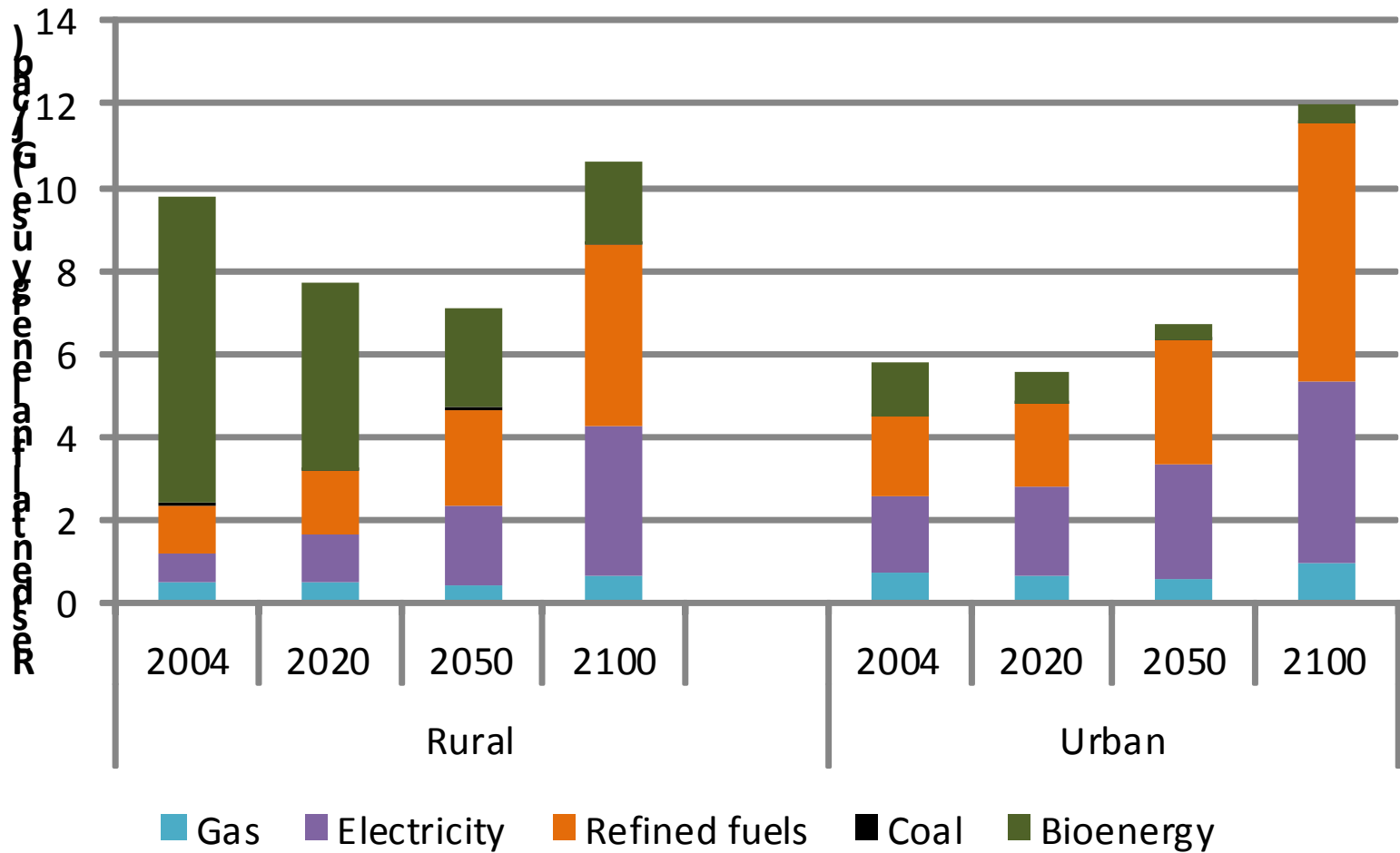
# Total Expenditures



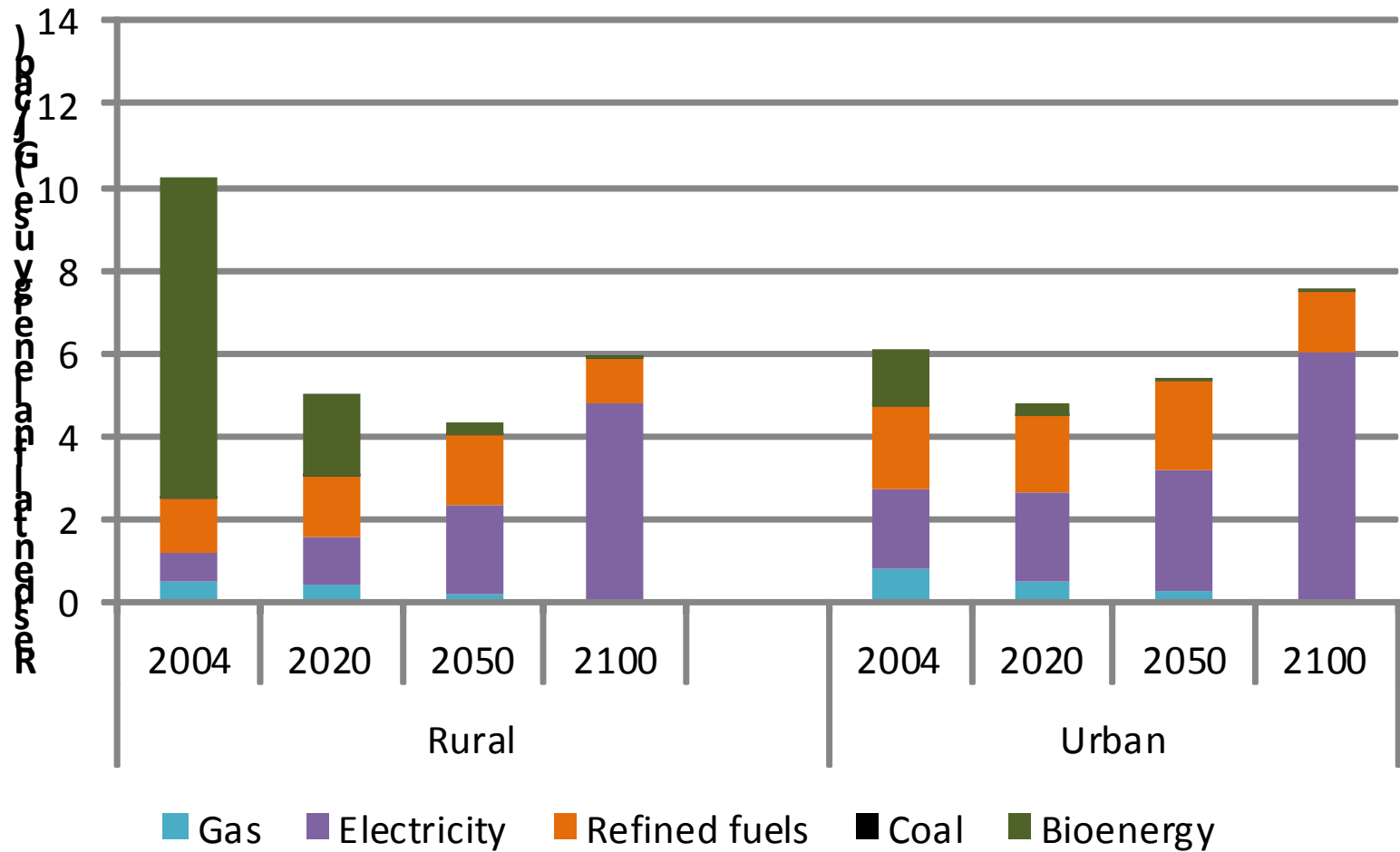
# Total Expenditures



# Final energy use per capita



# Final energy use pc (10 \$/tCO<sub>2</sub>+4%pa)





# Wrapping up

- Method for downscaling results from representative household to multiple household types
- Capture trends and differences
- Next steps:
  - Education household types
  - Explore
    - details: multi prices? Different responses?
    - uncertainty:  $\beta$  values, other parameters
  - Impacts analyses