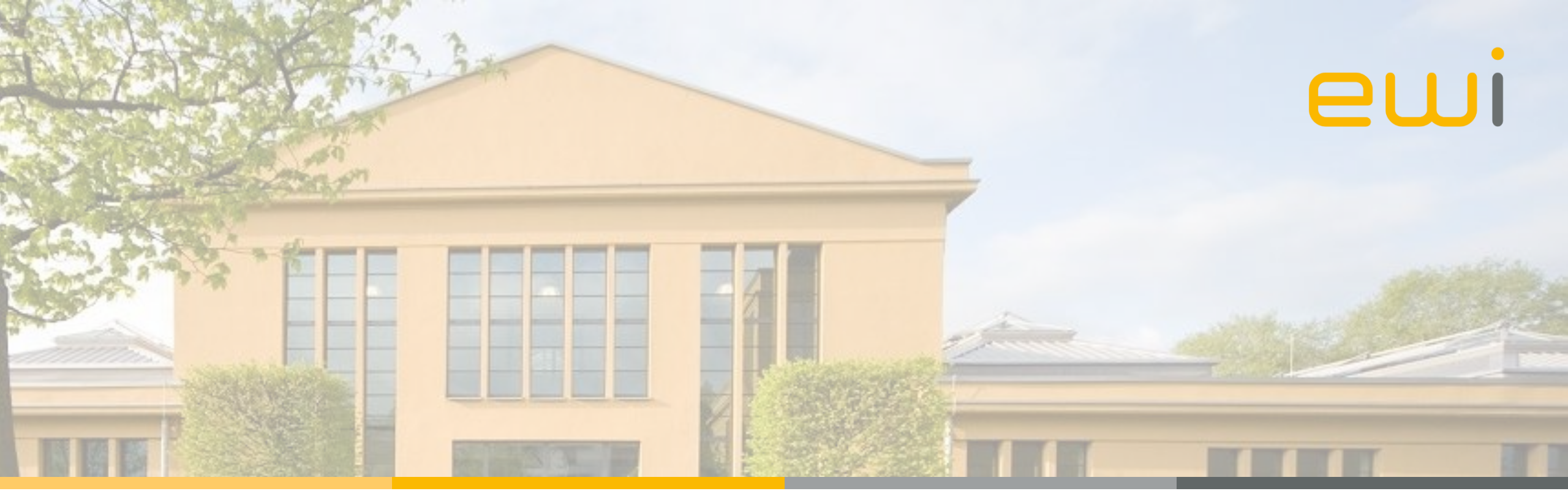

MODELLING OPTIMAL REGIONAL ENERGY SUPPLY BASED ON 3D GEODATA FOR BUILDINGS AND RENEWABLE ENERGIES

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Agenda

1 Motivation

2 Literature

3 Methodology

4 Scientific Contribution of the Results

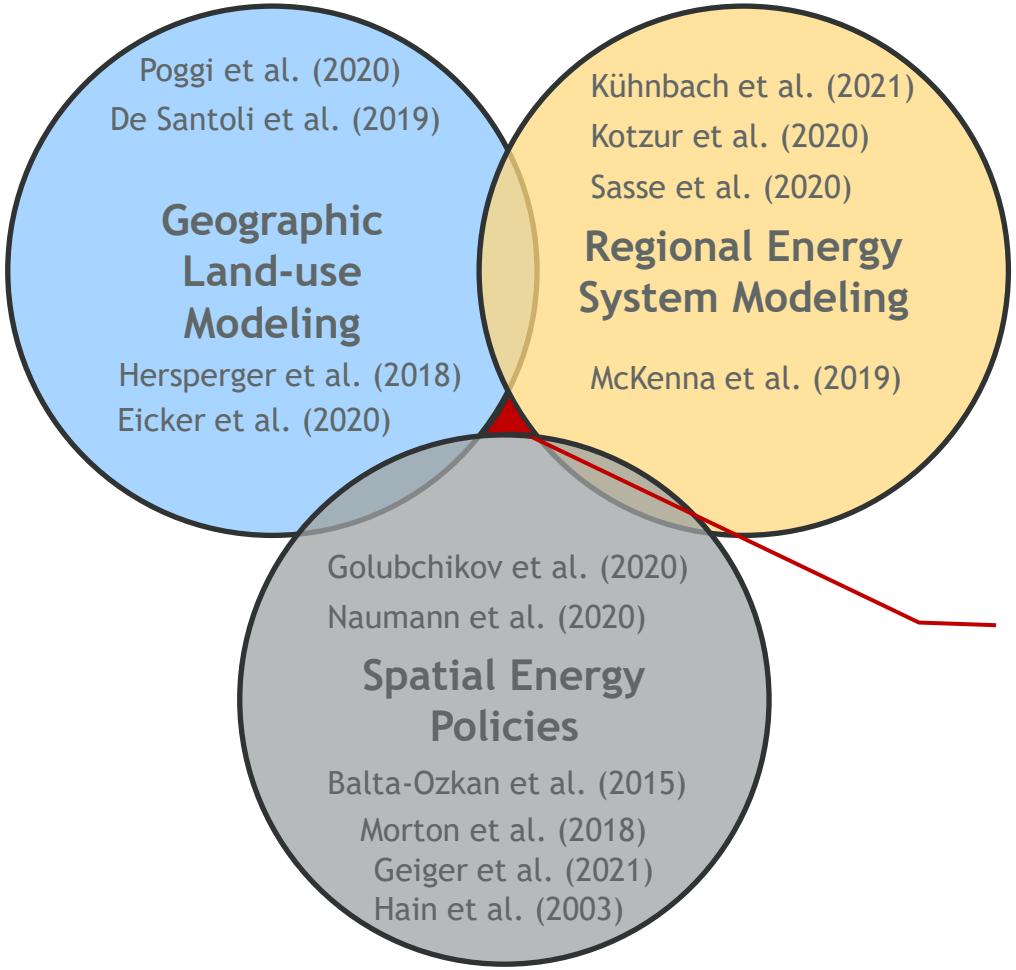
5 Outlook

Motivation: Spatial components of energy transformation

- Energy Transformation increasingly replaces fossil fuels with RES
- RES typically less dense energy sources - two Implications:
  - ⇨ Concentration of energy supply decreases
  - ⇨ Transportation increasingly becomes an issue
- Geographic unique characteristics increasingly matter due to decentralization
  - ⇨ Availability of renewable primary energy sources: Wind, Radiation, Biomass
  - ⇨ Economic Activity: Population, Building Stock, Energy Demand
- The spatial distribution of these characteristics is uneven and heterogenous

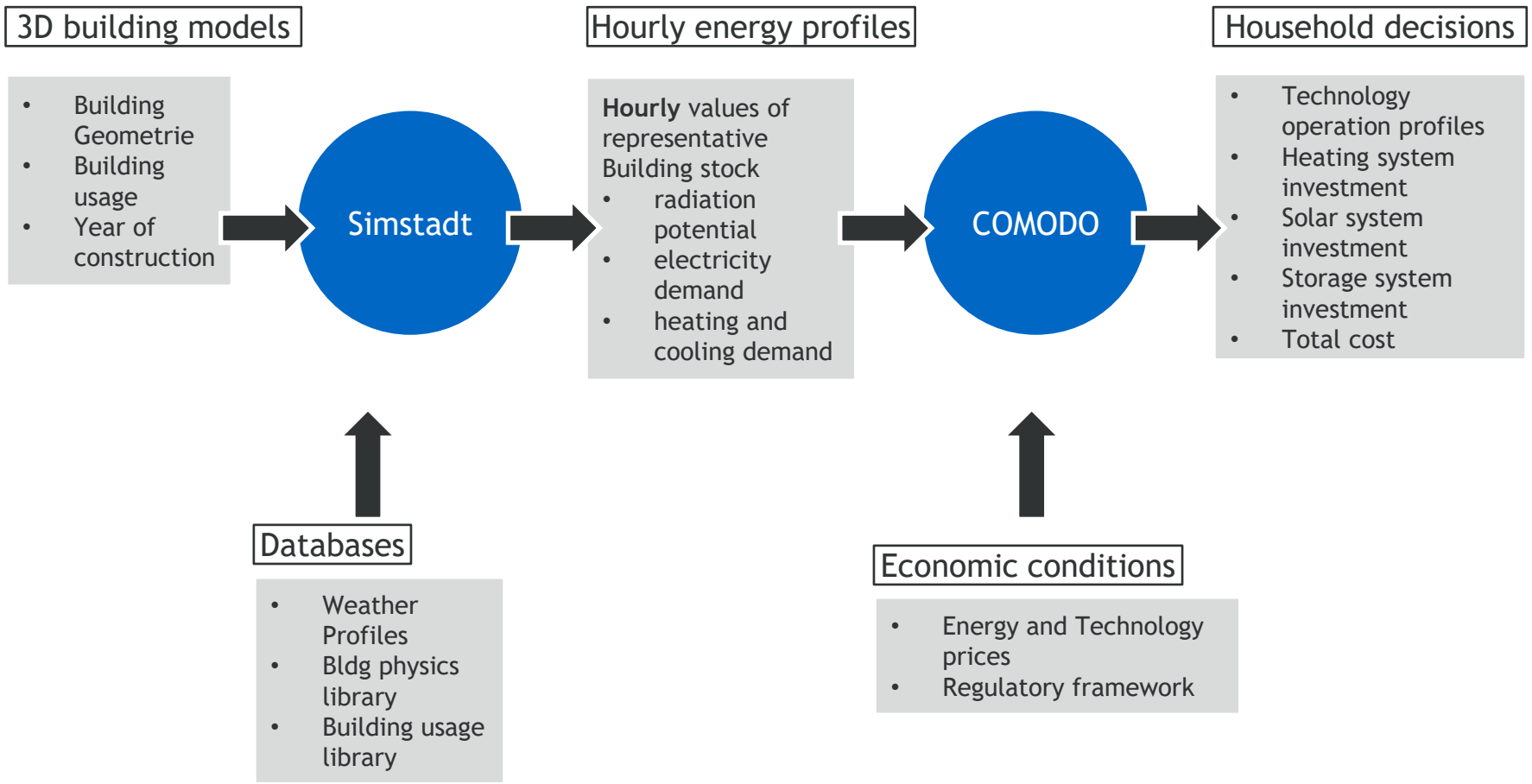
Understanding the impact of regional characteristics on energy transition should be of particular interest for policy makers

Literature: On spatial energy economics



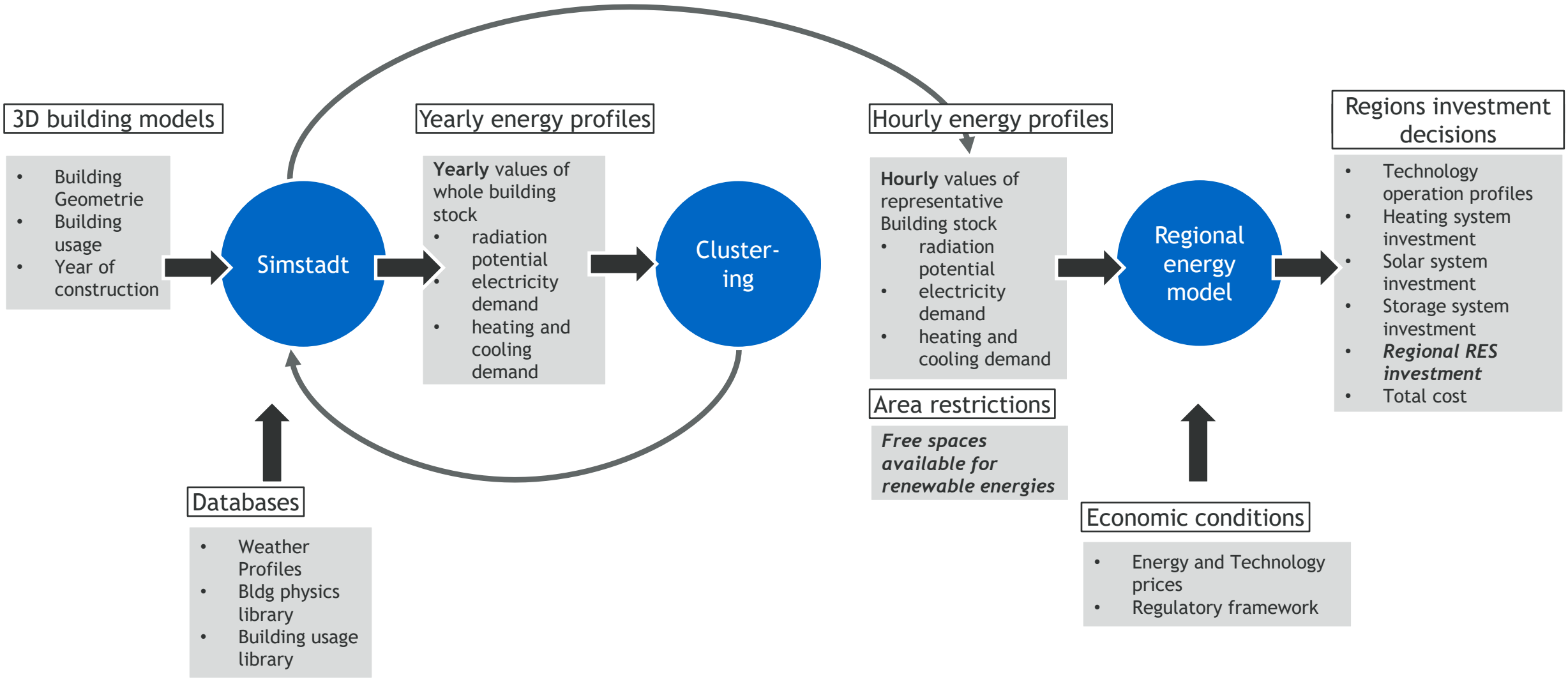
How do regional energy systems transform and what does this mean for decarbonization policies?

Methodology: Building Sector



Based on Theile et al. (2021) *There's No Place Like Home – The Impact of Residential Heterogeneity on Bottom-Up Energy System Modeling.* Forthcoming

Methodology: Building Sector



Based on Theile et al. (2021) *There's No Place Like Home – The Impact of Residential Heterogeneity on Bottom-Up Energy System Modeling.* Forthcoming

Methodology: RES with consideration of land-use conflict

Modelling of RES and land-use Conflict

All RES technologies require already scarce land

- $Area_{Biomass} = Freearea - Area_{OSPV} - Area_{Wind}$
- $Capacity_{Wind} \leq upper\ cap\ Capacity_{Wind}$

Modelling of Invest and Deployment in building sector

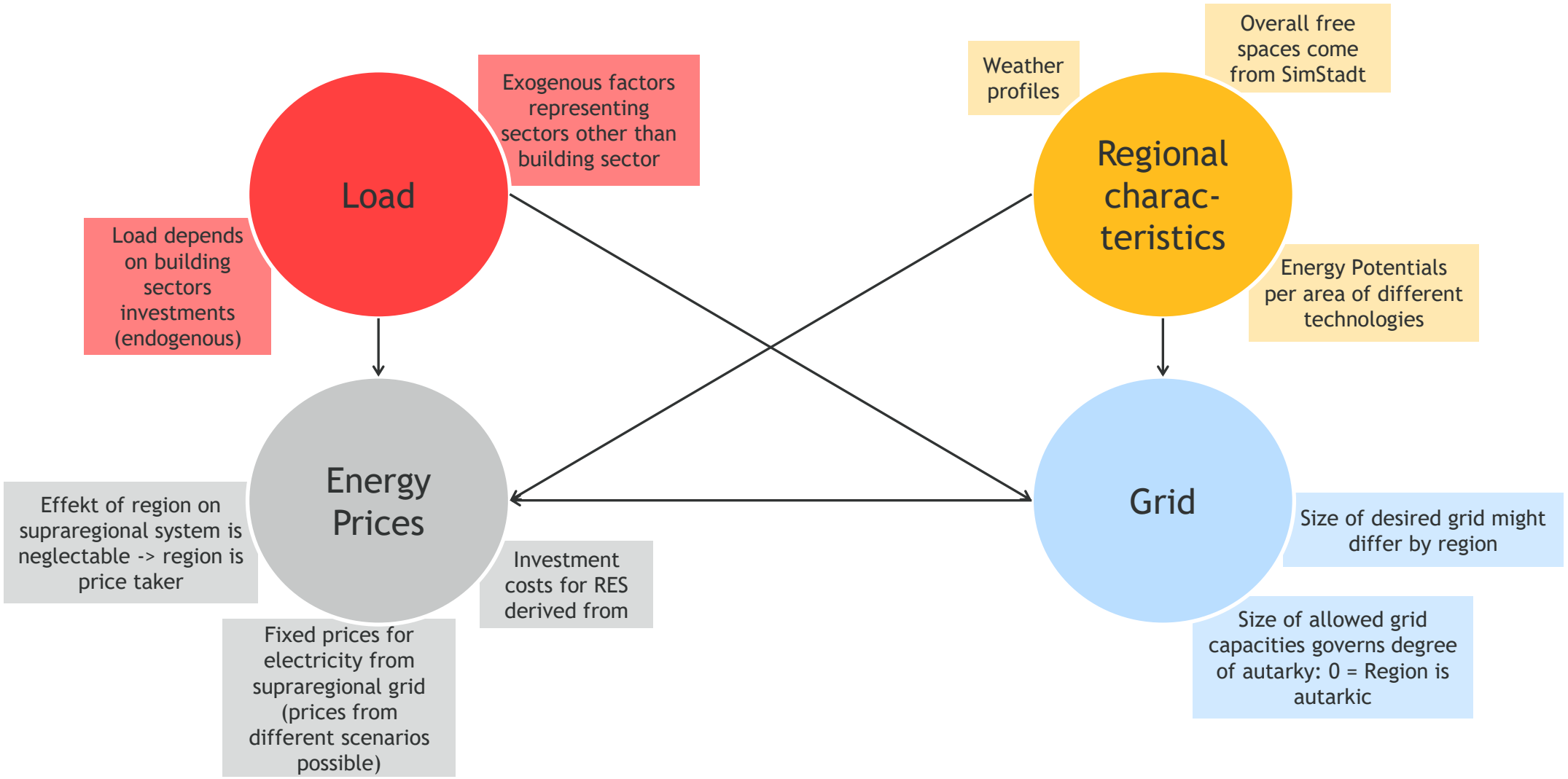
- $min\{Total\_Cost_{bs}\}$
- $Total\_Cost_{bs} = IC_{bs} + FOMC_{bs} + R_{bs} + EBC_{bs}$

IC: annualized investment costs
FOMC: fixed operation and maintenance costs
R: revenues and remuneration
EBC: energy based costs

Modelling of regions investment decision in RES

- $min\{Total\ Cost\},\ s.t.\ operation\ constraints\ and\ energy\ balances$
- $Total\ Cost = IC_{RES} + FOMC_{region} + R_{region} + Total\_Cost_{bs} + Supply\ from/to\ National\ Grid$

Methodology: Relevant metrics



Scientific Contribution of the Results

Determining spatially resolved energy transition paths

- Optimal spatial technology diffusion for primary energy conversion accounting for regional land-use conflicts
- Optimal spatial technology diffusion for final energy conversion in the building sector
- Spatially resolved abatement cost curves

Relevance for policy makers

- Evaluation of spatially heterogeneous responses to national policies
- Identification of gaps between regional transition ambitions and capabilities
- Design of spatially resolved policies

Outlook

Next Steps

- Modelling four regions in Germany (Dithmarschen, Ilm-Kreis, Ludwigsburg, Köln)
  - Determine regional biomass, PV, and wind power potentials with GIS-based work-flows
  - Specify modelling of area conflict
- Assess results
  - Draw conclusions about connection of regional peculiarities and energy model outcomes
  - Draw policy implications from that

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Merci

Thank you! Thoughts?