Universität zu Köln

ewi Energiewirtschaftliches Institut an der Universität zu Köln

# Bottom-up modelling of heating investment in Germany

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# Bottom-up modelling of heating investment in Germany

## AGENDA

I. Motivation

II. Approach and Model

III. Outlook and Challenges

# I. Motivation

# Background

## Motivation and Research Focus

- Energy consumption of households accounts for roughly a quarter of the final energy consumption in Germany (UBA 2018).
- Reducing GHG emissions in households may mean electrification of heat supply systems or investment in less GHG intense heating technologies.
- Development of the heating and building infrastructure is the result of investment decisions of individuals.

⇨ Therefore we propose a bottom-up approach based on the aggregation of individual choices to the total building stock

Research Focus

**German energy transition scenarios accounting for individual household heating technology investment and operation decisions**

# Background

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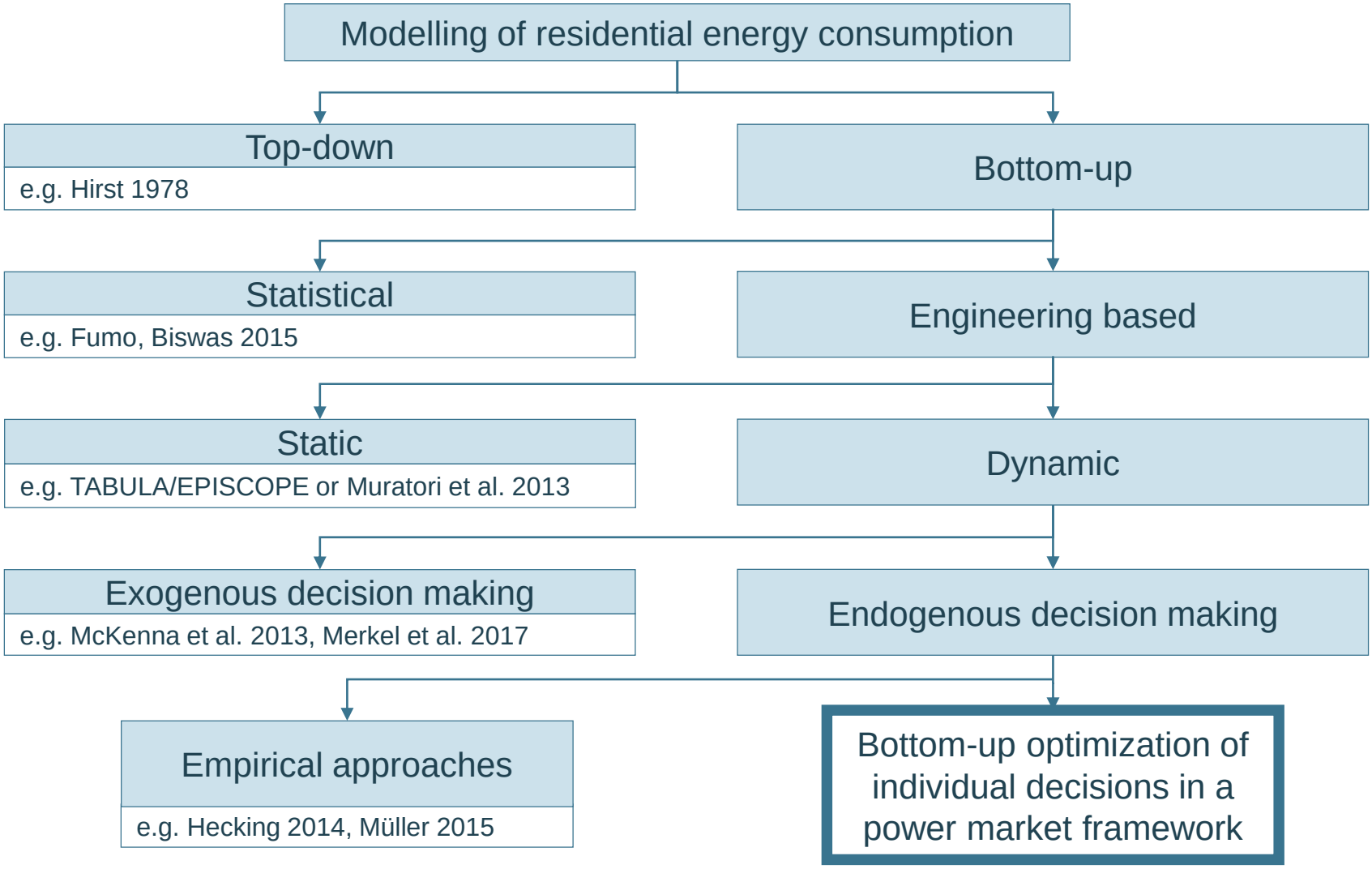
**Research Focus**

- How can individual choices be scaled up to a superordinate level?
- How can reciprocal effect between household decisions and the energy markets be modelled?
- How can input information be condensed to address computational demands?

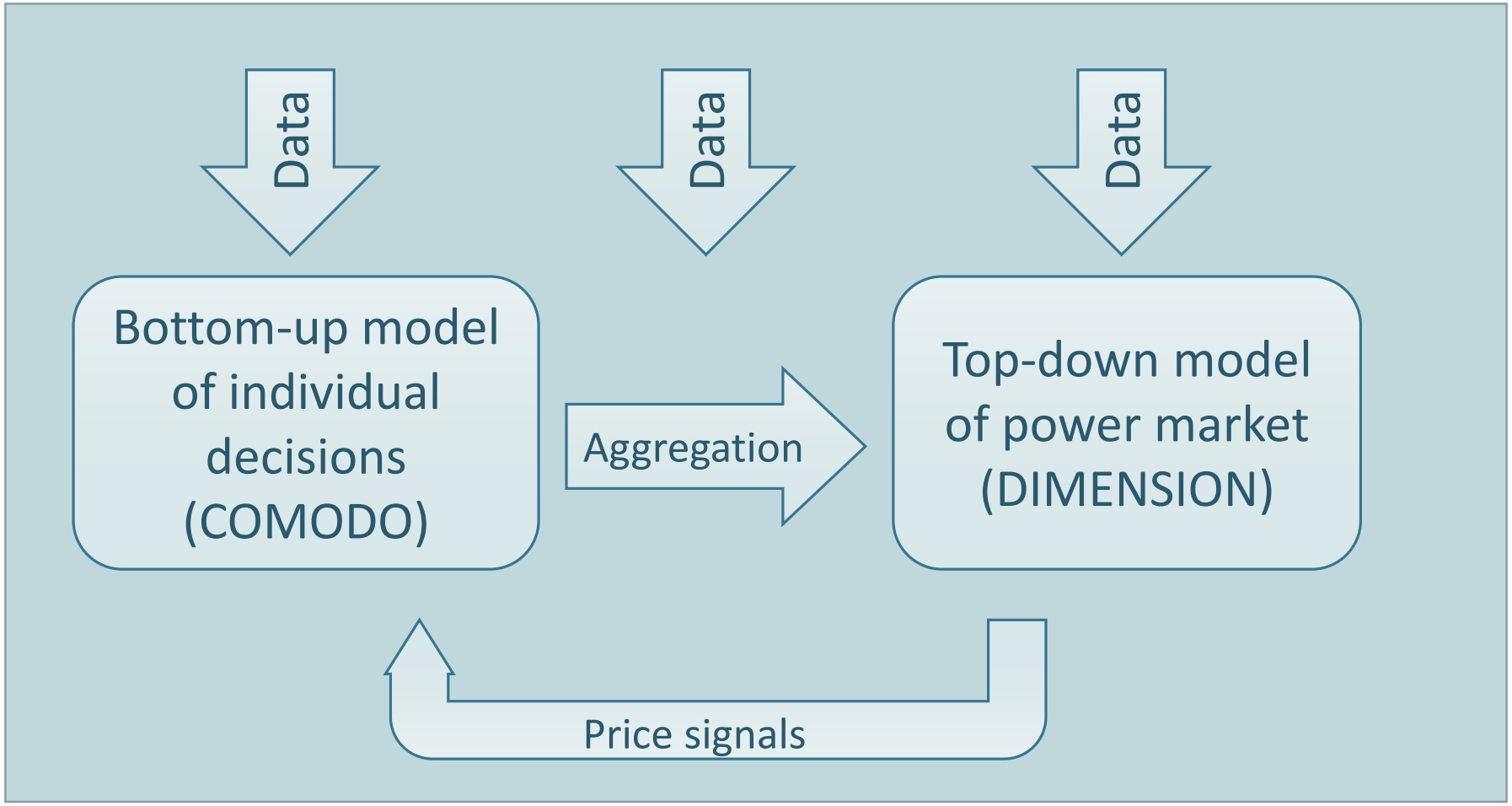
# Literature – Existing Models



# II. Model

# Approach

Bottom-up optimization of individual decisions in an power market framework



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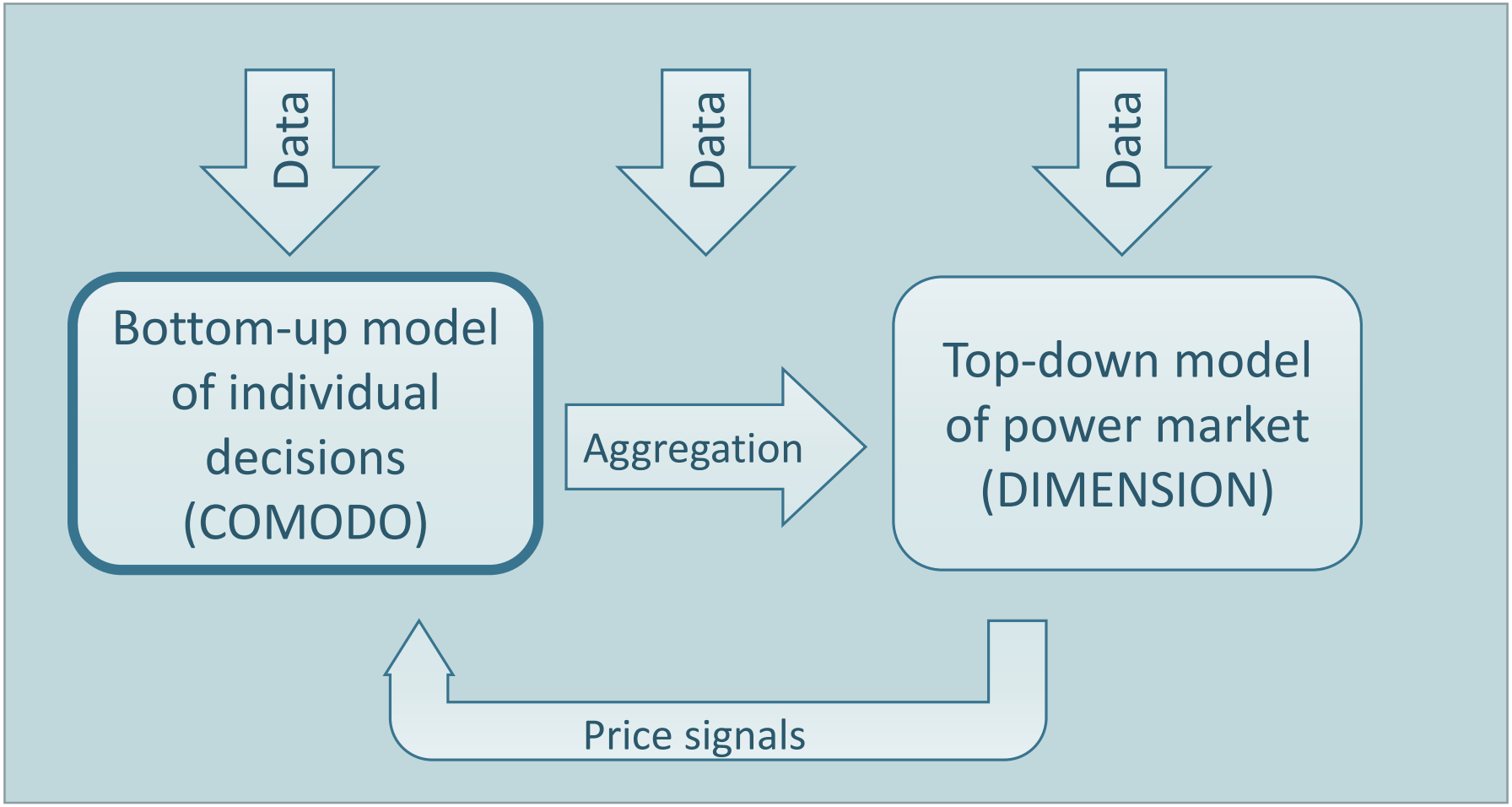
Bottom-up optimization of individual decisions in an power market framework



# Modelling steps

## Economic optimisation of individual heating technology investment and operation

**Consumer Input**

Load profiles
- Electricity
- Heating
- Hot water

Generation profiles
- Solar thermal
- PV

**COMODO**

Total cost optimisation

Optimisation of invest

Optimisation of storage and technology operation

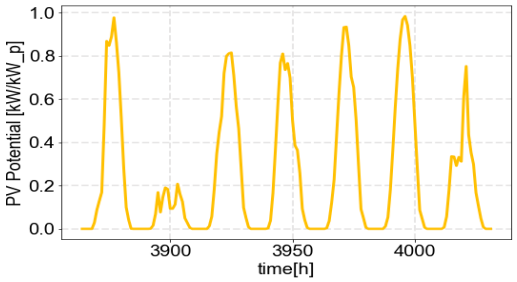
**Output**

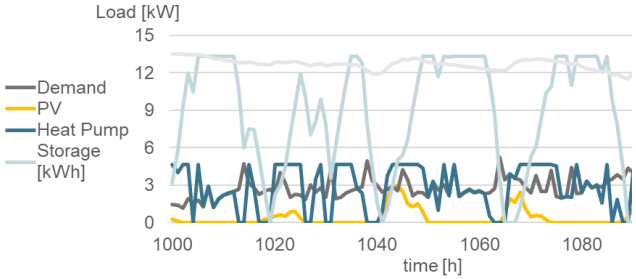
Installed capacities and investment

Profiles of energy usage

Operation profiles

Subsidies and fees
- Feed in tariffs
- Market premiums
- Grid fees, taxes



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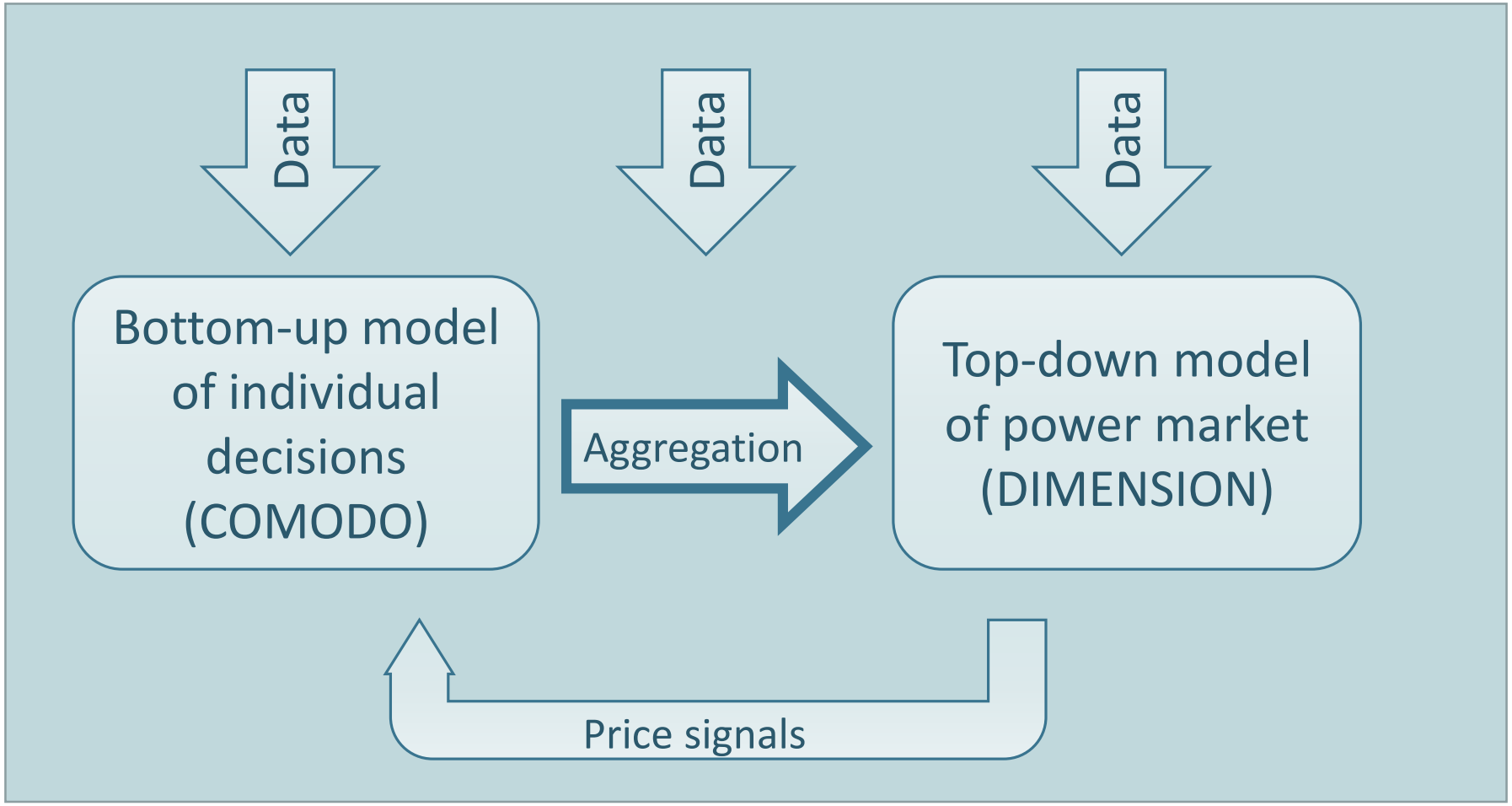


# Modelling steps

## Aggregation

- Definition of representative household types

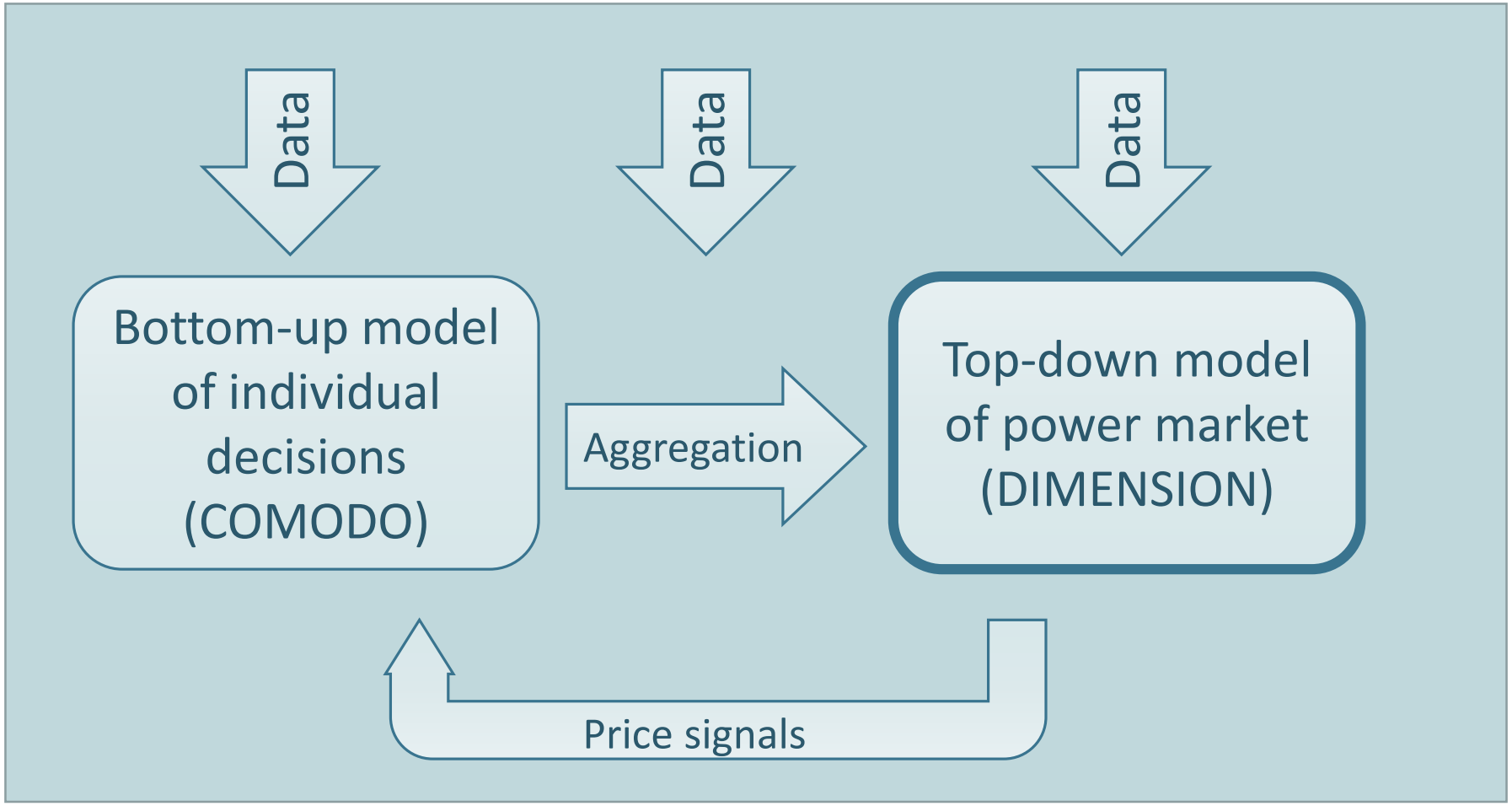
Building type
Habitable area
Building age
Rooftop area

No. of inhabitants
Region
Insulation level
Installed technology

- Scenario based constraints
  - Building replacement and demolition
  - Insulation rate
  - Technology development

# Approach

Bottom-up optimization of individual decisions in an power market framework



# Modelling steps

Integration with power market model in order to capture reciprocal effects

- Soft coupling of consumer model and power market model
- Iterative exchange of outputs
- Optimal solution where models converge

# Outlook

# Challenges

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# Potential research spin-offs

- How do regulatory changes affect the building stock in Germany?
  - RE support schemes/ surcharges
  - Grid fees
  - Taxes
- How do market aspects (fuel costs, EU-ETS) affect the technology based decisions in the building stock in Germany?
- Under what circumstances do certain technologies prevail?
- How can emission and efficiency targets in the household heating sector be achieved?

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# Thank You!
# Questions?

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