BS 2019 2-4 SEPT ROME 16th IBPSA INTERNATIONAL CONFERENCE AND EXHIBITION

INTERNATIONAL BUILDING PERFORMANCE SIMULATION ASSOCIATION

Quantifying Uncertainty Propagation For The District Energy Demand Using Realistic Variations On Input Data

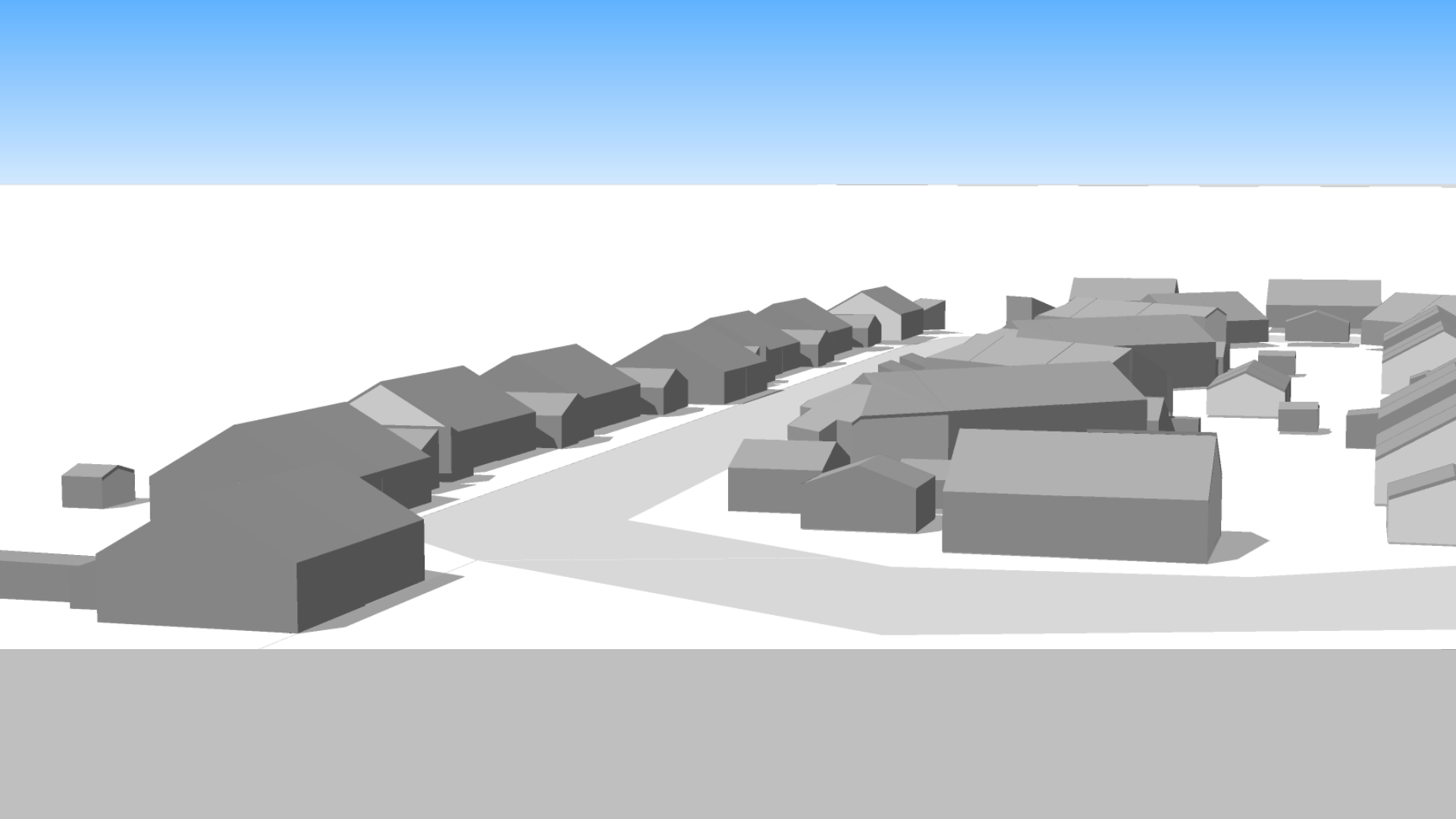
- Focus on simulation time and efficiency (IBPSA Project 1 WP3)

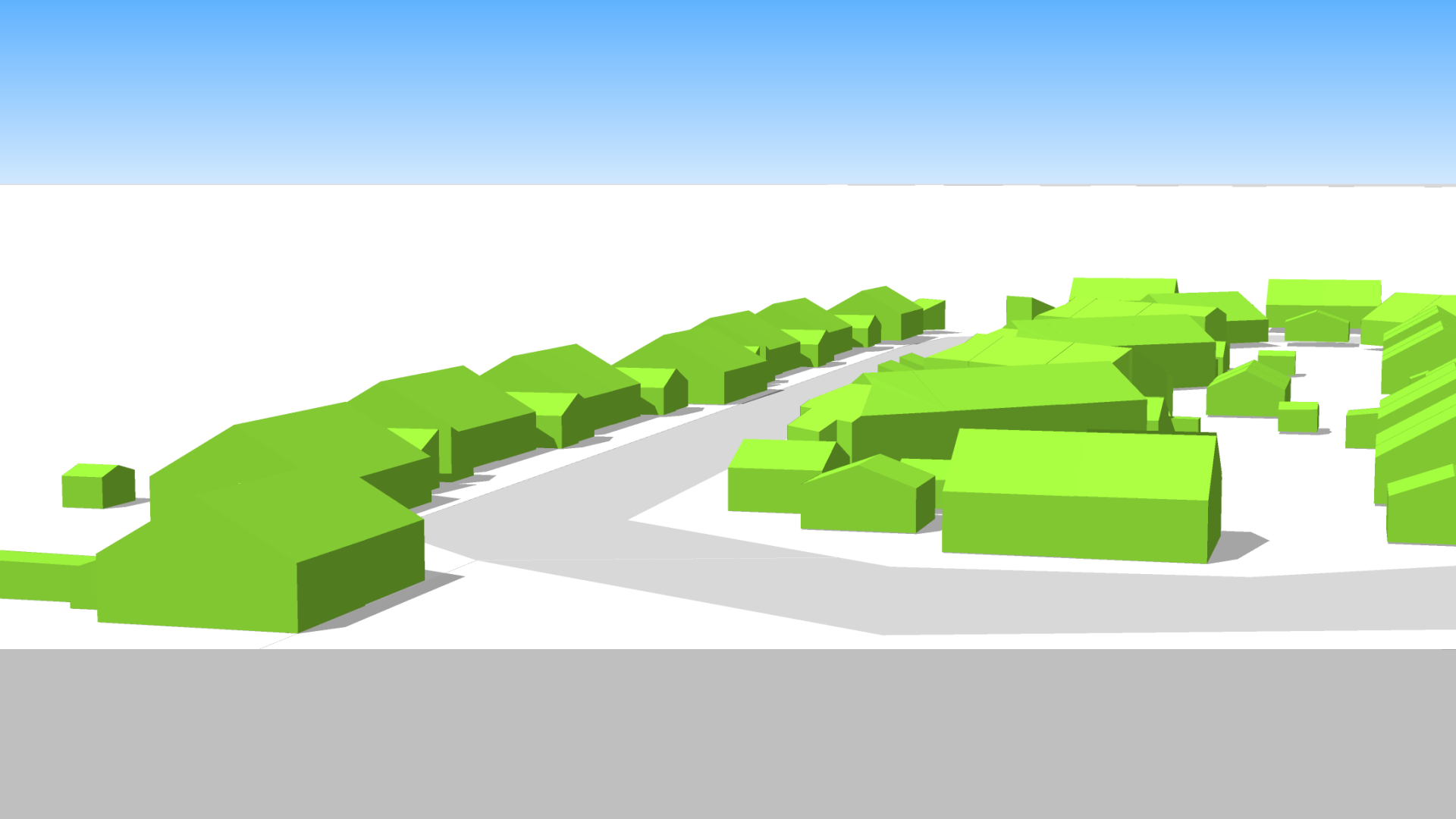
Speaker:

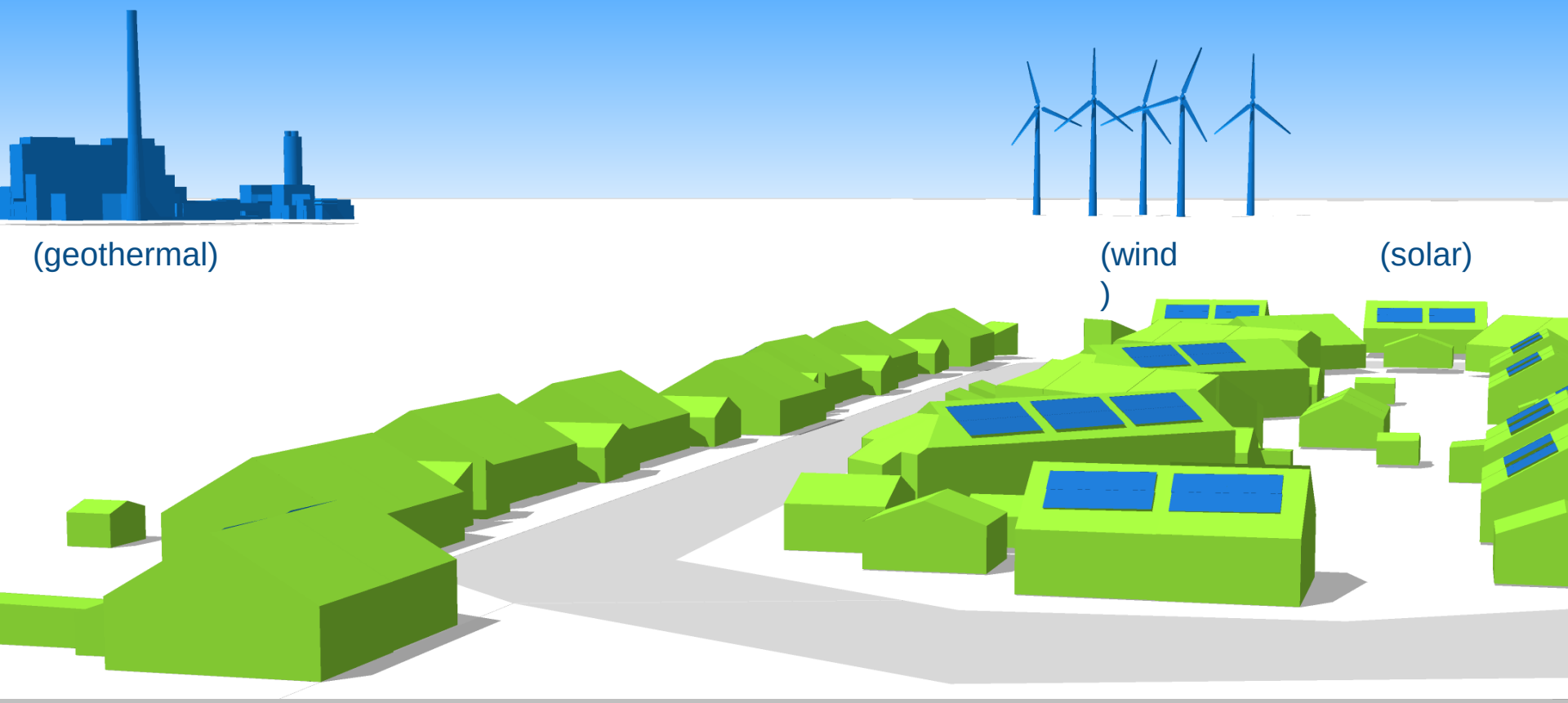
Ina De Jaeger
EnergyVille / KU Leuven / VITO

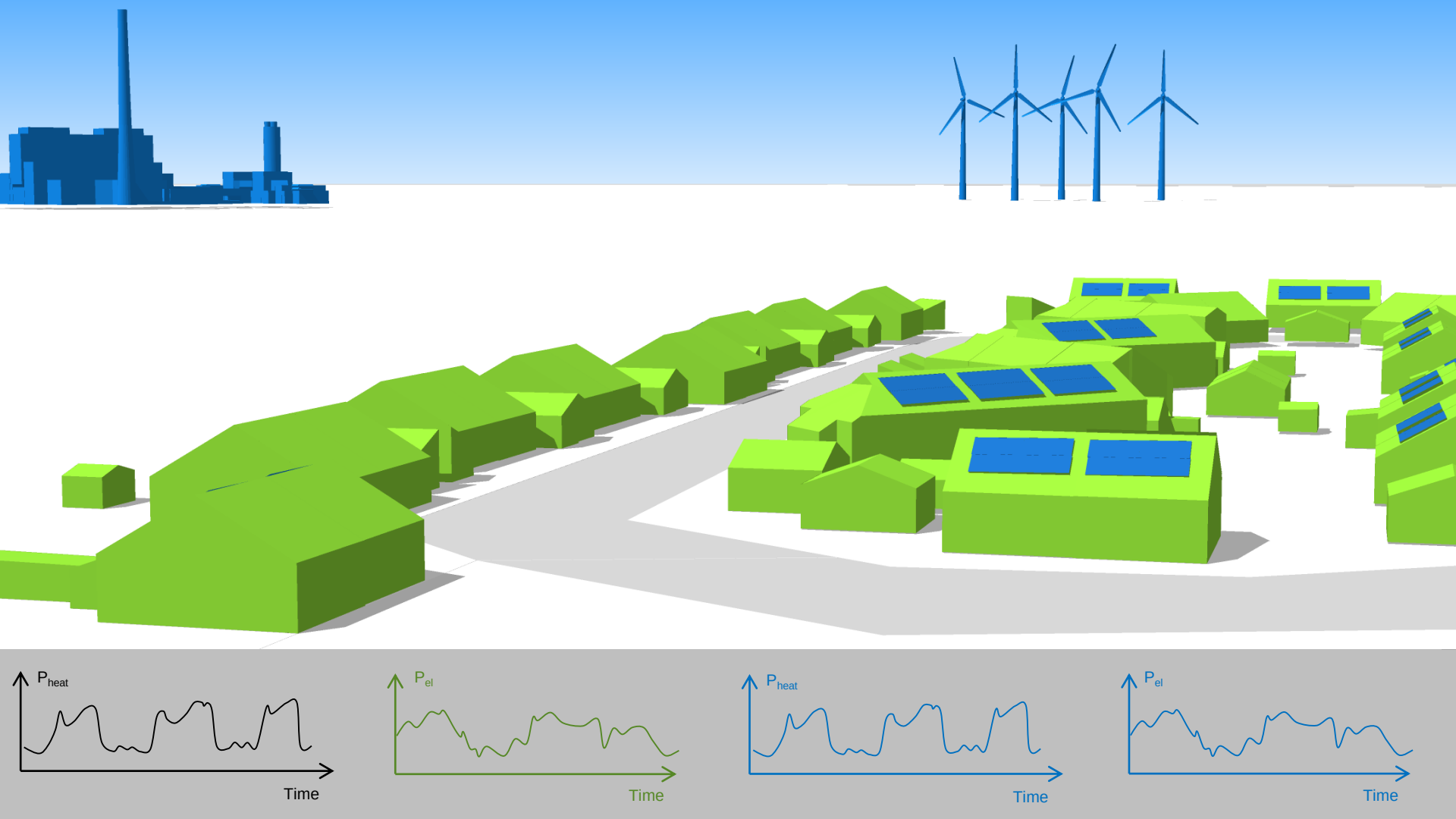
Authors:

Ina De Jaeger, EnergyVille / KU Leuven / VITO
Glenn Reynders, EnergyVille / VITO
Dirk Saelens, EnergyVille / KU Leuven






(geothermal)
(wind
)
(solar)


P_{heat}
Time
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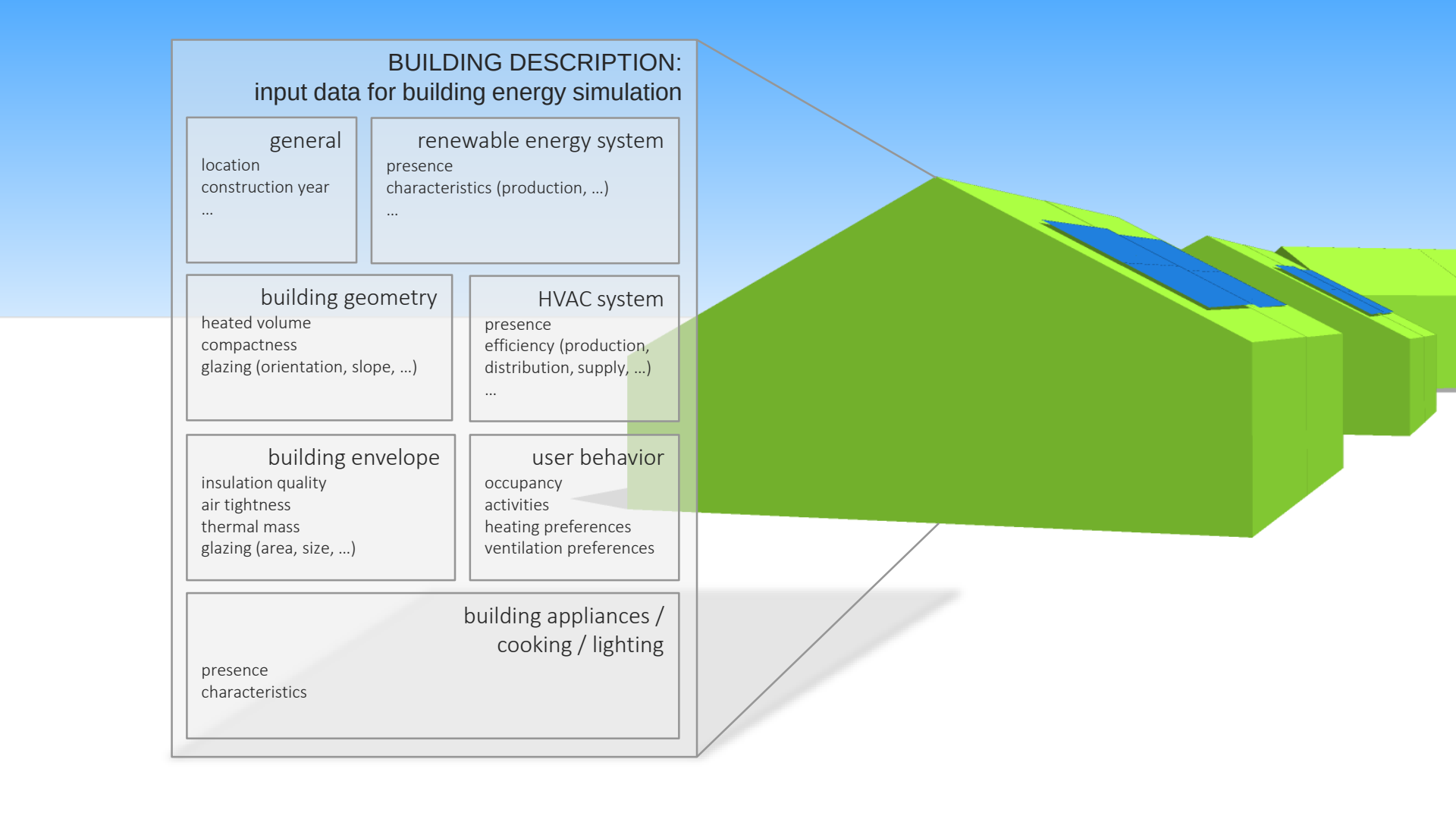

BUILDING DESCRIPTION:
input data for building energy simulation
general
location
construction year
…
renewable energy system
presence
characteristics (production, …)
…
building geometry
heated volume
compactness
glazing (orientation, slope, …)
HVAC system
presence
efficiency (production, distribution, supply, …)
…
building envelope
insulation quality
air tightness
thermal mass
glazing (area, size, …)
user behavior
occupancy
activities
heating preferences
ventilation preferences
building appliances / cooking / lighting
presence
characteristics

Introduction

Research questions

- How does uncertainty for the energy demand propagate from building level to district level as a result of the uncertainty on the inputs?

  ~ uncertainty analysis

- What are the main driving parameters?

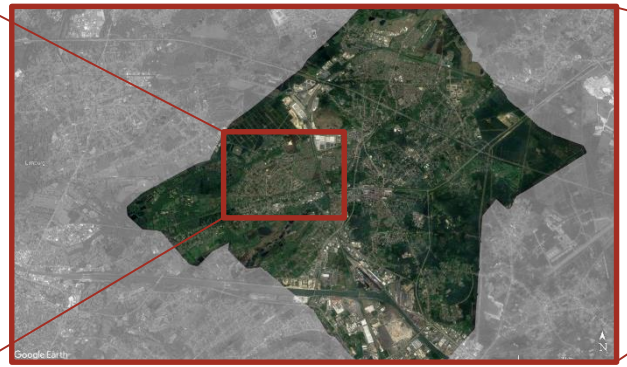
  ~ sensitivity analysis

Content

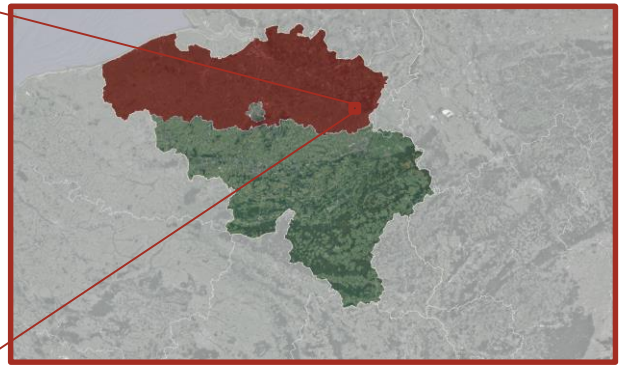
Methodology

- Studied district
  - Boxbergheide district, Genk, Belgium (350 single-family dwellings)

[Boxbergheide district]



[Genk]



[Belgium]

Methodology

- Studied district
  - Boxbergheide district, Genk, Belgium (350 single-family dwellings)
- Available data
  - CityGML LOD2
  - Construction year per dwelling (based on visual survey)

Methodology

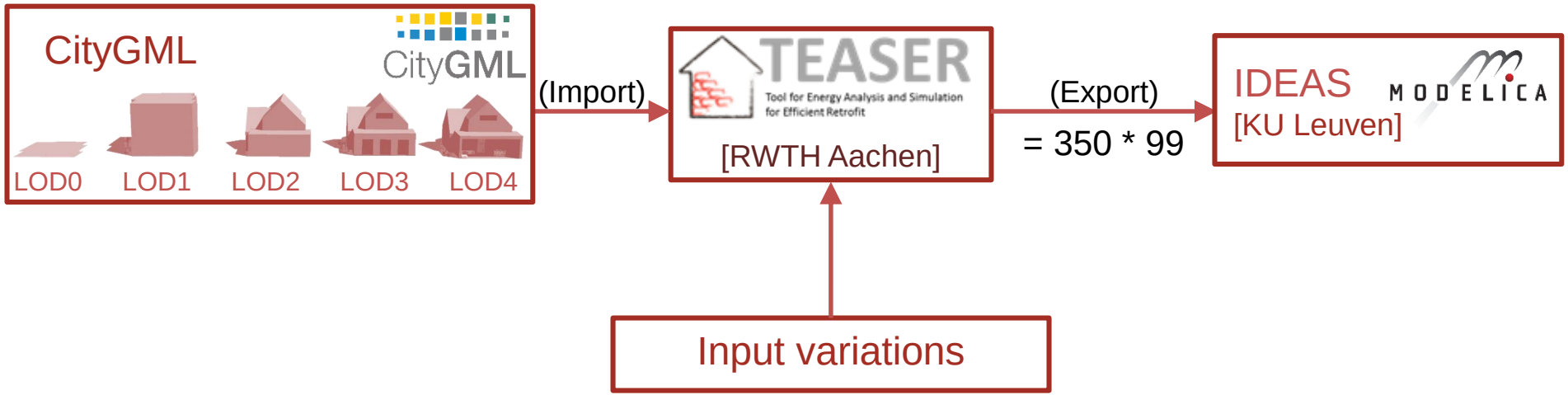
1. Input variations and sampling
2. Generation and simulation of building energy models
3. Aggregation from building to district level
4. Uncertainty quantification
5. Sensitivity quantification

Methodology

1. Input variations and sampling
   - Quasi-Monte Carlo Simulations
     - Sobol' sequence
     - 14 considered parameters
     - 99 samples per building

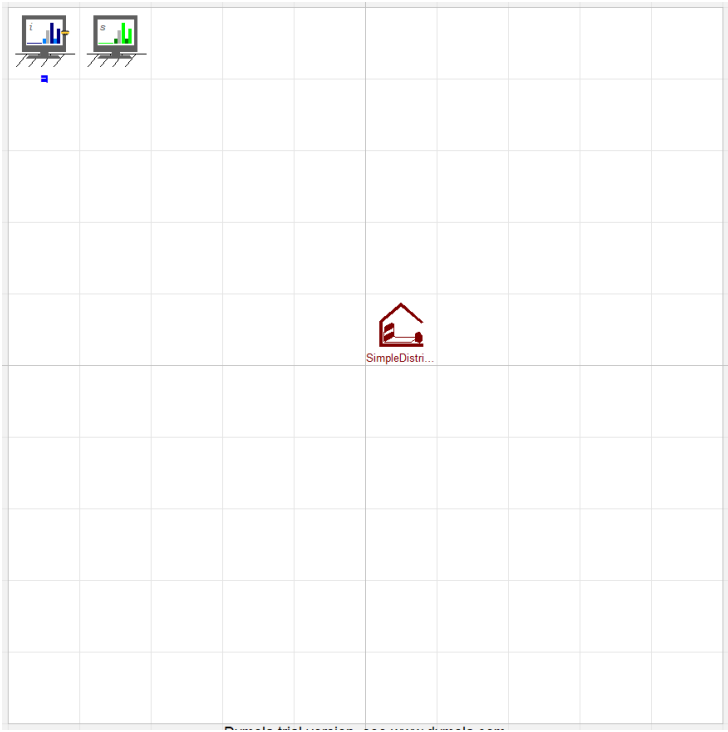
Methodology

2. Generation and simulation of building energy models



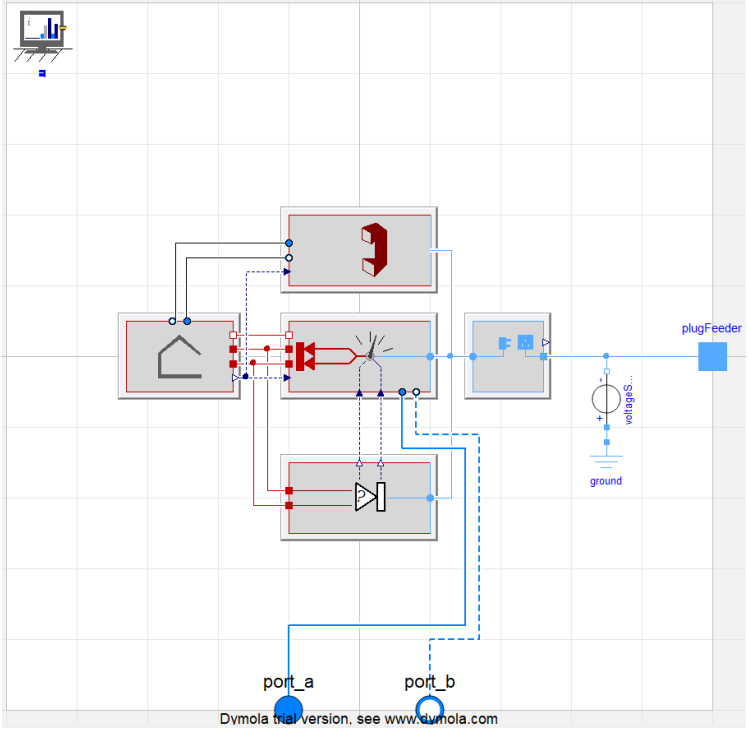
Building Energy Simulations

- All buildings are simulated separately



Building Energy Simulations

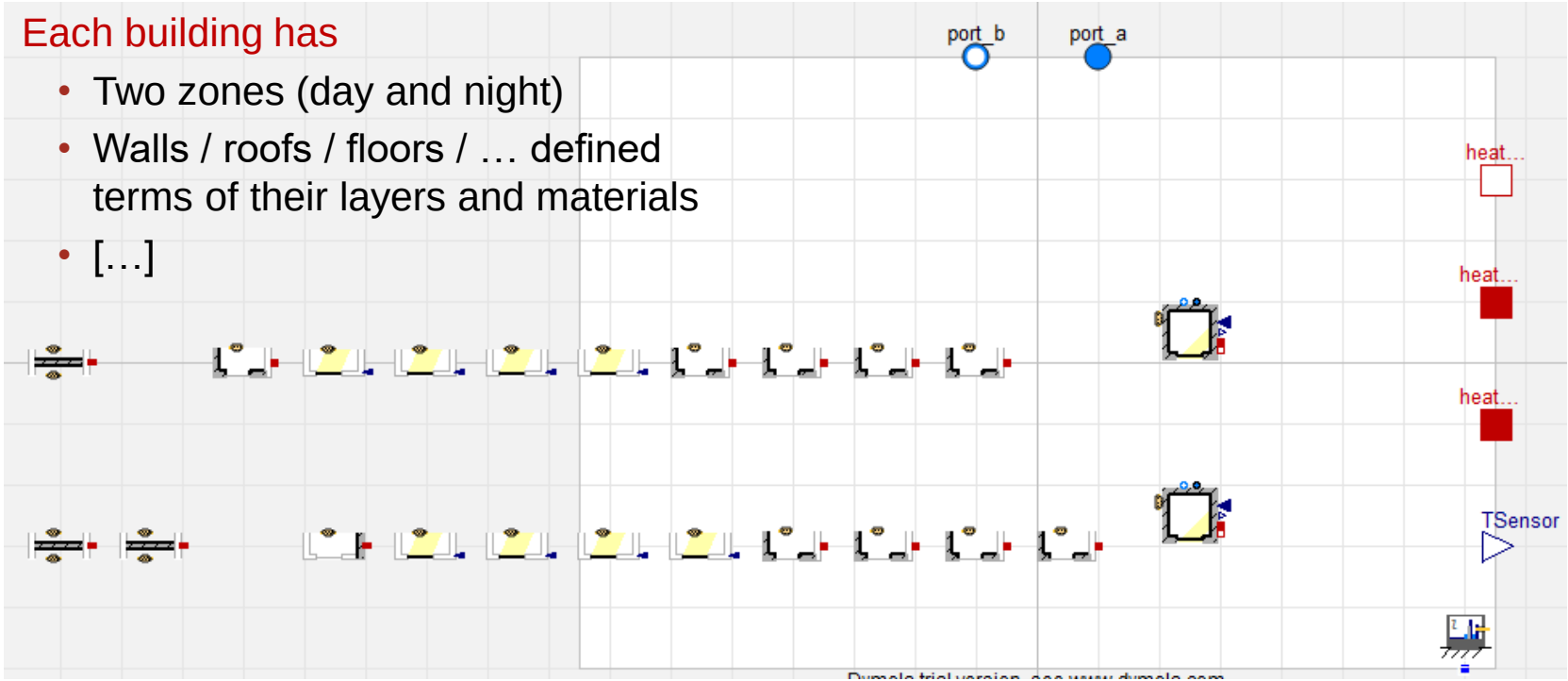
- Each building has
  - A stochastic occupant (StROBe)
  - An ideal heating system
  - An in-home electrical grid
  - No ventilation system
  - A structure



Building Energy Simulations

Each building has

- Two zones (day and night)
- Walls / roofs / floors / … defined terms of their layers and materials
- […]



The latest simulations …

- 240 buildings of the Boxbergheide district & 100 samples per building

→ 22 000 (simulations are not finished)

- Simulations for 1 year + 1 month initialization
- Currently running for 212 hours (8+ days)

= 103 sims / h (in total, 15 in parallel)

* Computer:

Suggestions? Questions?

Thank you!