



# EnergyVille

## Thermal mass of dwellings as a source of energy flexibility

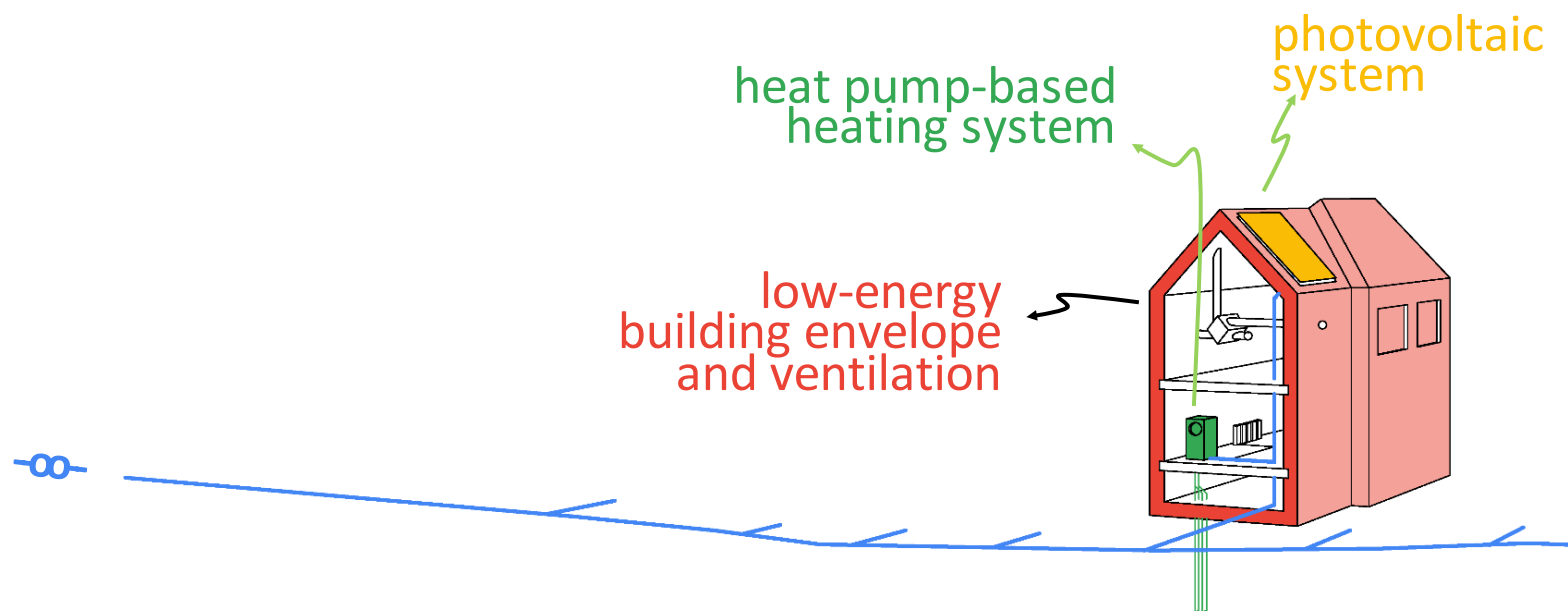
Glenn Reynders

Workshop Energy Flexible Buildings Performance and Potential,  
26 sept. 2017, Vienna





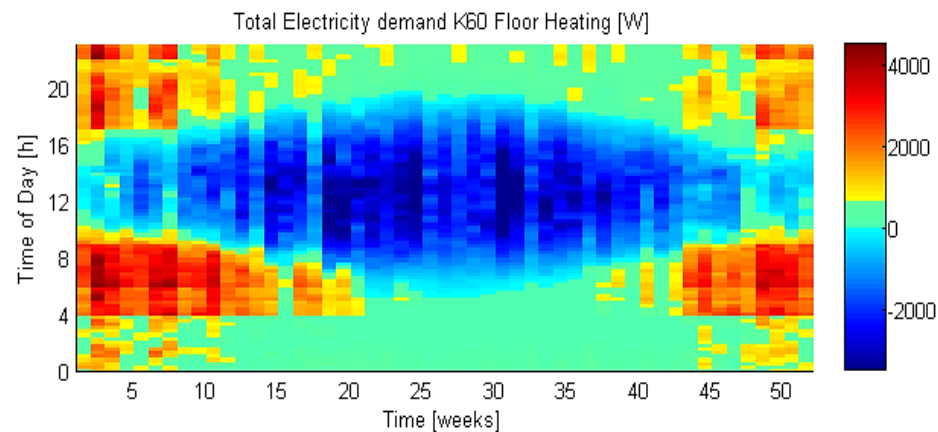
# From individual building assessment ...



# Example

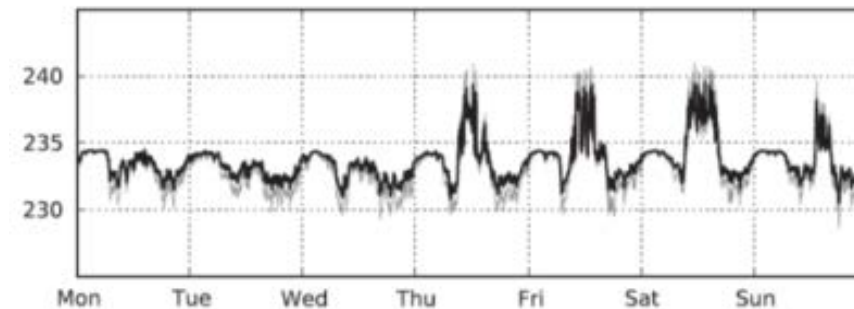
## Integrated District Energy Assessment by Simulation

- Modelica environment to assess PV integration in districts
- Solar paradox: mismatch between supply and demand
- Virtual storage in the grid



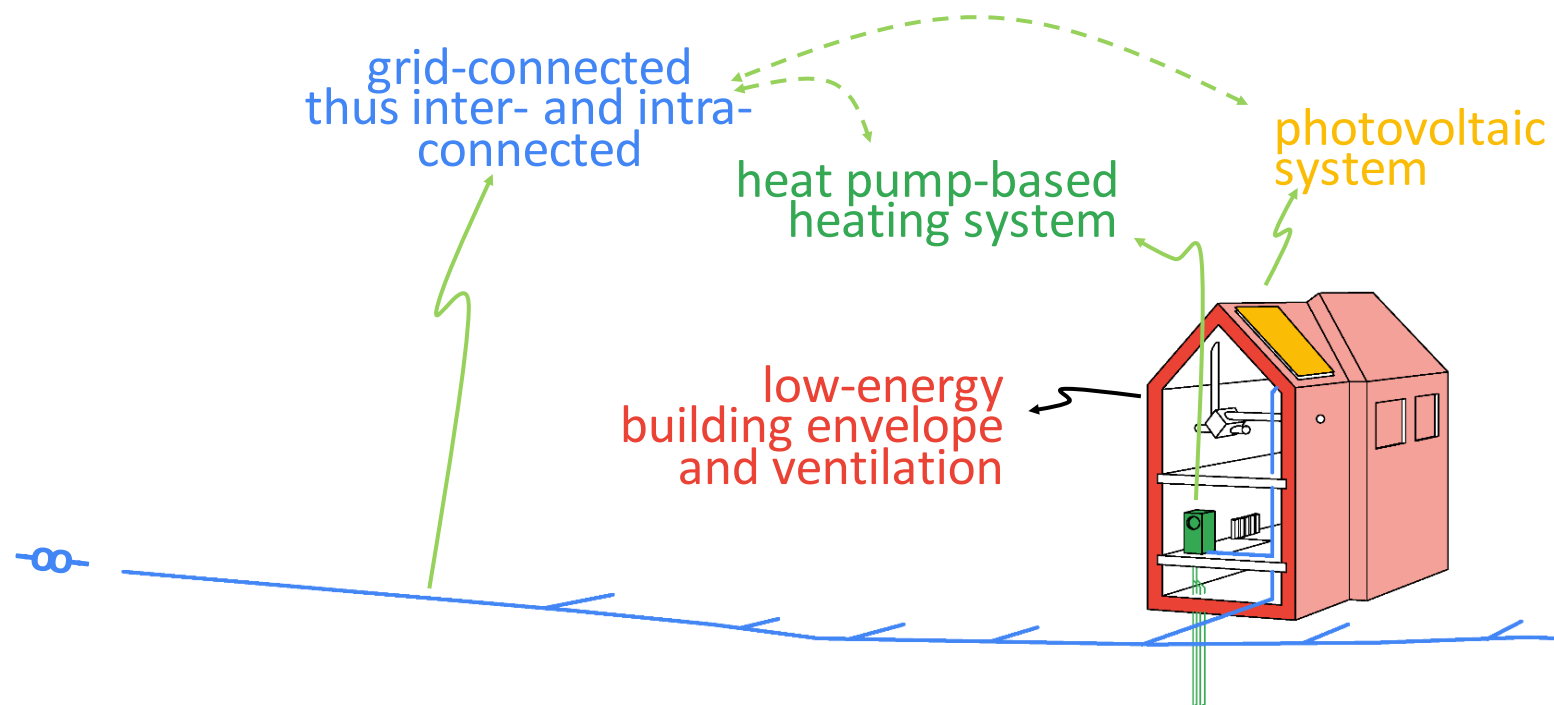
Reynders, G., Nuytten, T., Saelens, D. (2013). Potential of structural thermal mass for demand-side management in dwellings. Building and Environment 64, 187-199.

FEEDER VOLTAGE (V)



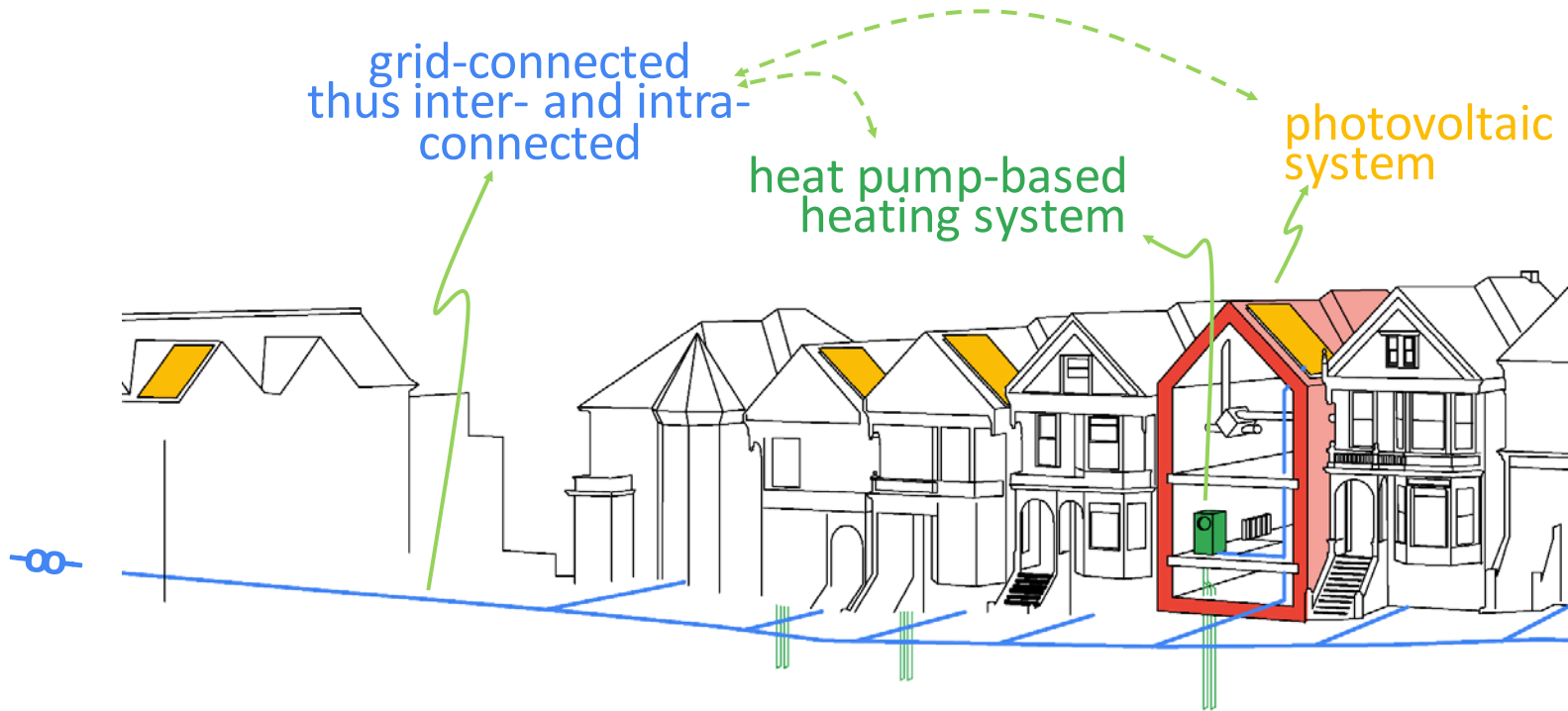
Baetens, R., Saelens, D. (2013). Multi-criteria grid impact evaluation of heat pump and photovoltaic based zero-energy dwellings. Proceedings of Building Simulation 2013. International Conference of the International Buildings Performance Simulation Association. Chambéry, France, 25-28 August 2013

# From individual building assessment ...



# From individual building assessment ...

# ... to district energy systems



# Example

## Analysis of DES impact

*Overview drawing of an example distribution of rural and urban low-voltage distribution islands.*

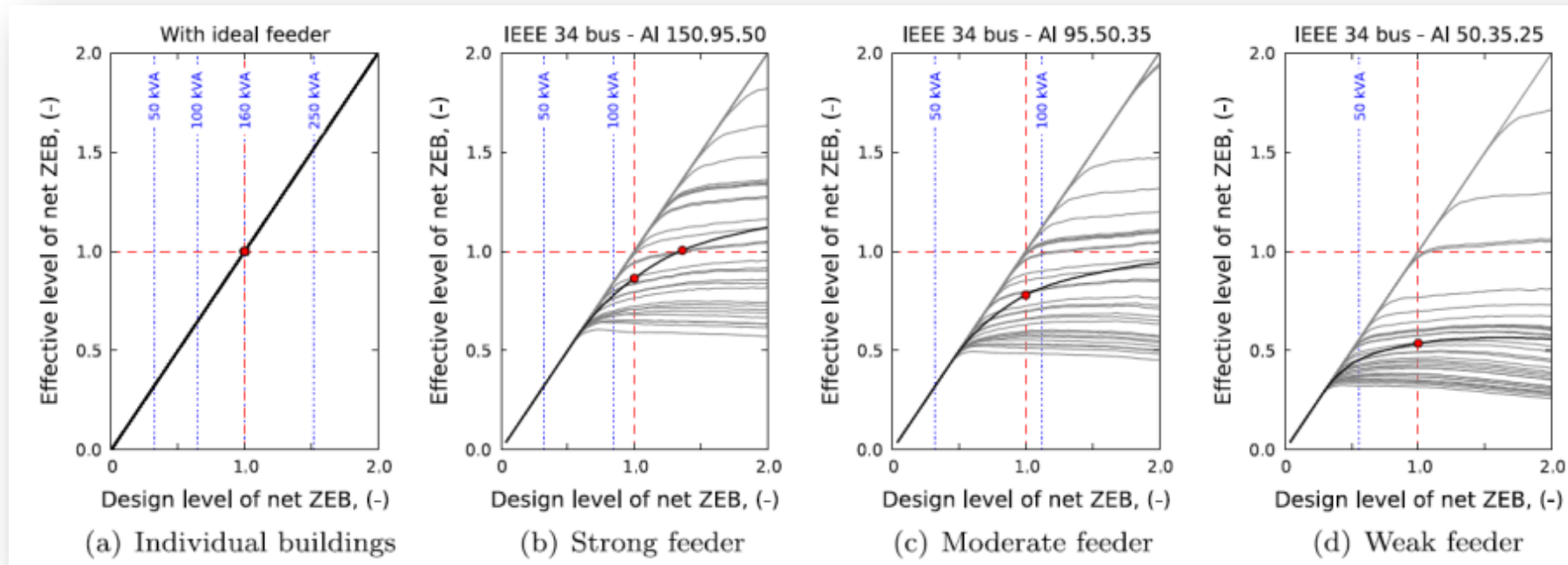


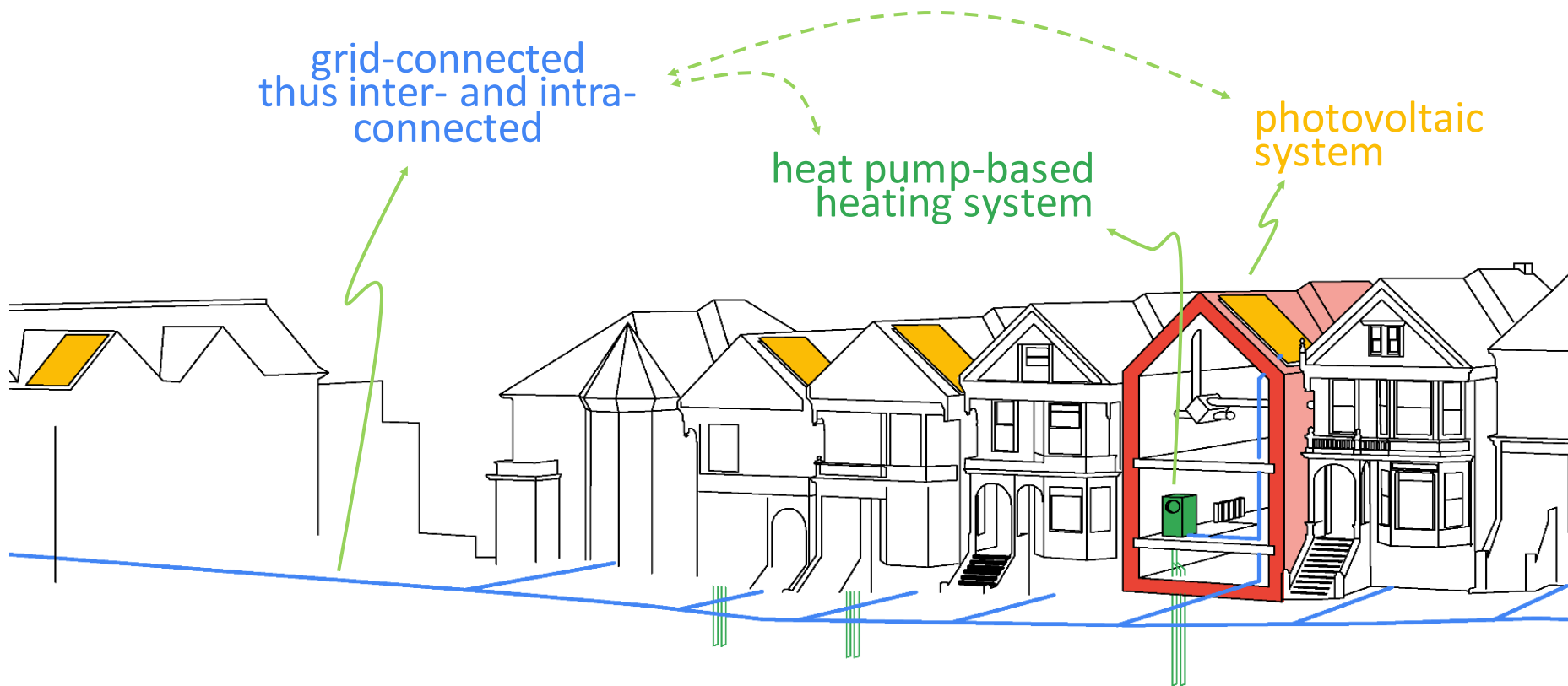
On externalities of heat-pump based low-energy dwellings at the low-voltage distribution grid, R. Baetens, 2015

# Example

## Integrated District Energy Assessment by Simulation

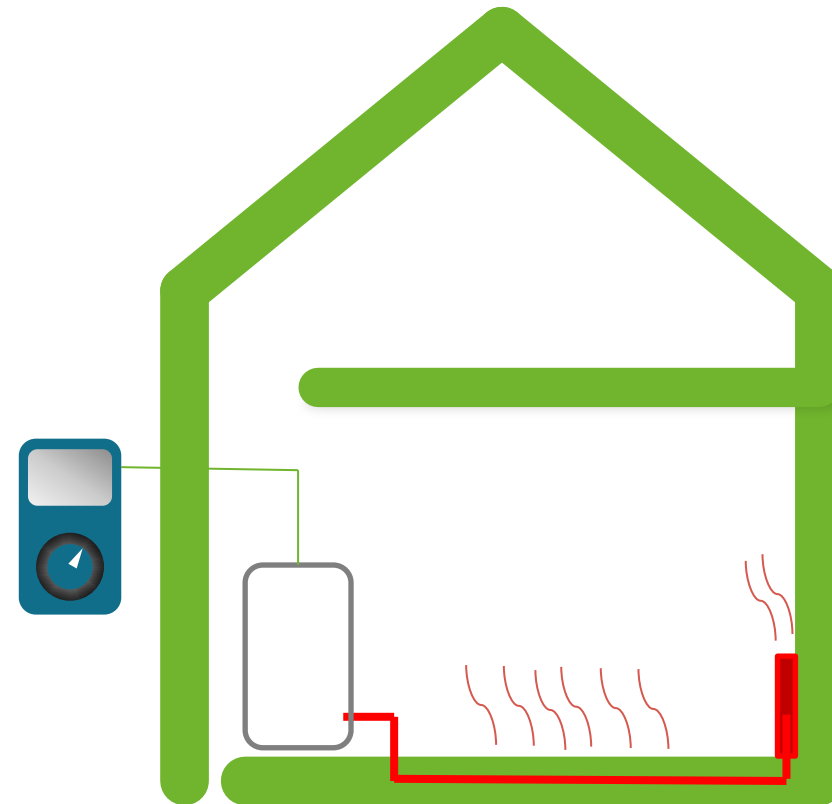
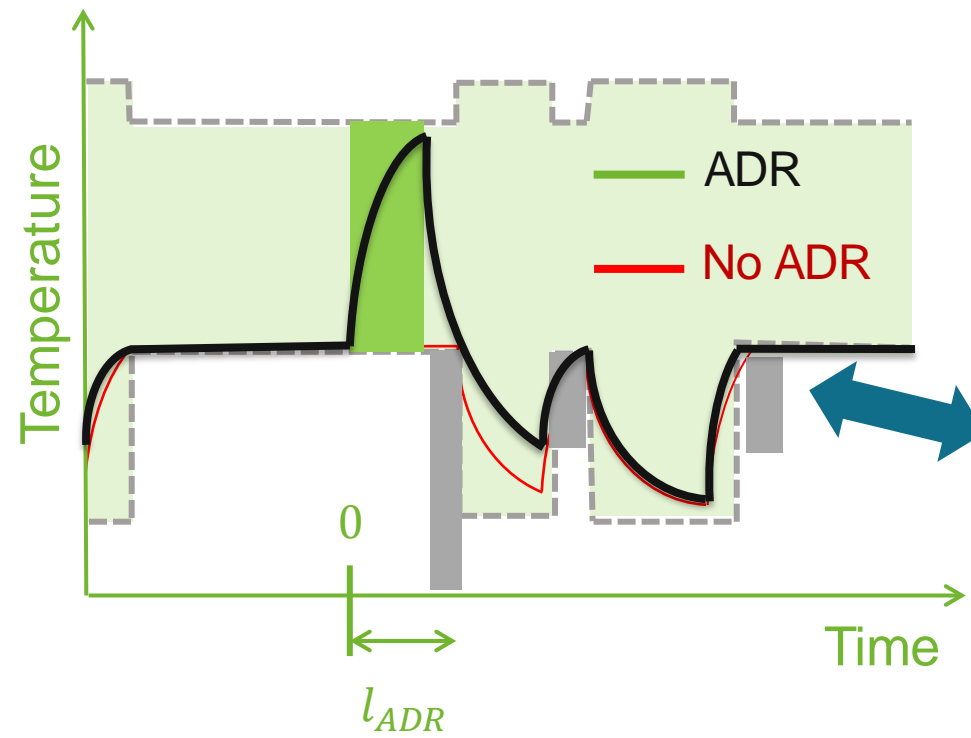
- Modelica environment to assess PV integration in districts
- Effective nZEB-level compared against design ZEB level on individual building level (grey) and aggregated neighborhood level (black).




















- *What impact do buildings have on district energy system?*
- *What can buildings offer as flexibility to the grid?*

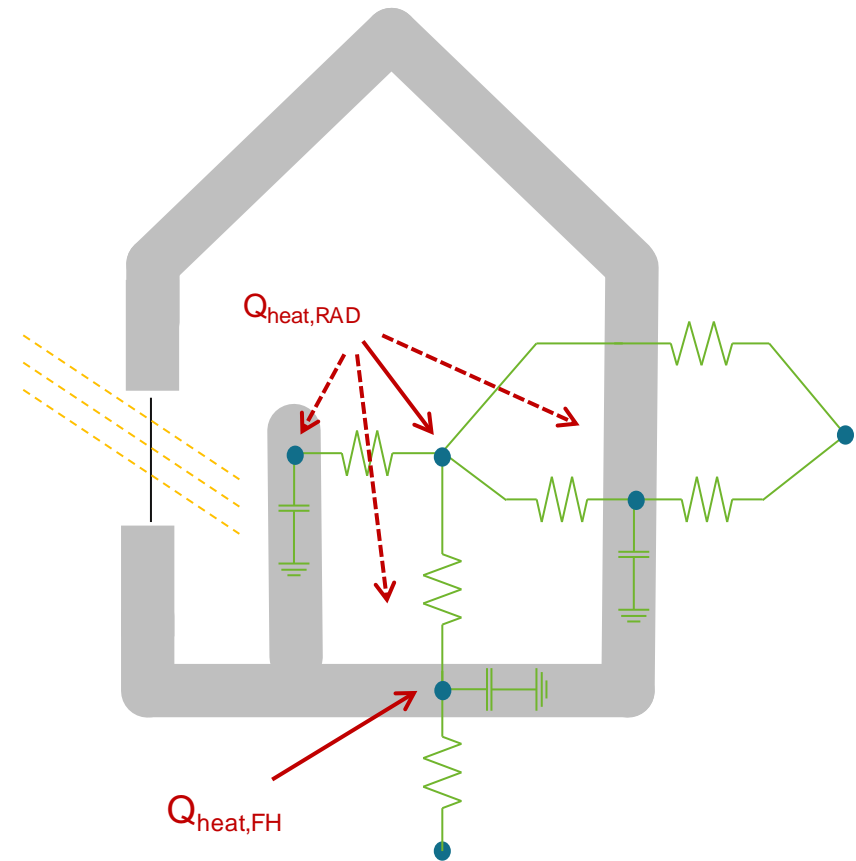




# ADR potential of Belgian residential stock

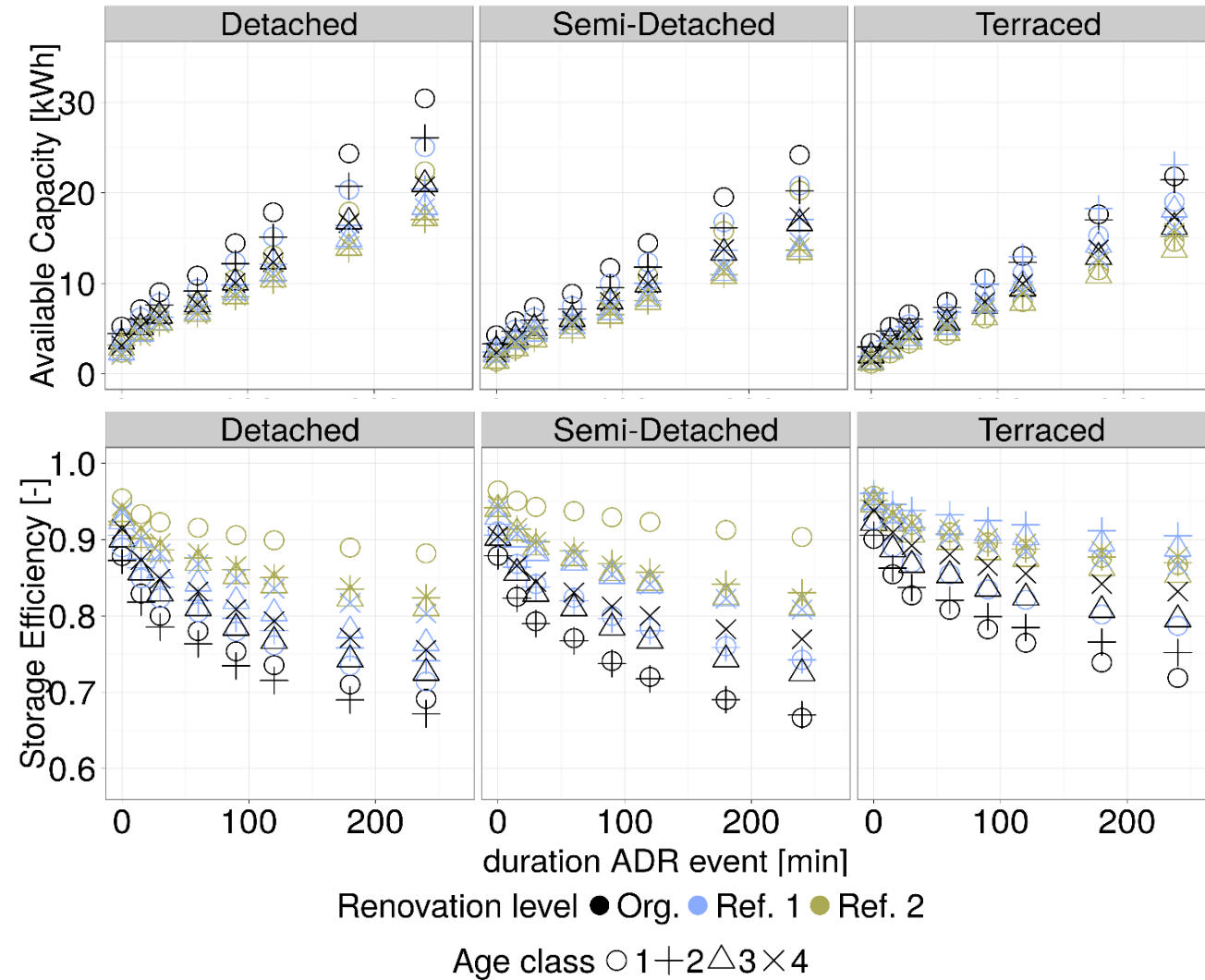
## I. REDUCED-ORDER BUILDING STOCK MODEL

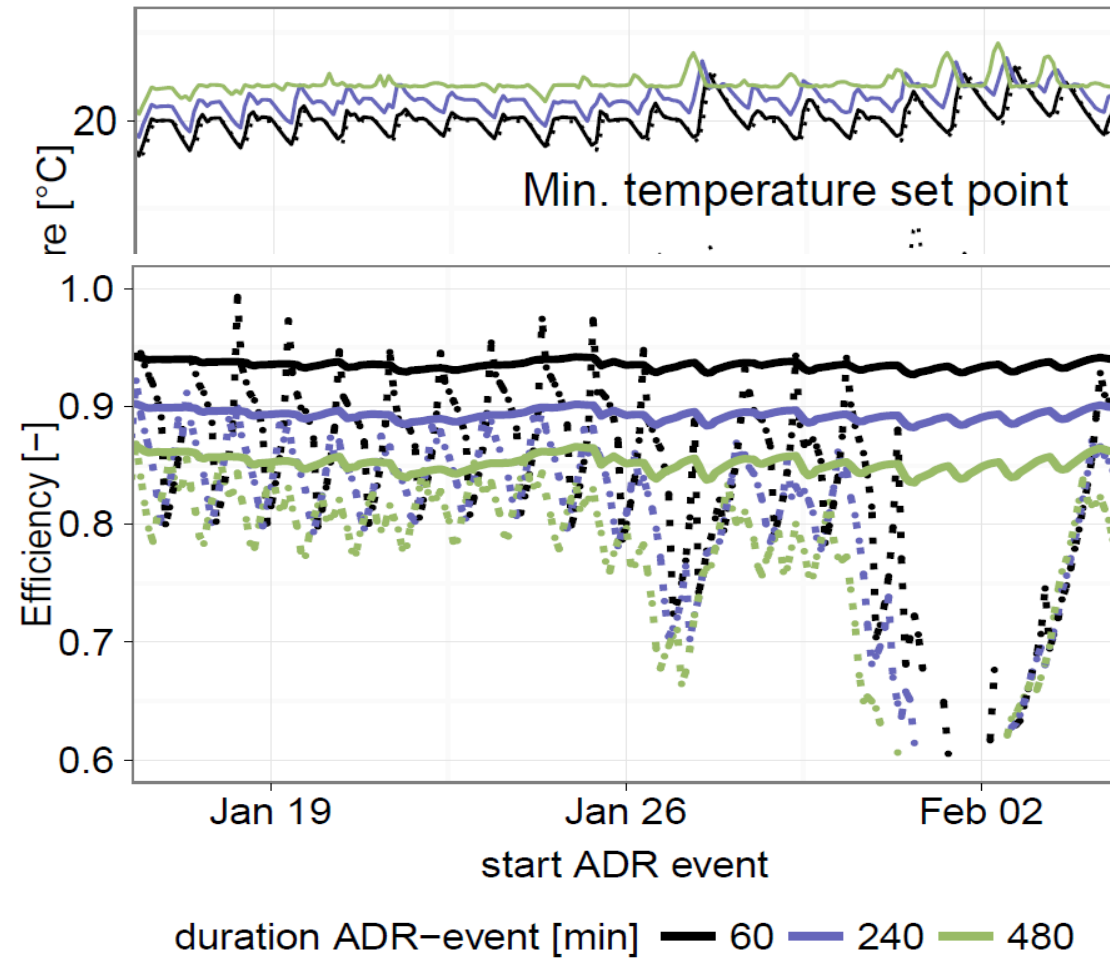
Main matrix of the Belgian housing typology					
	Region	Construction Year Class	Single Family House - Detached	Single Family House - Semi detached	Single Family House - Terraced
1	national (Belgium)	... 1945	 BE.N.SFH.01.deta	 BE.N.TH.01.semi	 BE.N.TH.01.terr
6	national (Belgium)	1946 - 1970	 BE.N.SFH.02.deta	 BE.N.TH.02.semi	 BE.N.TH.02.terr
12	national (Belgium)	1971 - 1990	 BE.N.SFH.03.deta	 BE.N.TH.03.semi	 BE.N.TH.03.terr
18	national (Belgium)	1991 - 2005	 BE.N.SFH.04.deta	 BE.N.TH.04.semi	 BE.N.TH.04.terr
24	national (Belgium)	2006 ...	 BE.N.SFH.05.deta	 BE.N.TH.05.semi	 BE.N.TH.05.terr



# ADR potential of Belgian residential stock

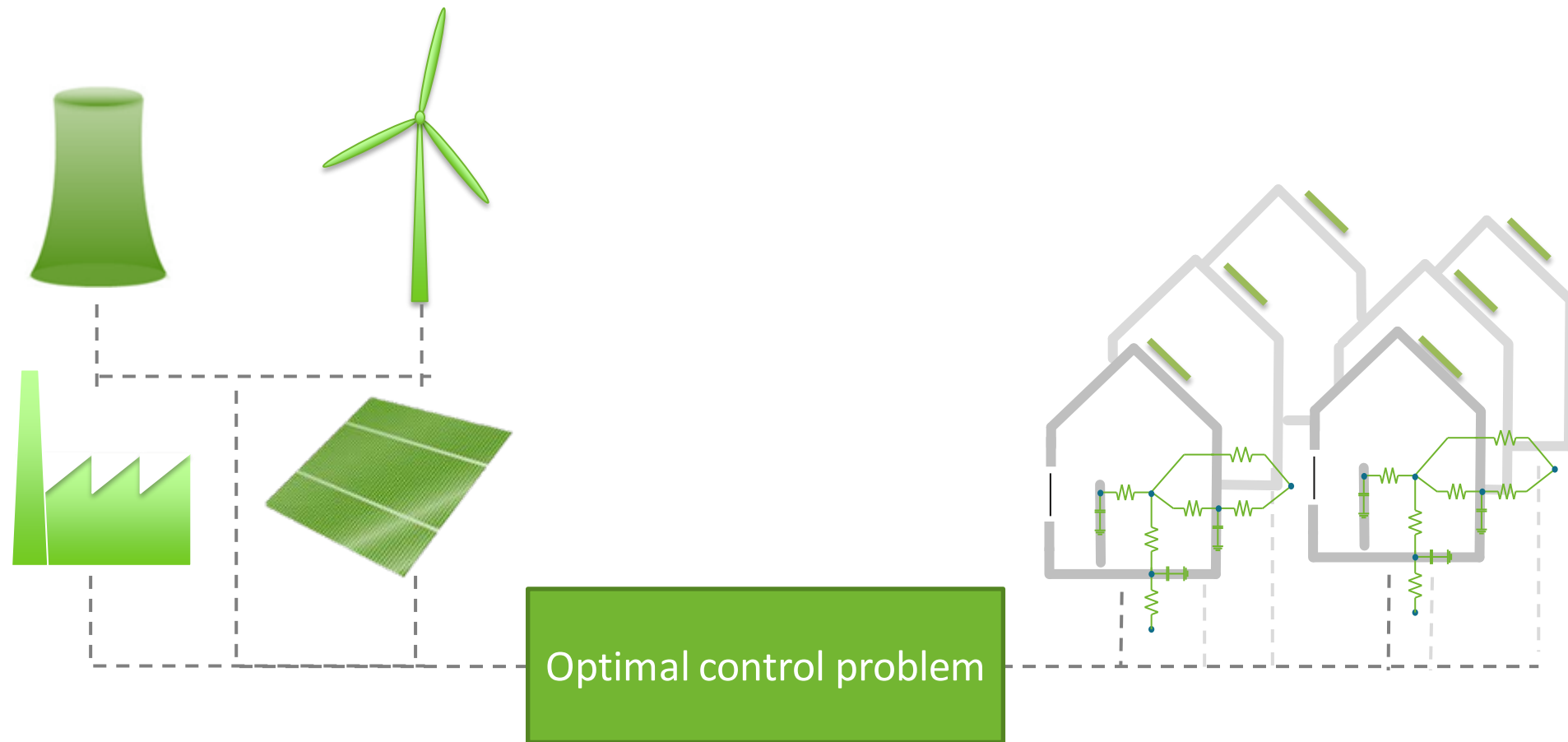
## II. ADR CHARACTERISTICS





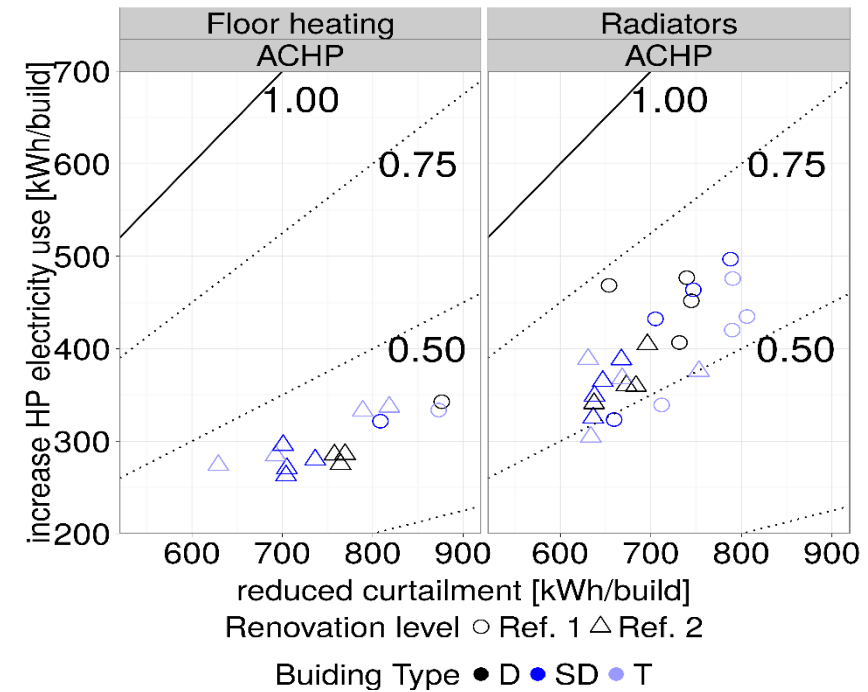
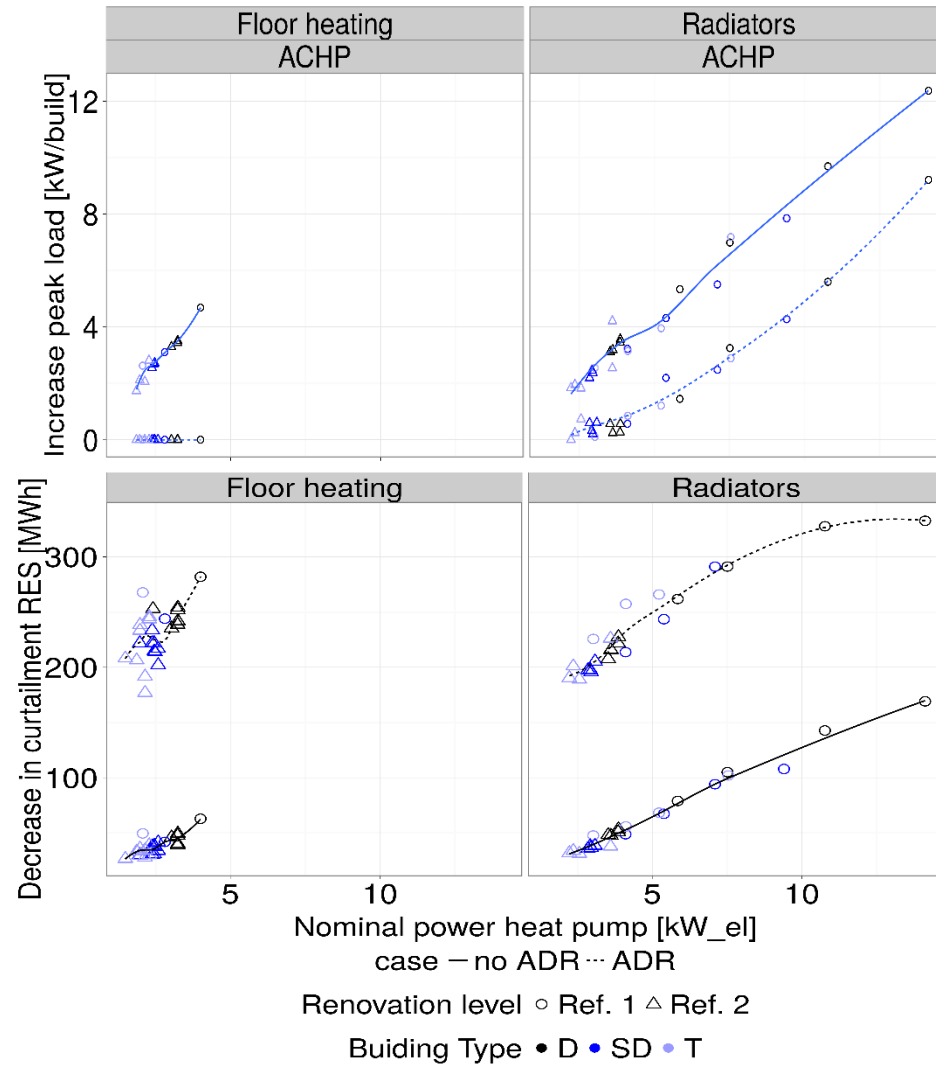
# ADR potential of Belgian residential stock

## III. INTEGRATED OPERATIONAL MODEL



# ADR potential of Belgian residential stock

## GRID IMPACT



# Main conclusions

## 🍃 Further optimization of energy in buildings requires district energy perspective

- ✦ Fully benefit from renewables
- ✦ Cost-effective mitigation of CO<sub>2</sub>

## 🍃 Available capacity & storage efficiency

- ✦ interpretable as building signature
- ✦ mainly influenced by:
  - heat emission system
  - heat loss coefficient
  - heat loss coefficient / thermal mass

## 🍃 Characteristics are coupled and not constant!

## 🍃 Case study showed buildings have significant potential as short-term storage

- ✦ 8-16 kWh (thermal) in 2h
- ✦ Local energy use increase: 73-96 % efficiency
- ✦ Peak capacity and RES curtailment significantly reduce = system cost saving
- ✦ Available in existing buildings

Thank you!



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