INVESTIGATION OF THE ENERGY FLEXIBILITY POTENTIAL OF DANISH RESIDENTIAL BUILDING ARCHETYPES

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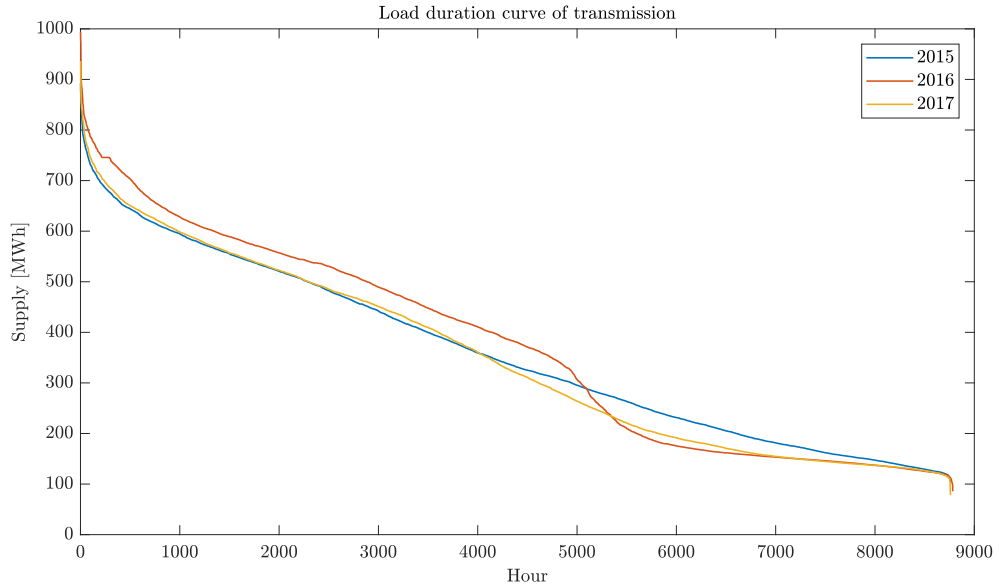
PROJECT: LOCAL HEATING CONCEPTS
FUNDED BY EUDP (PROJECT NUMBER 64017-0019)

AARHUS
UNIVERSITY
DEPARTMENT OF ENGINEERING

REQUIRED CAPACITY IN DHN NETWORKS

Consumption composed of:

- Space heating
- Domestic hot water usage
- Heat losses in the distribution network



*Data generously provided by district heating supplier *AffaldVarme Aarhus*

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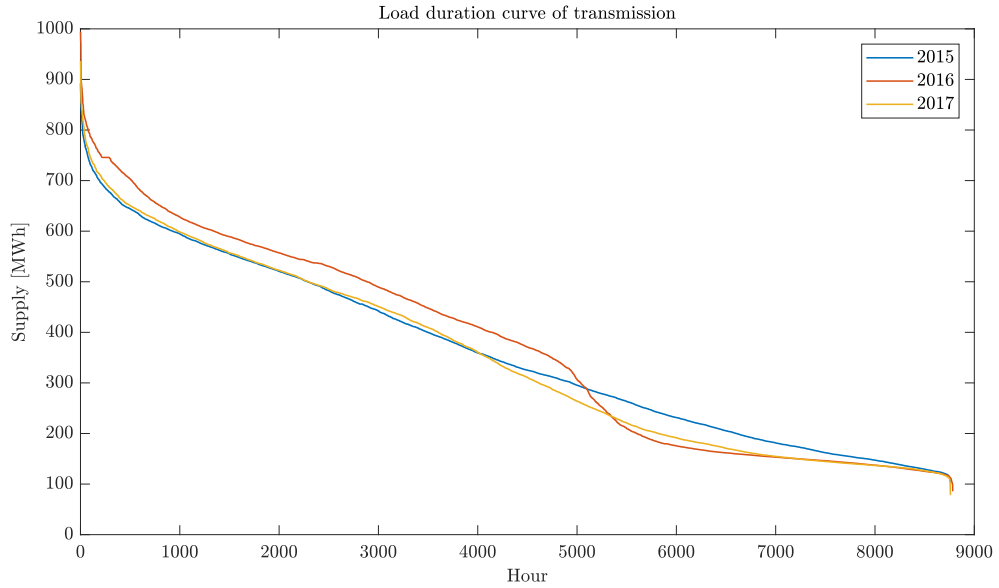
= **Oversized components for majority of year**



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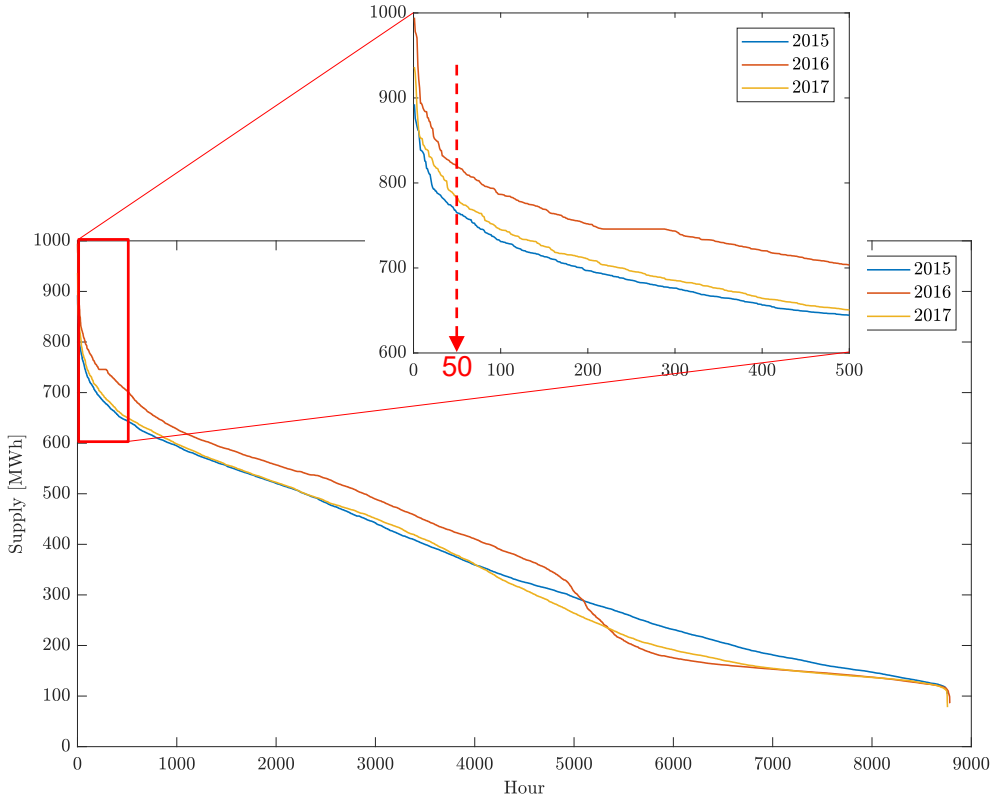
Removing the **50 hours** with highest consumption for each year yields significant capacity reductions.

Production: 14.3% - 17.7%

Demand: 13.5% - 16.5%



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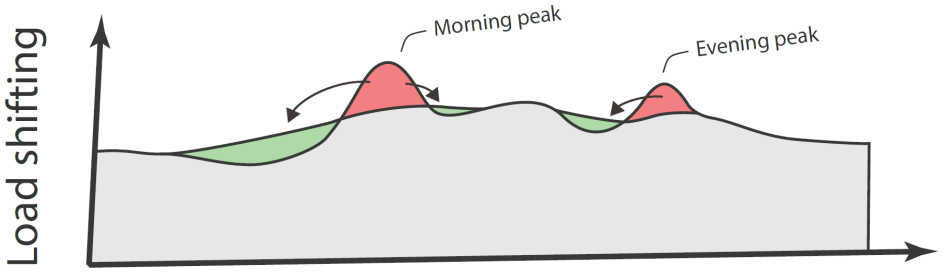
ENERGY FLEXIBLE BUILDINGS

Objective :

Shift consumption to lower peak demand.



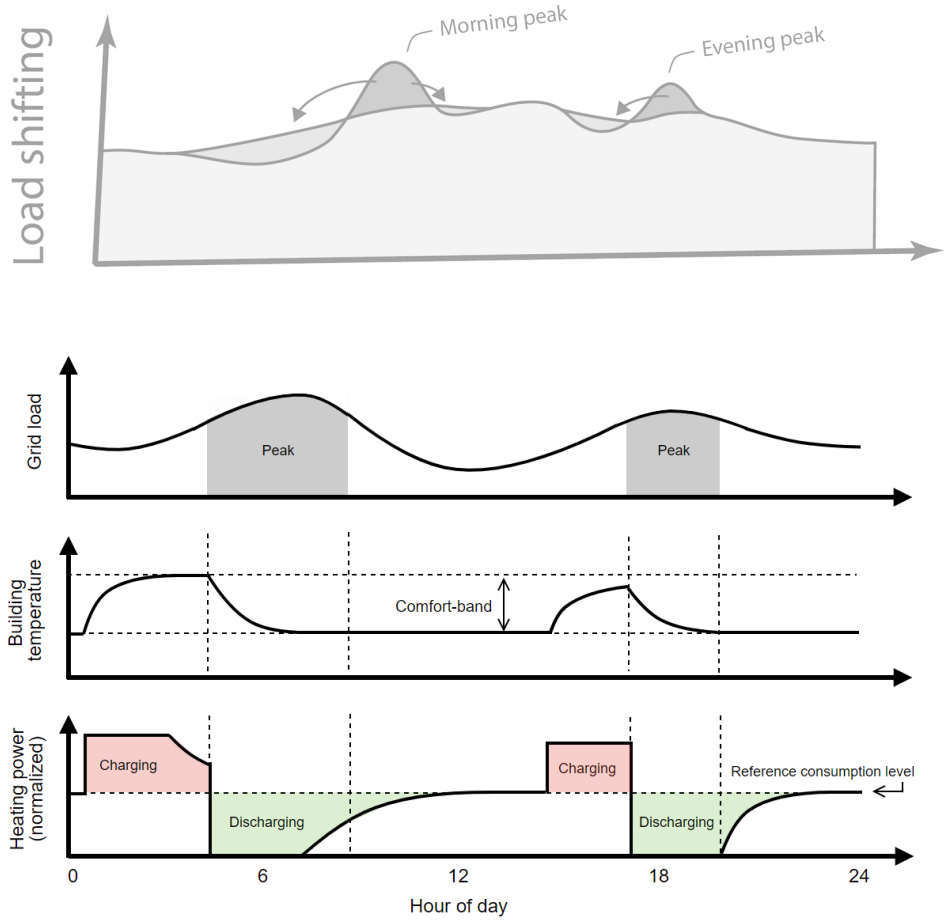
ENERGY FLEXIBLE BUILDINGS

Objective:

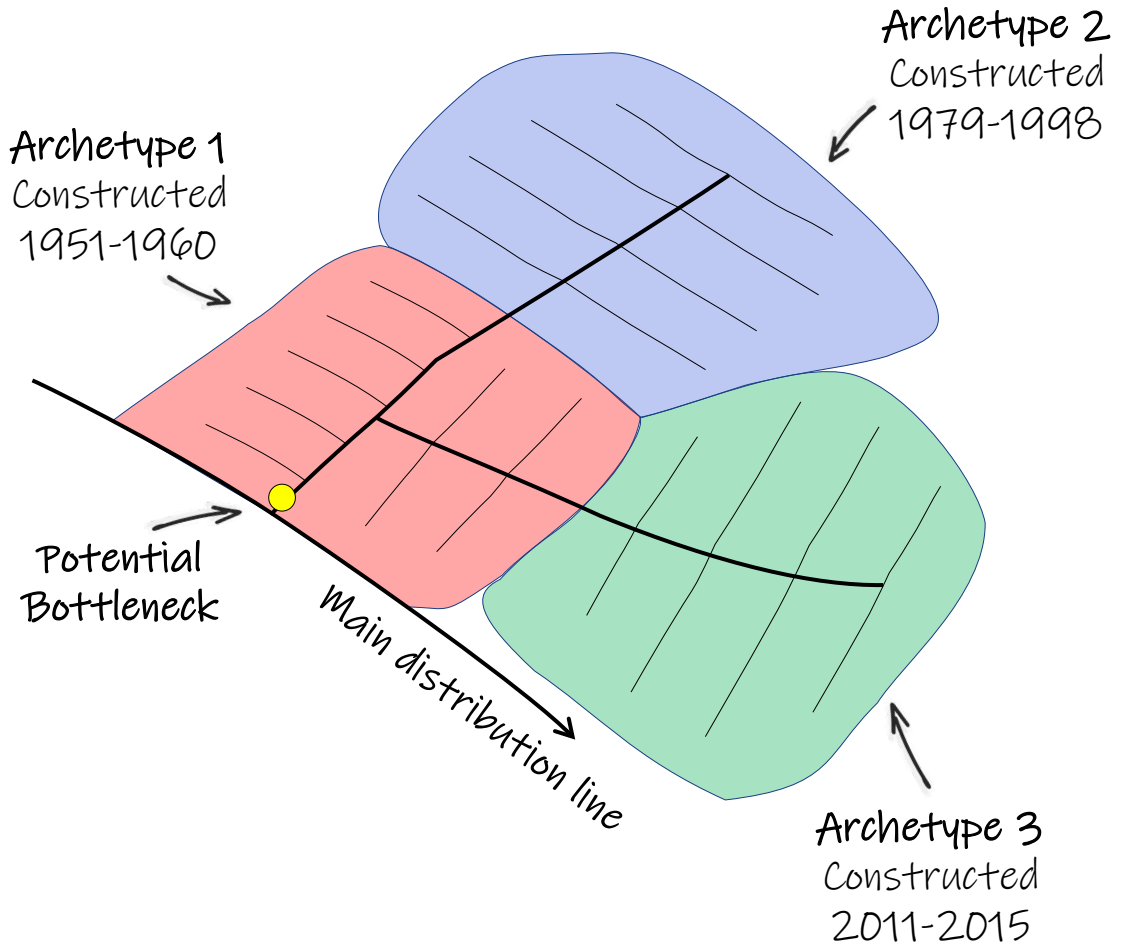
Shift consumption to lower peak demand.

Principle:

Utilize the inherent thermal capacity of buildings to shift consumption without impacting comfort.



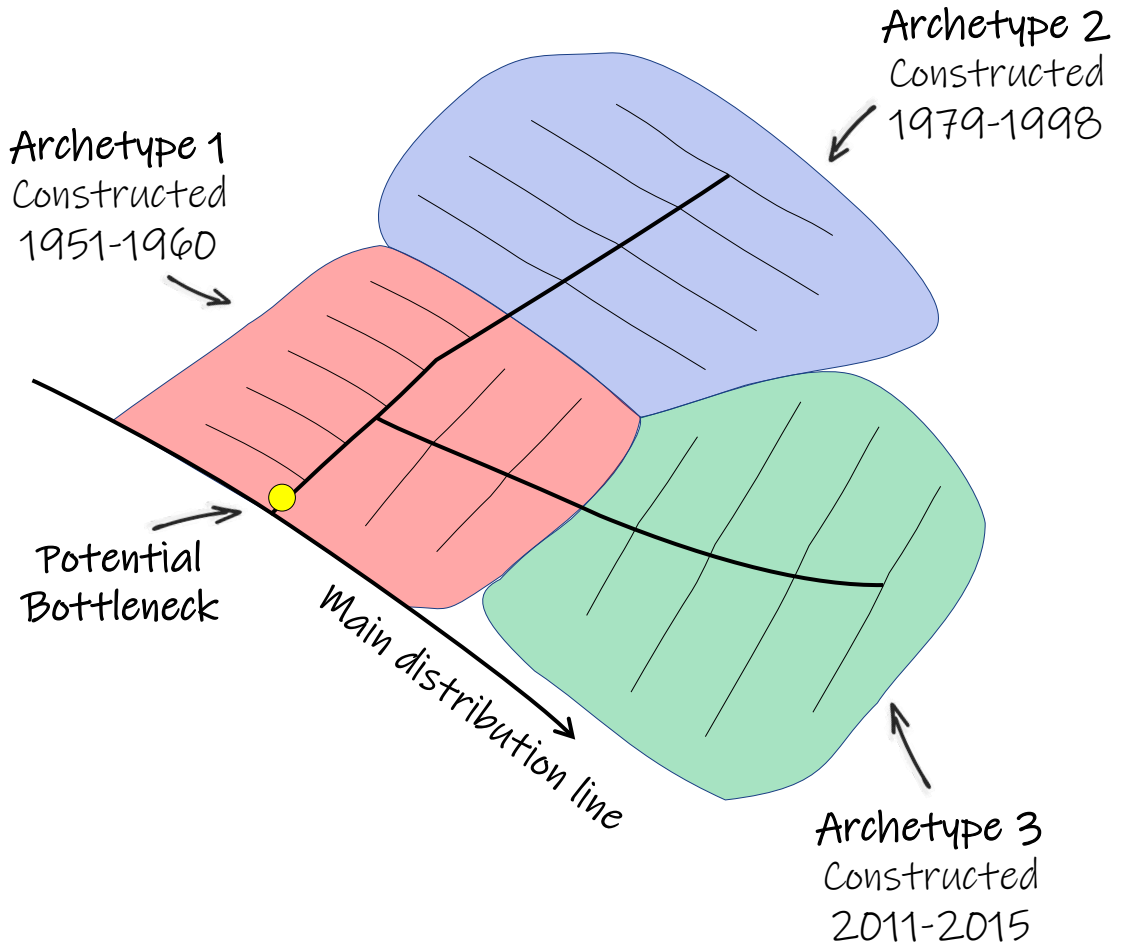
CASE STUDY: CITY EXPANSION SCENARIO



CASE STUDY: CITY EXPANSION SCENARIO

Questions:

1. To what extent can energy flexibility lower the required capacity of the neighborhood?
2. Should efforts be focused on making a given type of building flexible?



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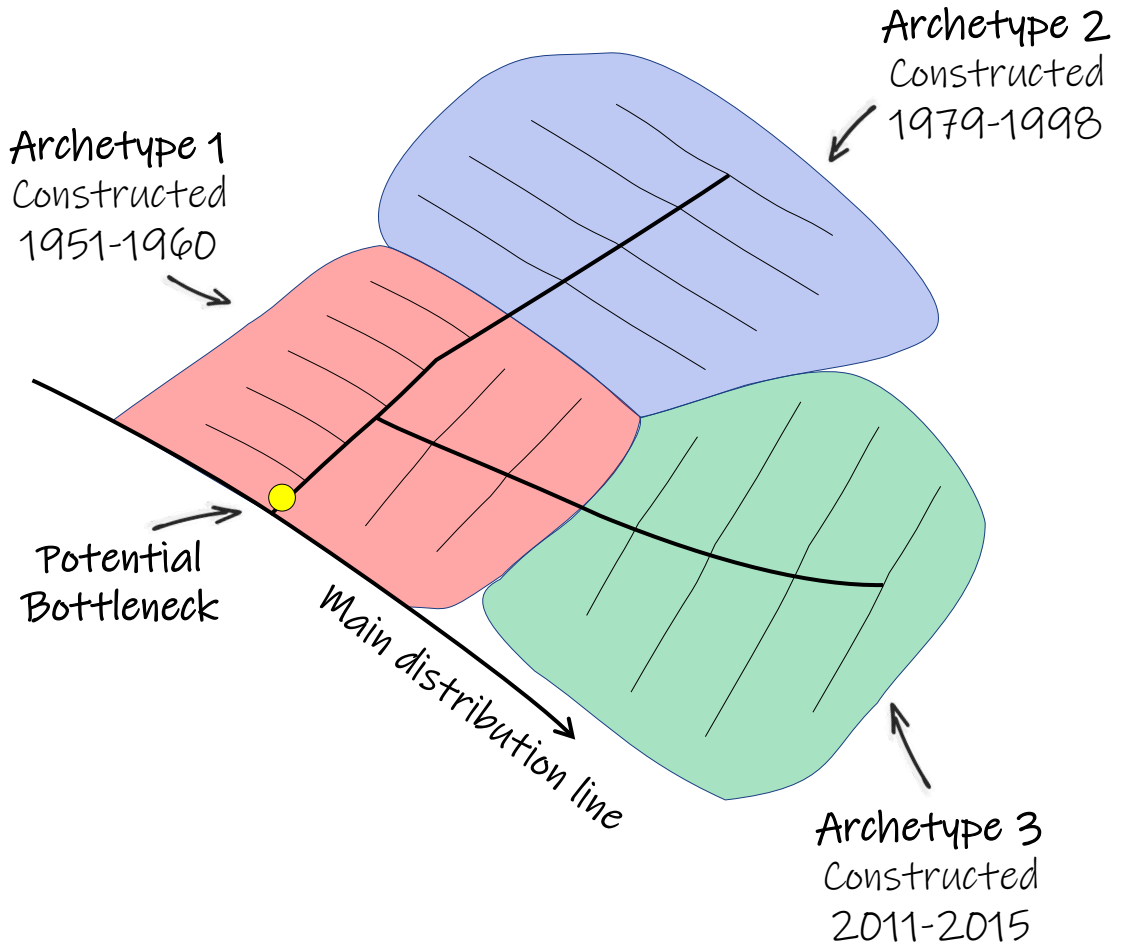
Method:

1: Establish dynamic models of buildings

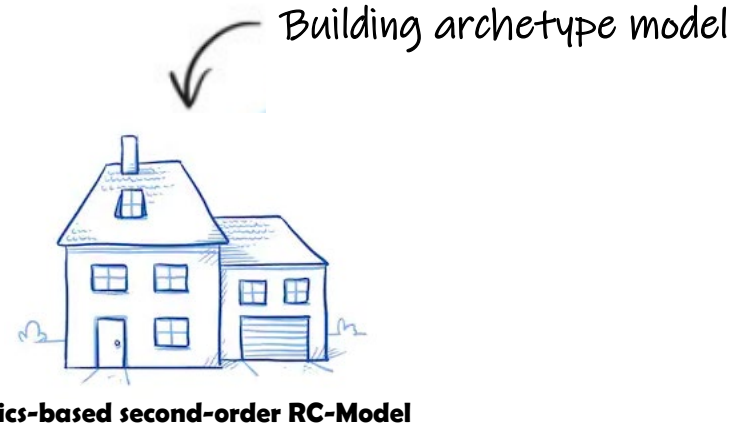
2: Perform multiple simulations of the area with different groups of buildings being flexible.



ARCHETYPE MODELLING

Archetype modelled:

- Archetype 1: 1951-1960
- Archetype 2: 1979-1998
- Archetype 3: 2011-2015



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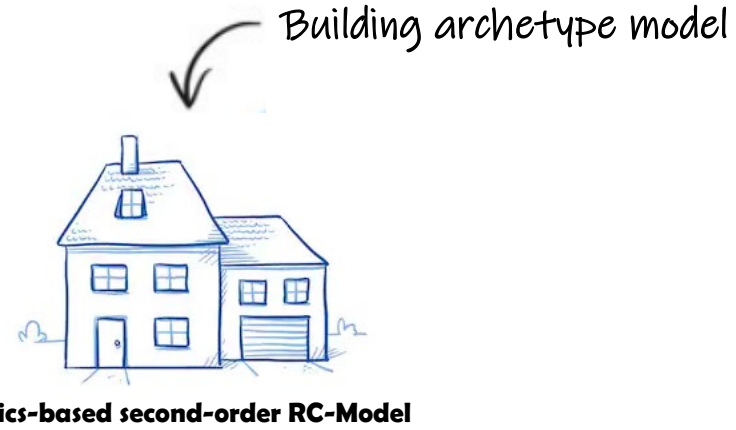
Calibration of dynamic archetype models

1. Smart-meter consumption measurements
   Sample: Six months worth of data from 100 buildings
2. Weather data (Temperature and solar radiation)
3. Prior knowledge (our best beliefs)



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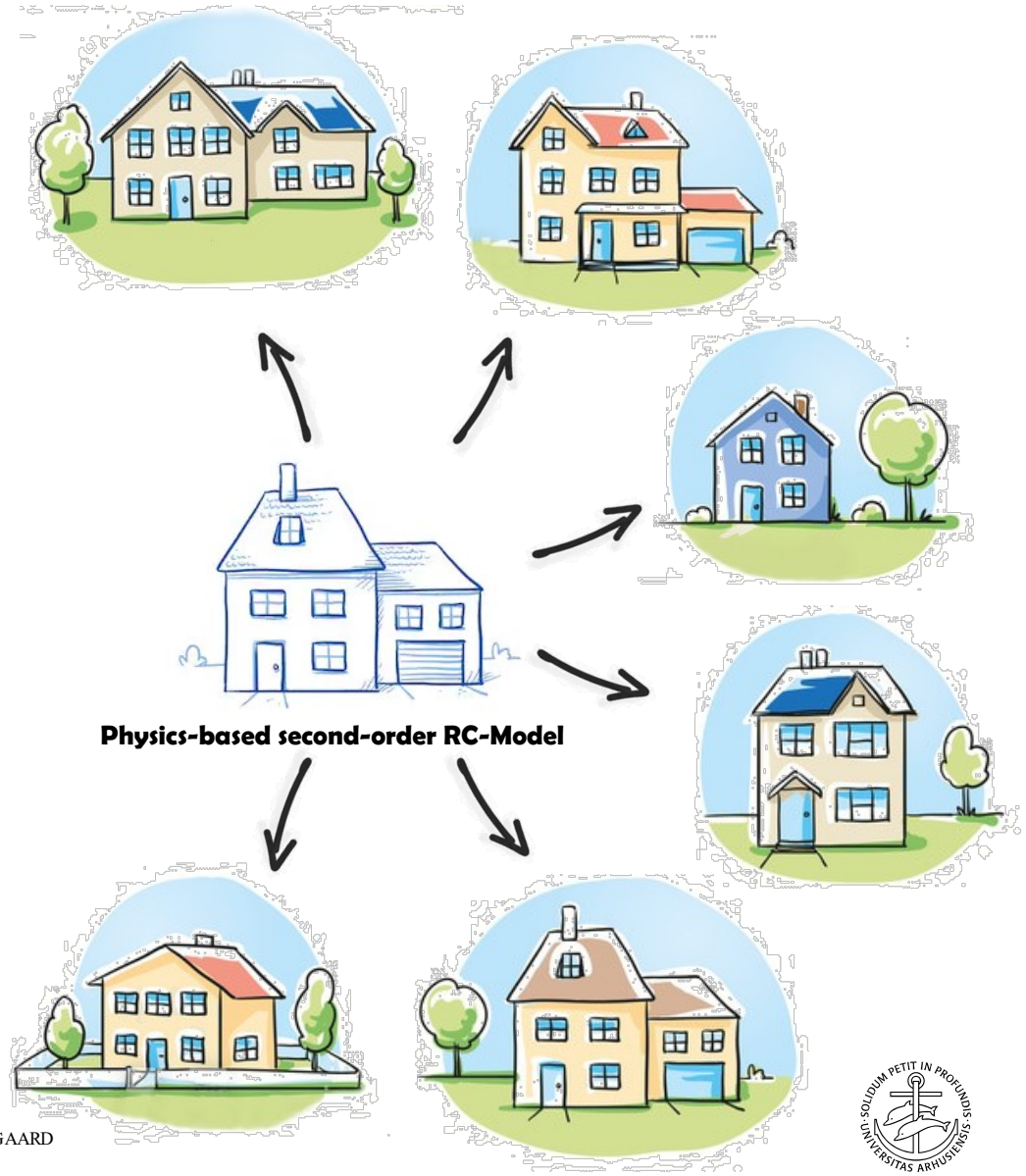
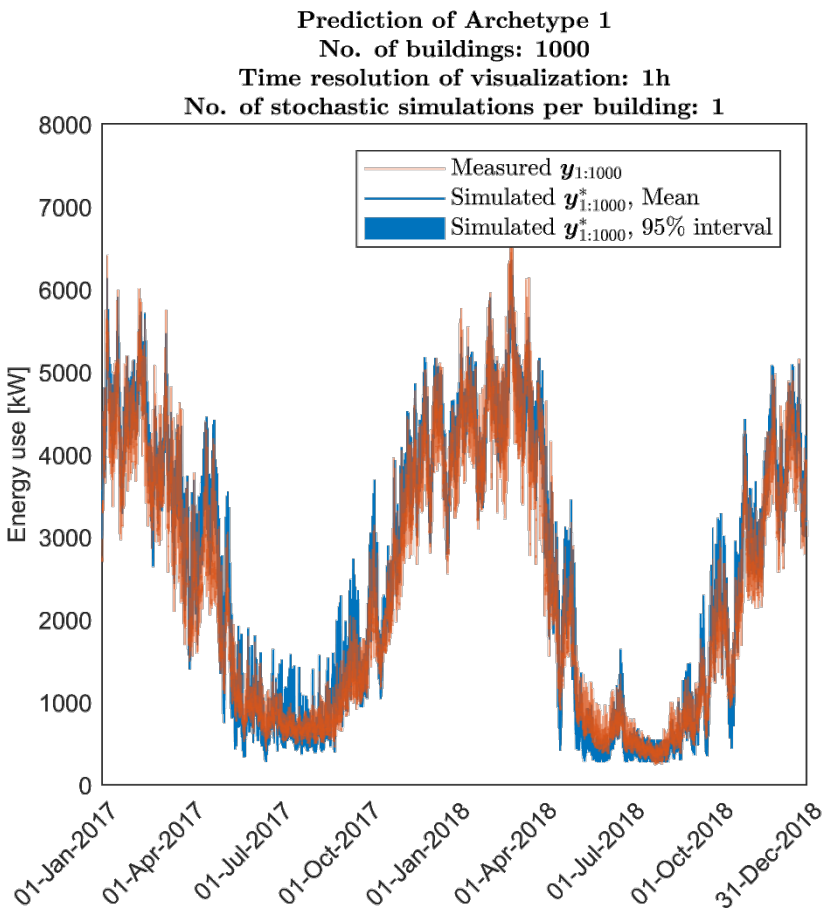
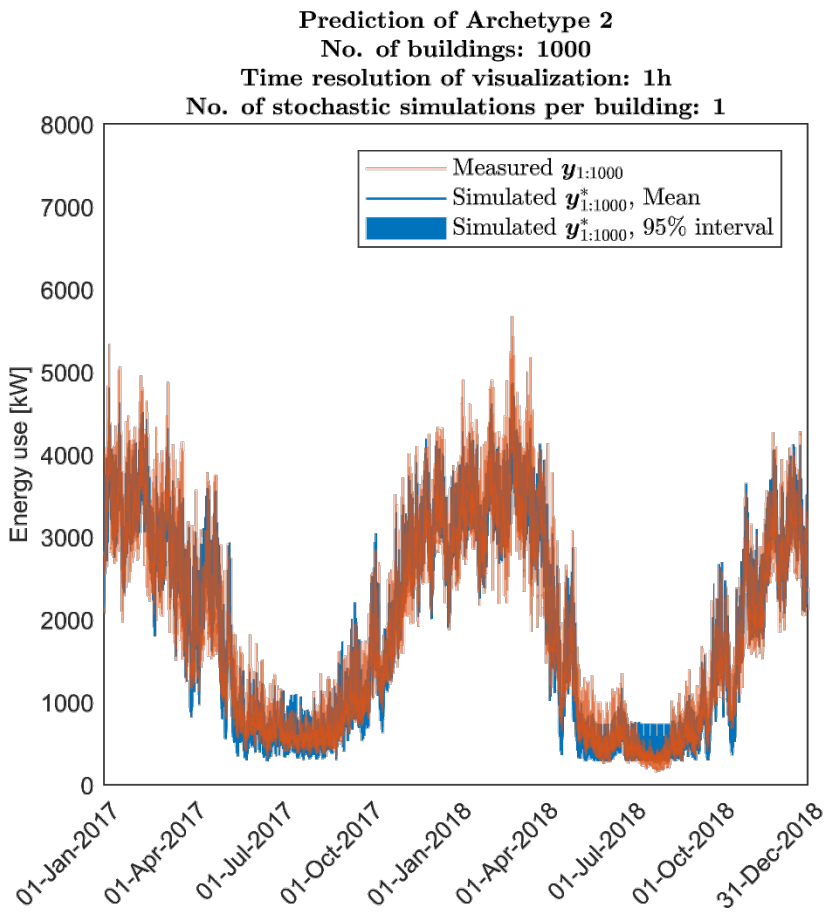
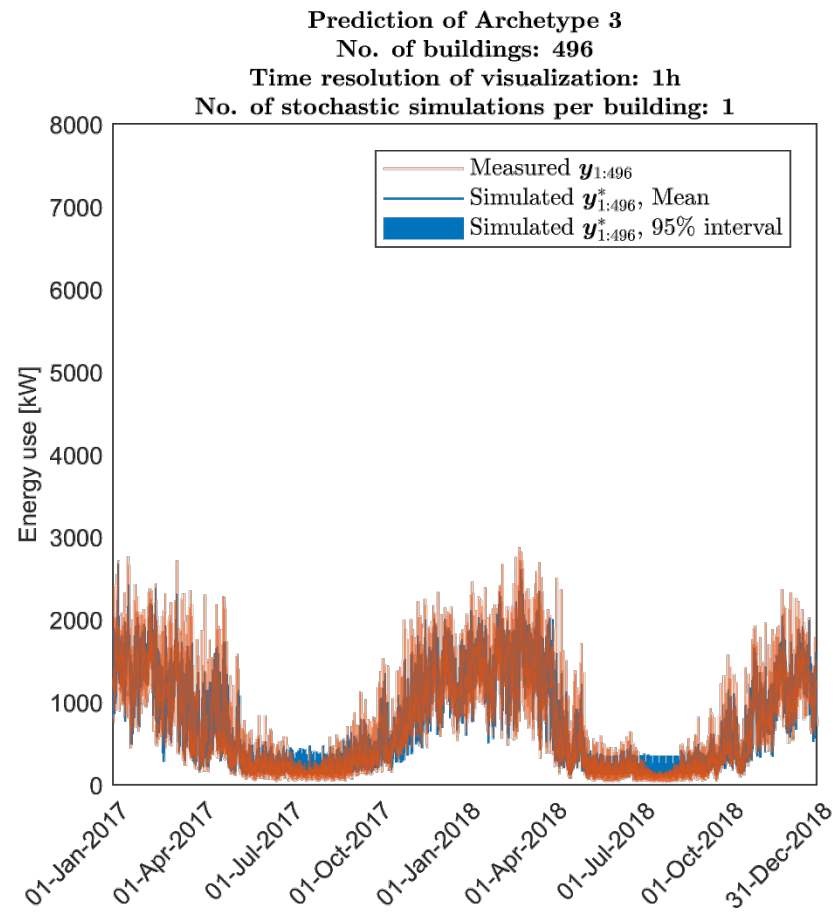


MODELS VS REALITY







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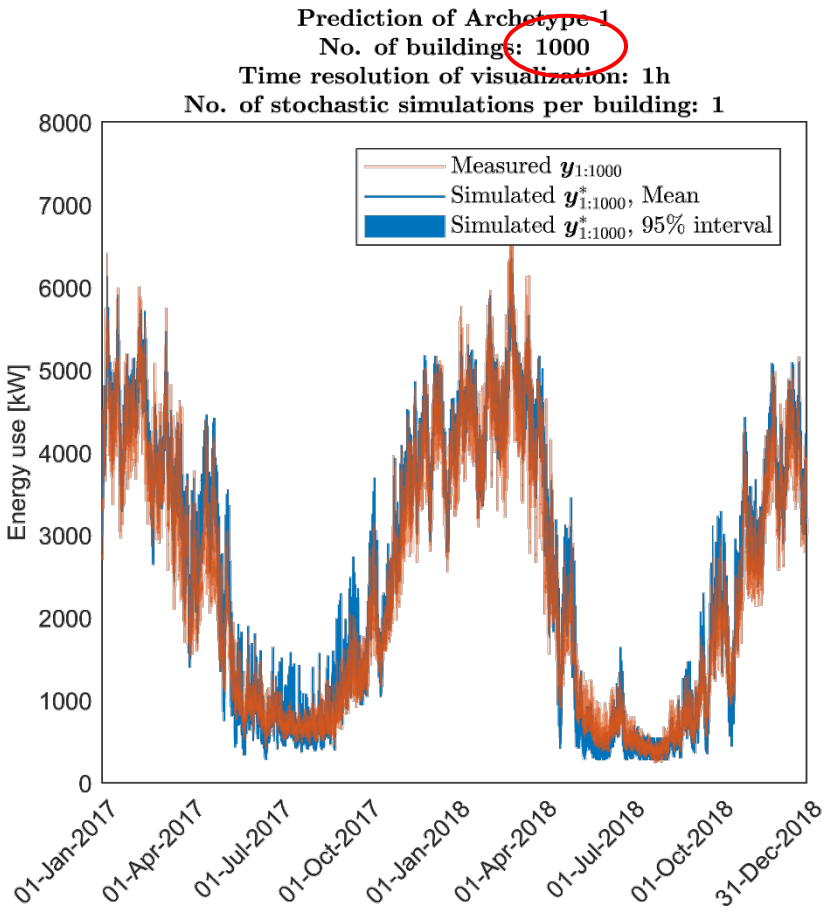

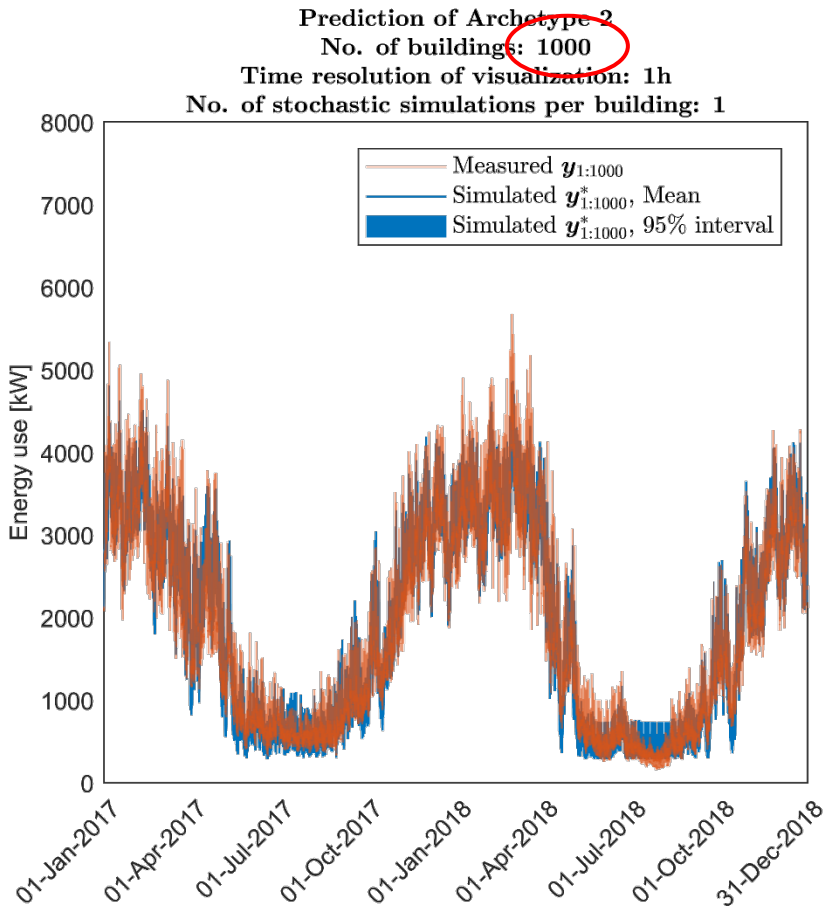

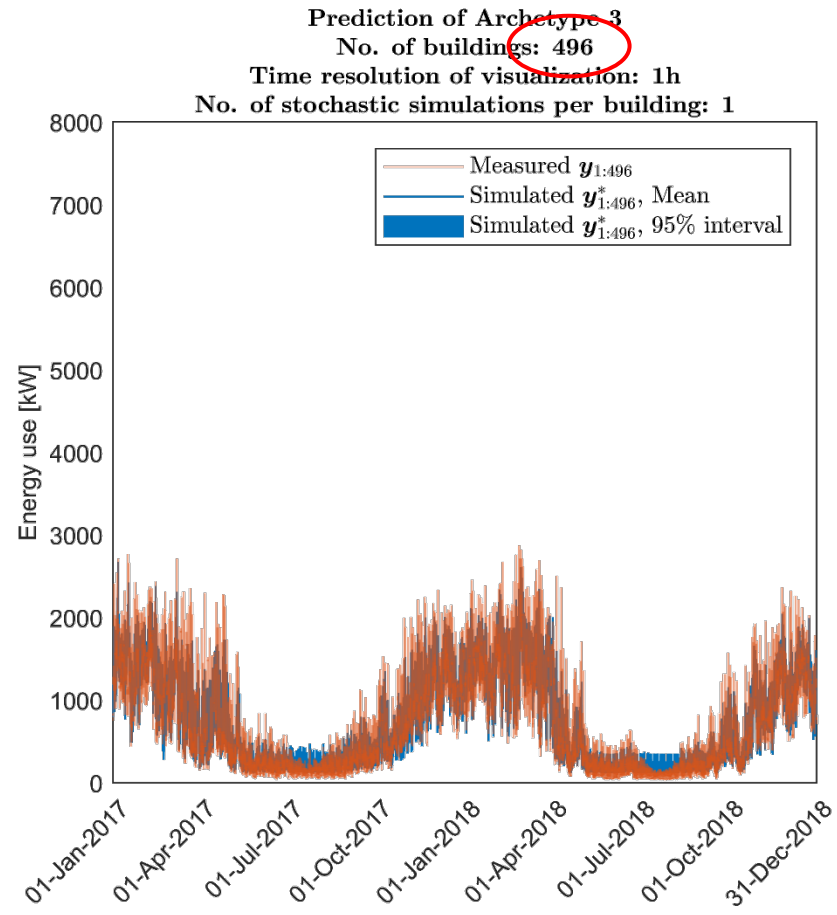

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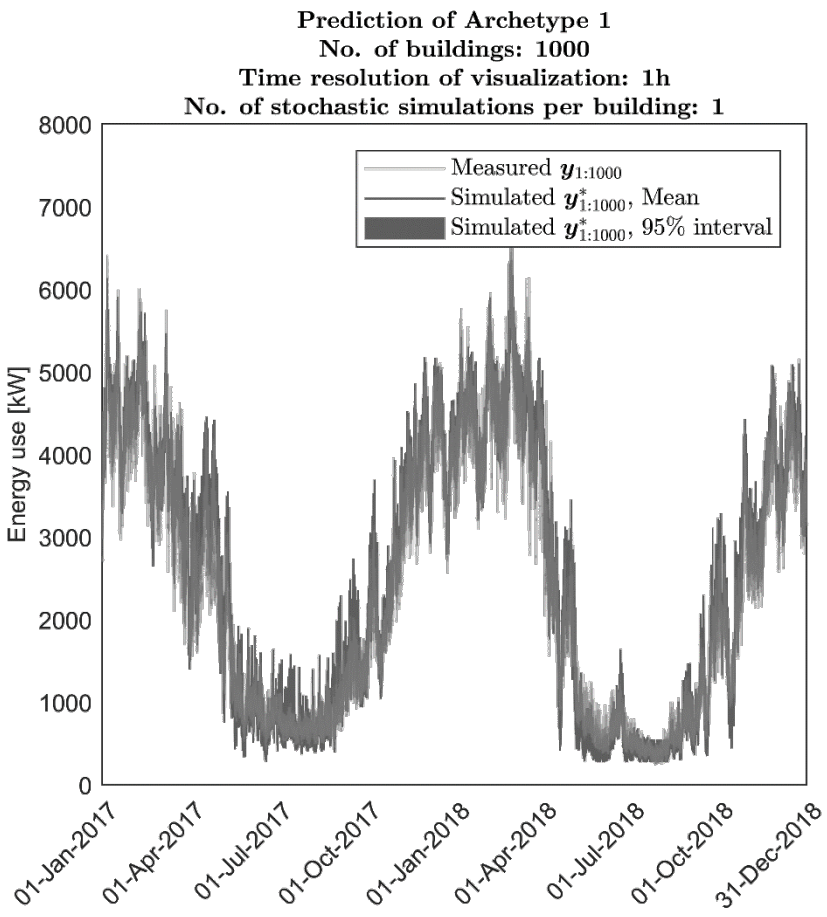

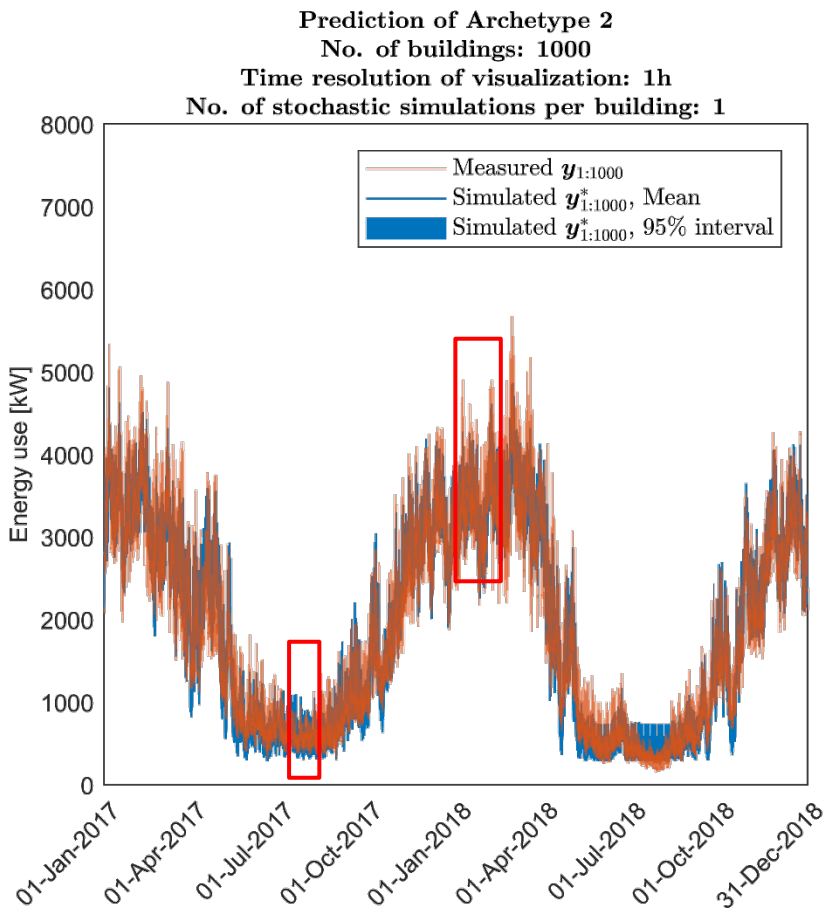

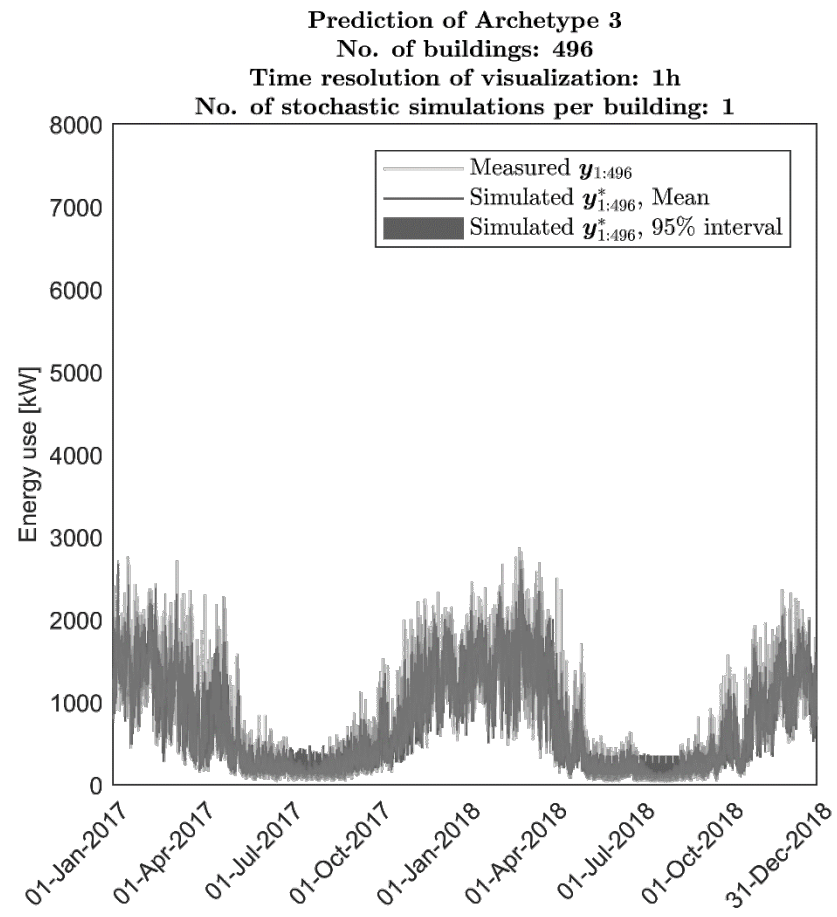

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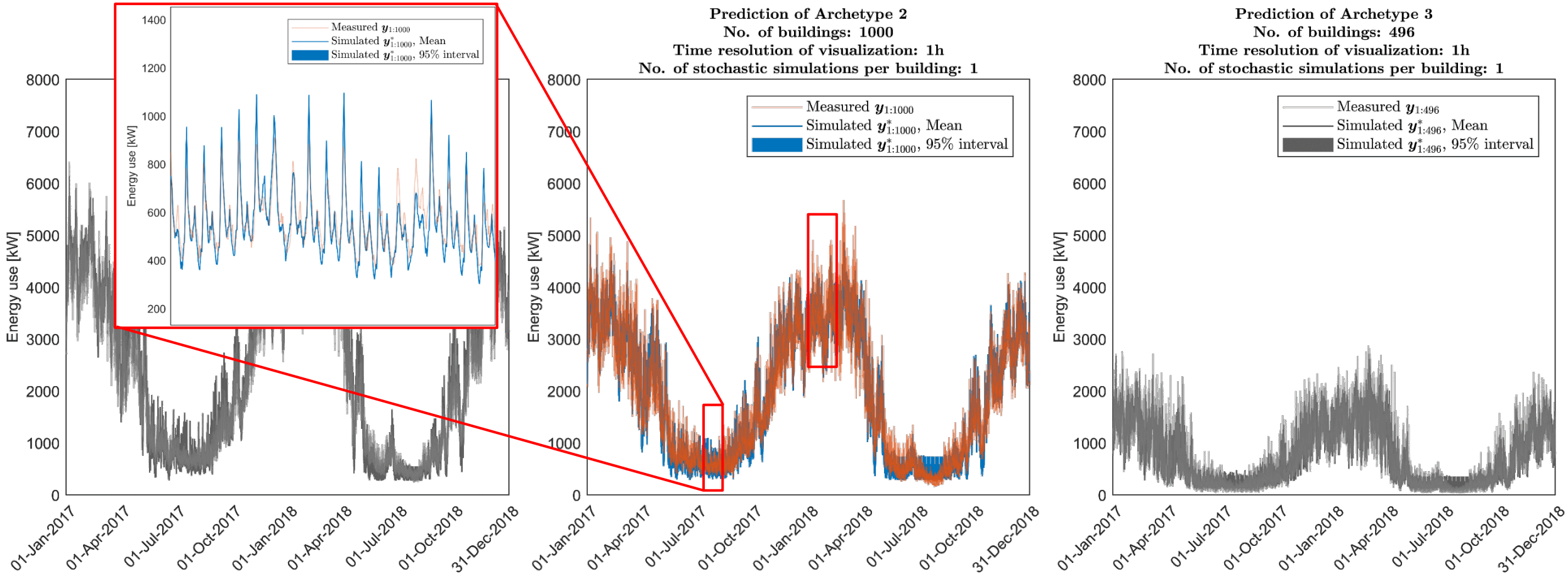

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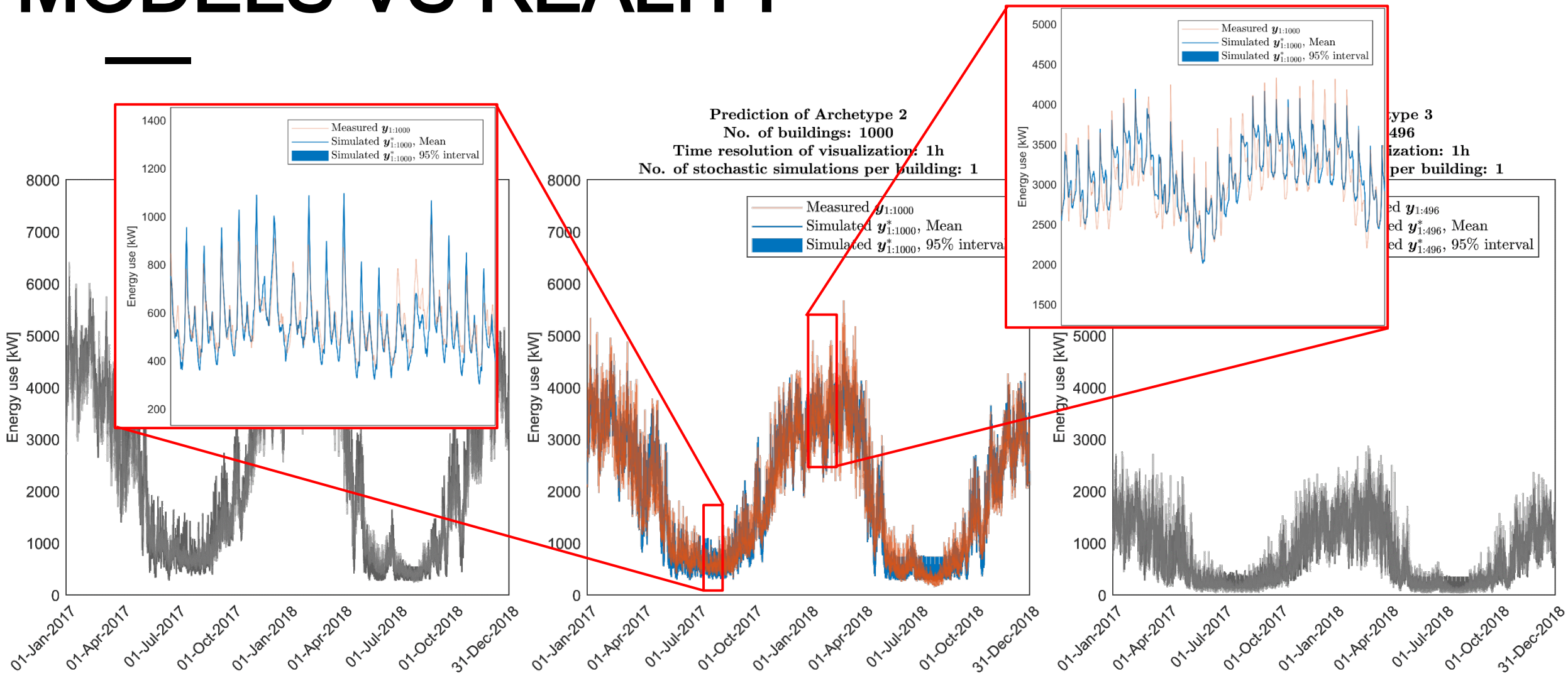
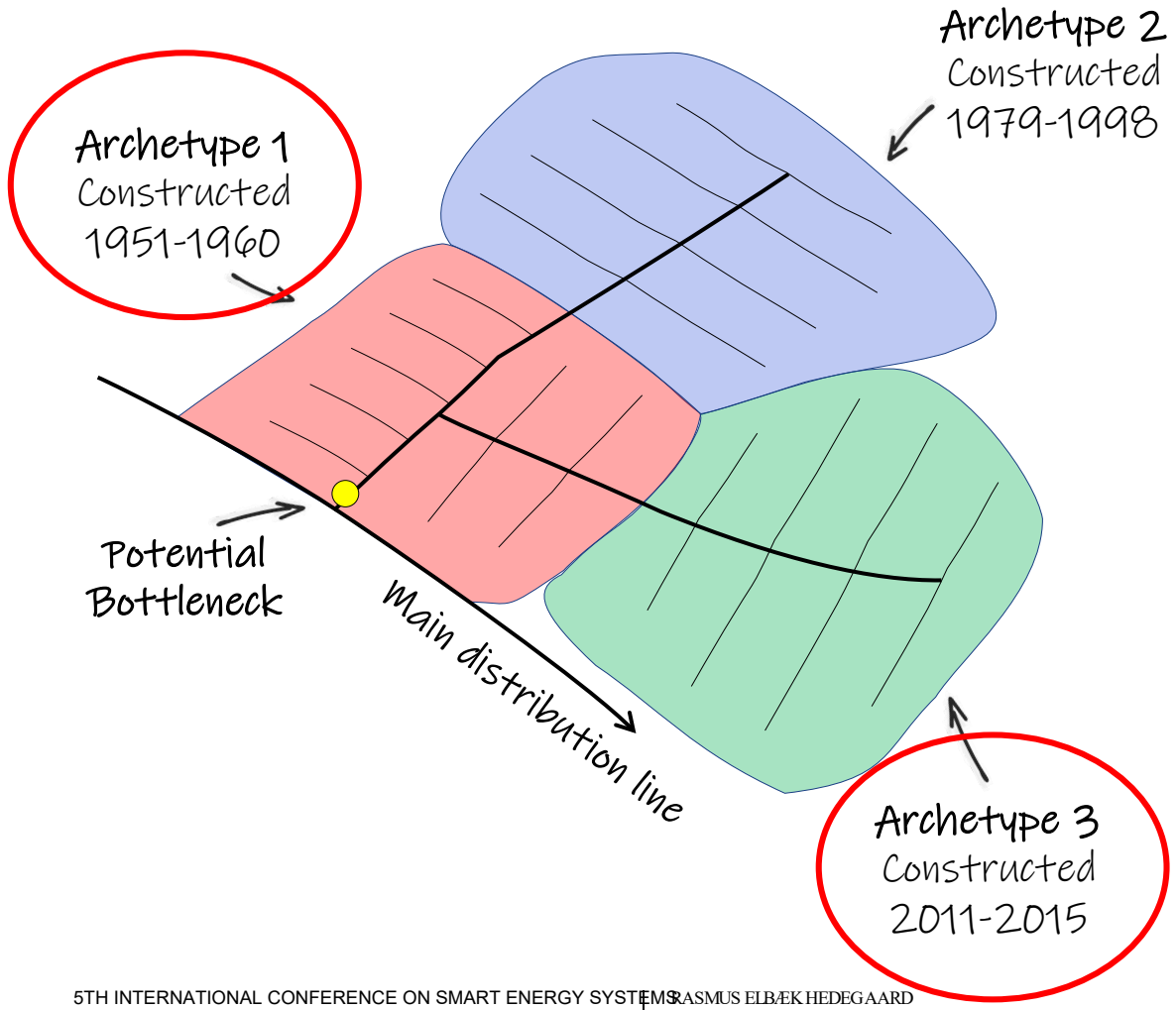


SIMULATION OF DEMANDRESPONSE



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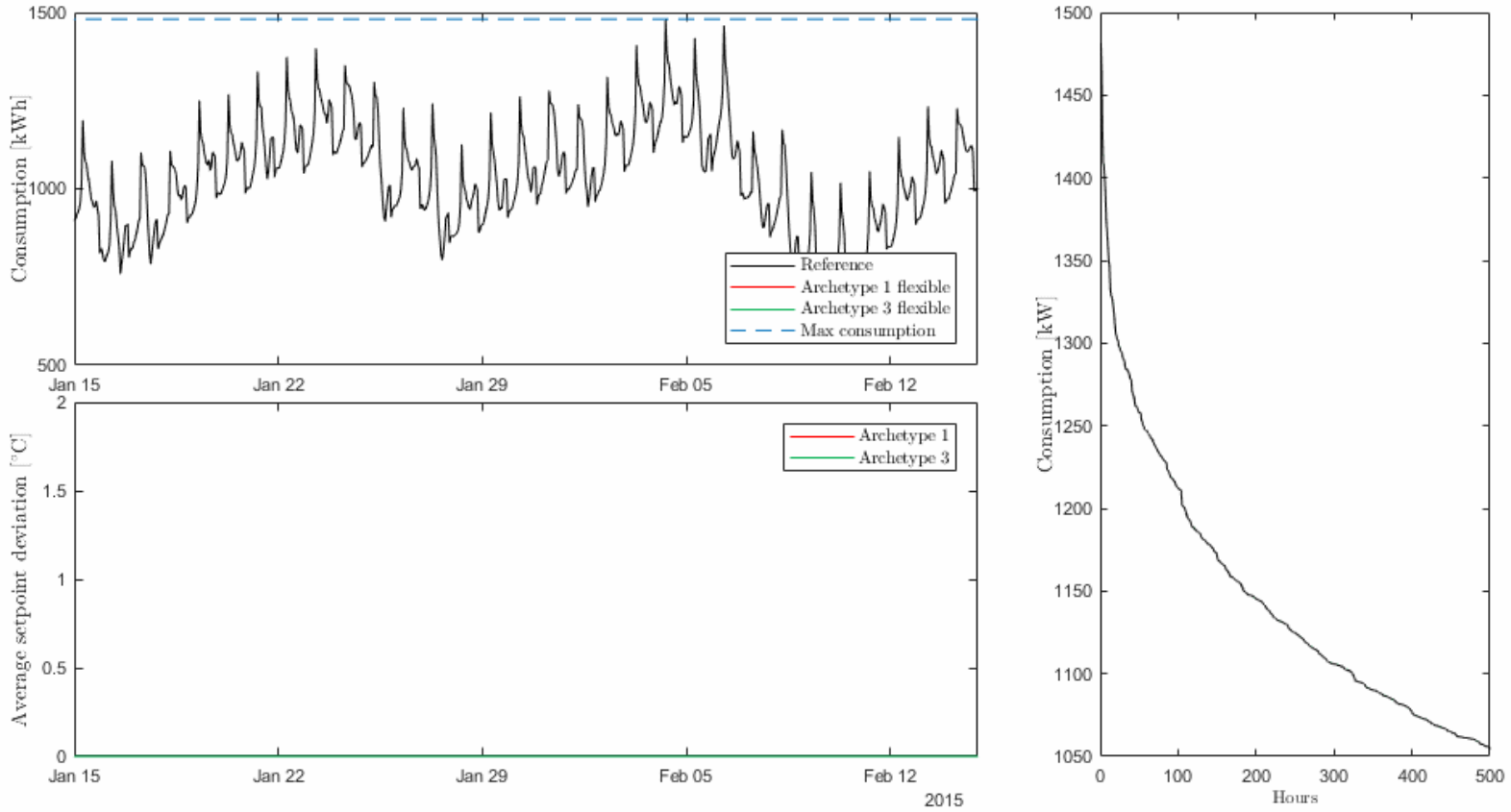

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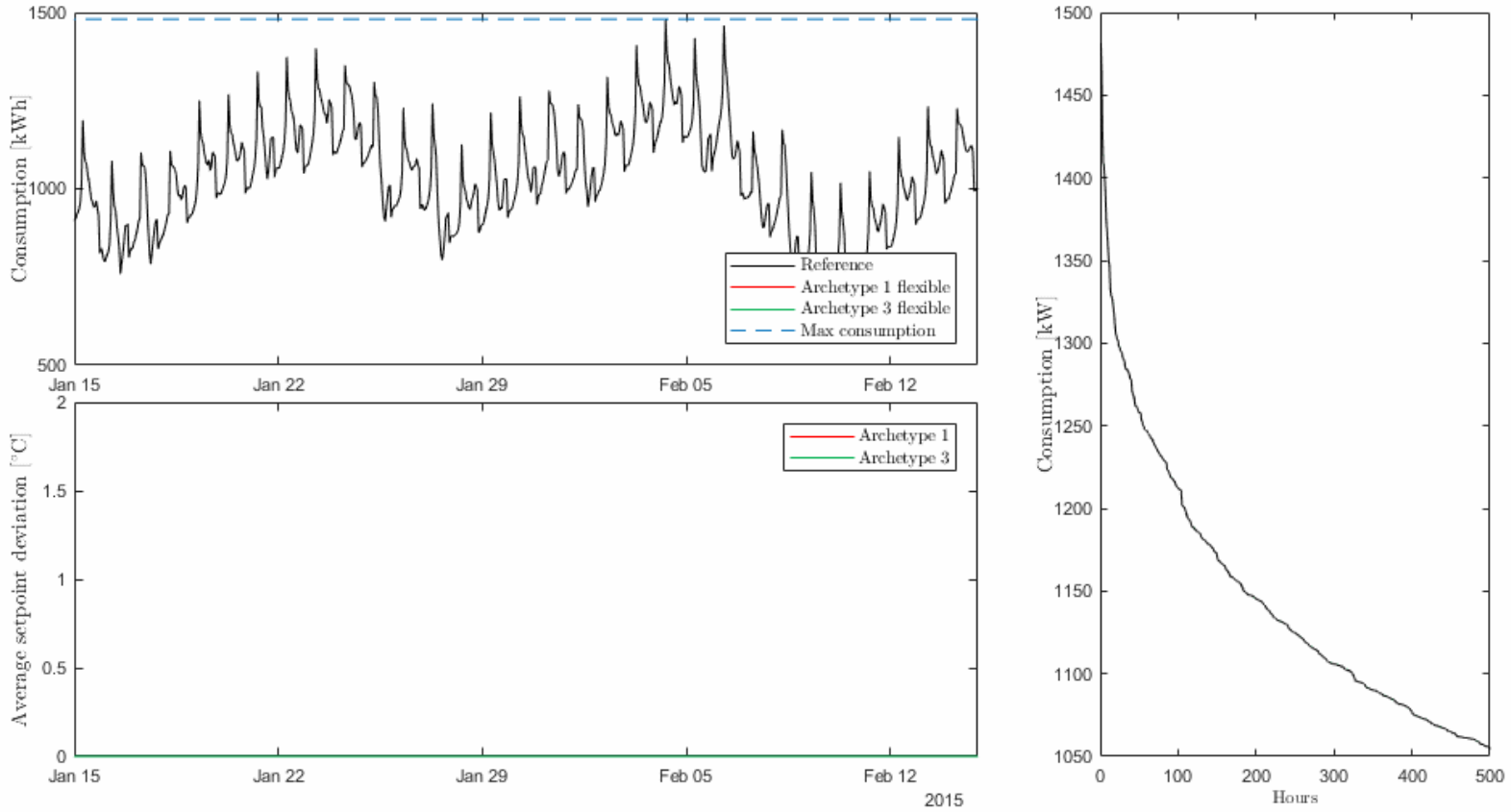
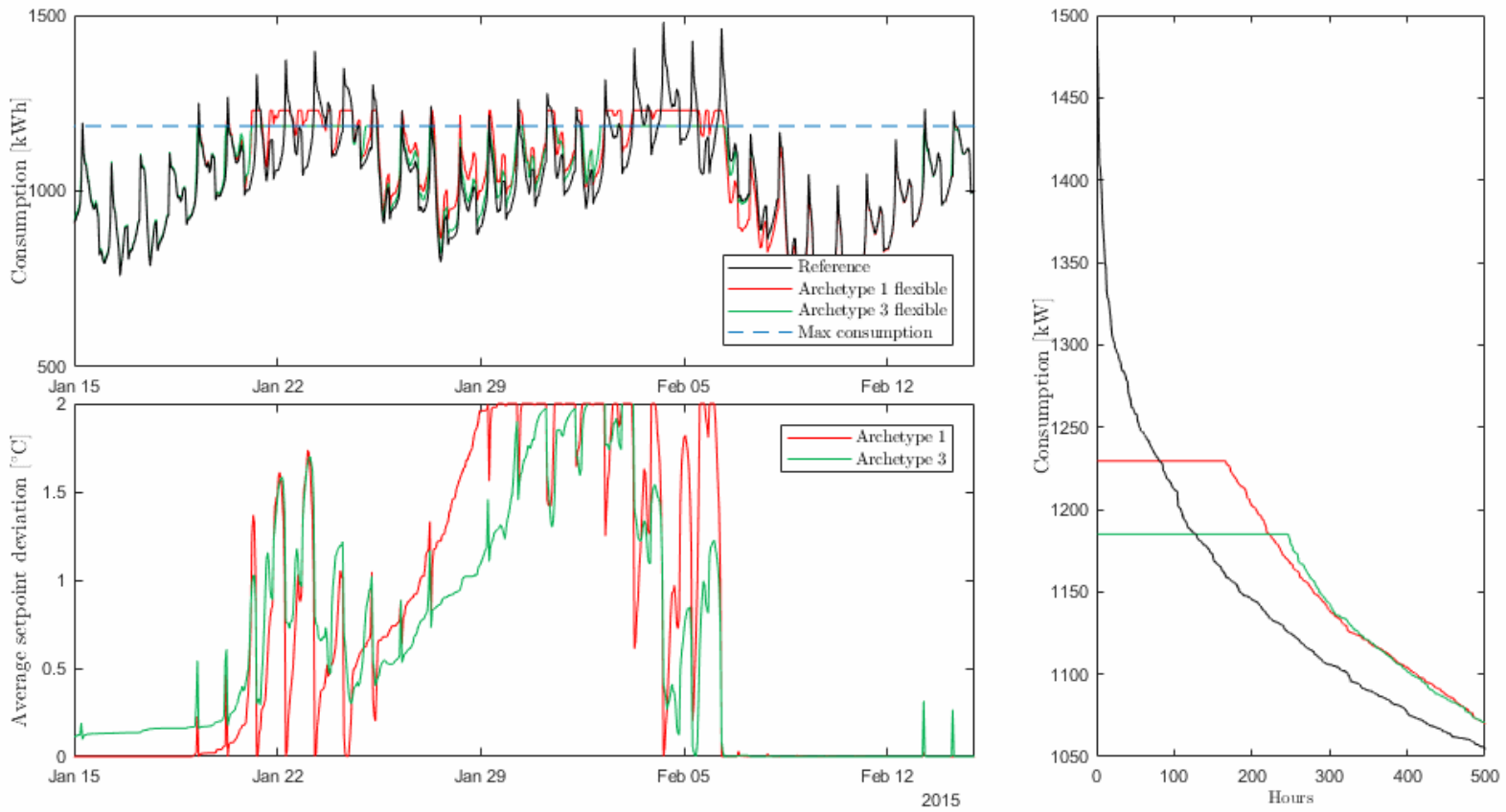
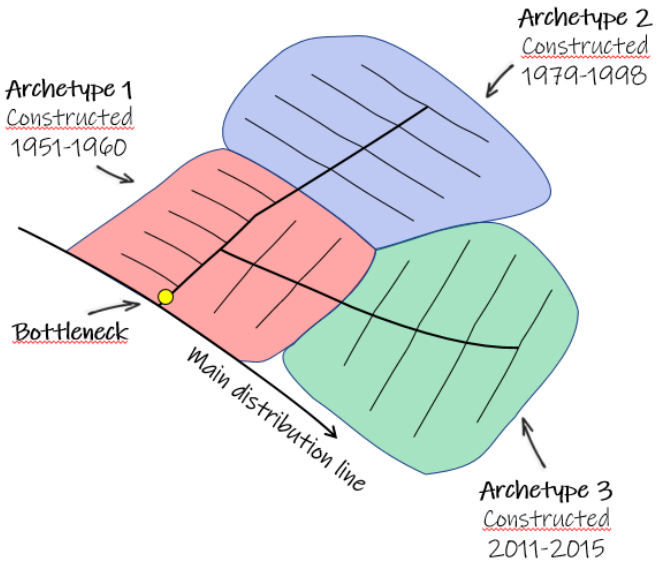


SIMULATION OF DEMAND RESPONSE



RESULTS BREAKDOWN



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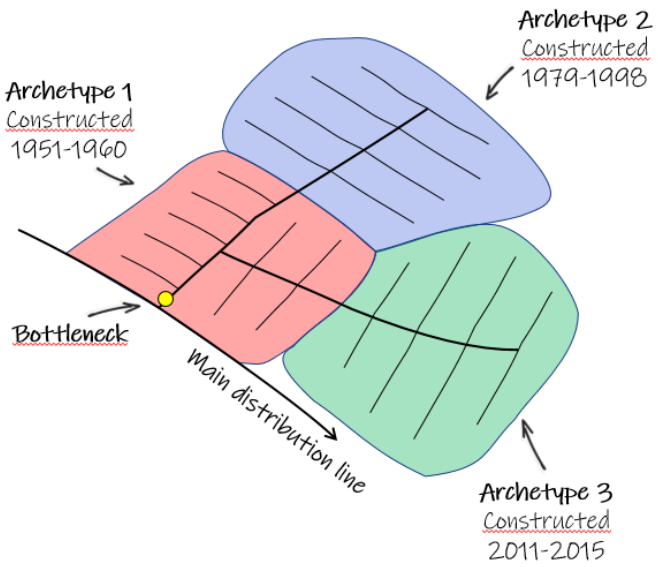

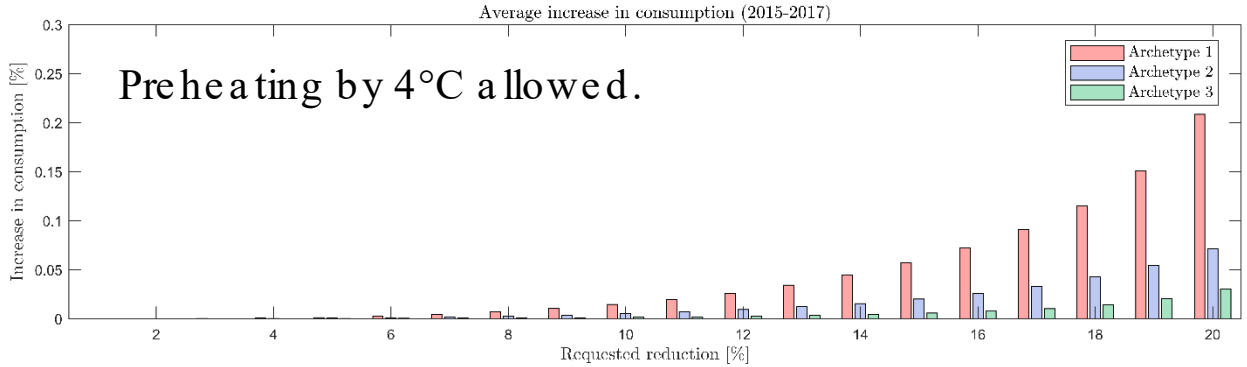

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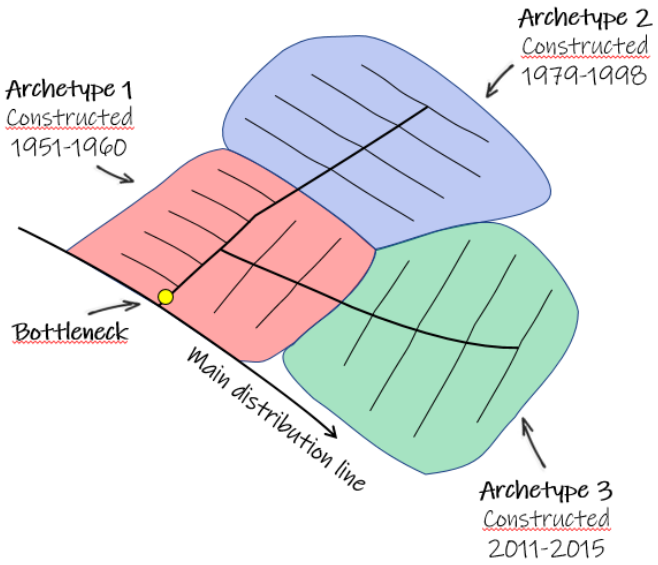
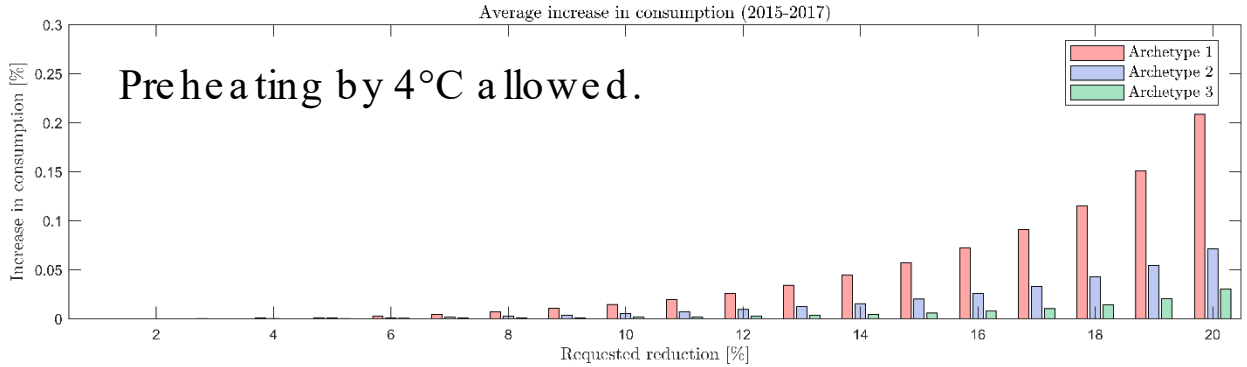
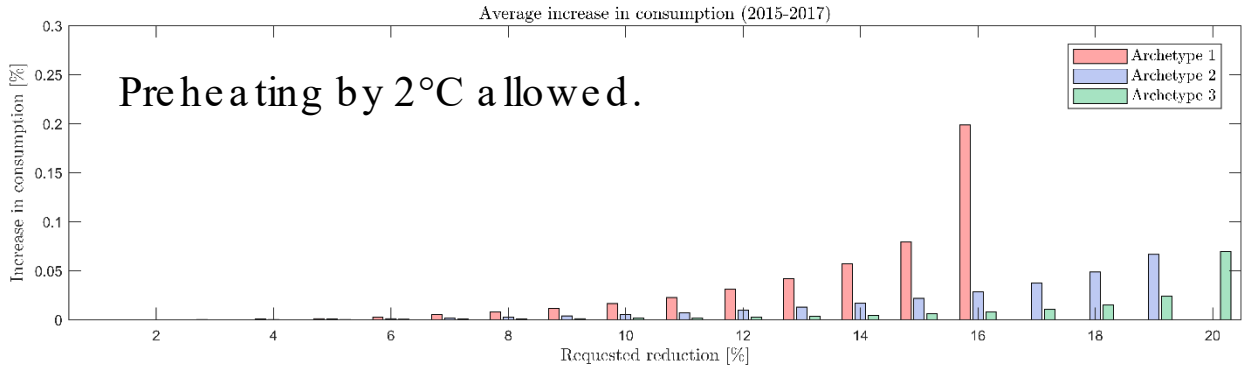


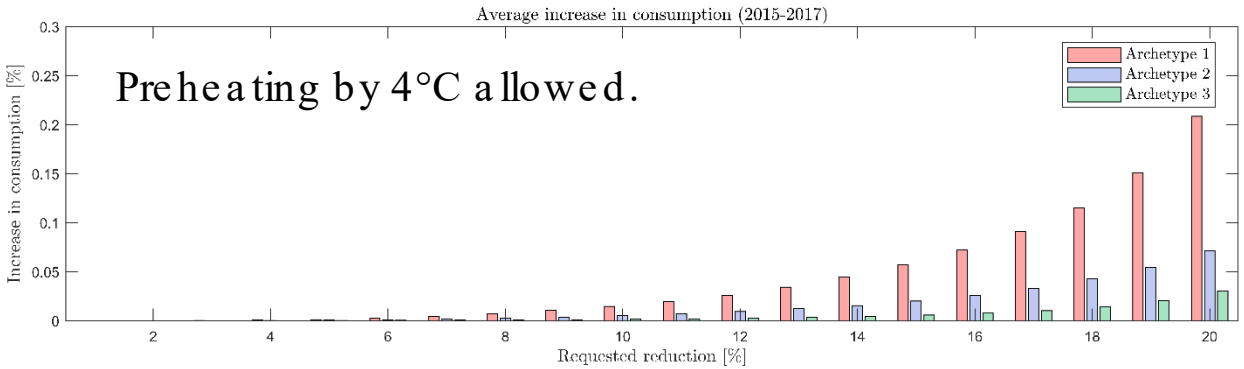


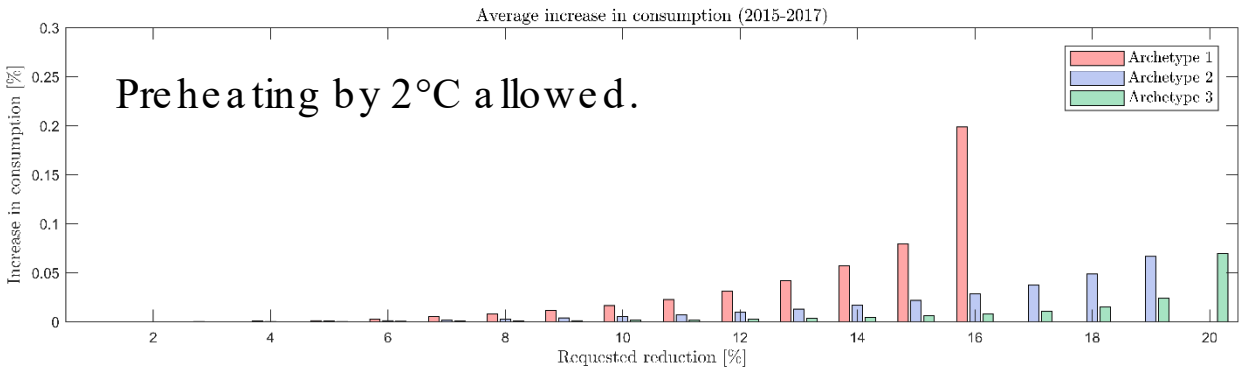


MAIN FINDINGS

Results indicated:

1. Significant capacity reductions may be achieved with only a modest increase in overall consumption.
2. Performance affected by:
   - Comfort preferences of occupants
   - Building energy efficiency





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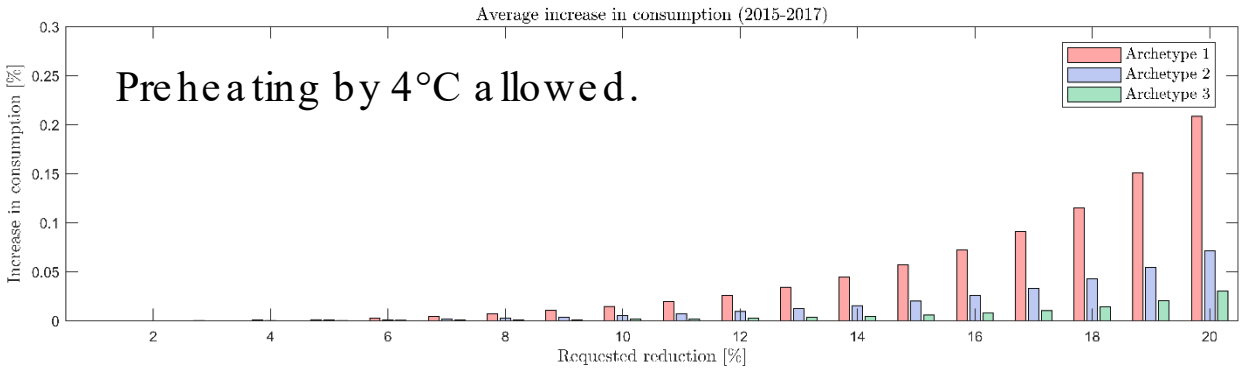
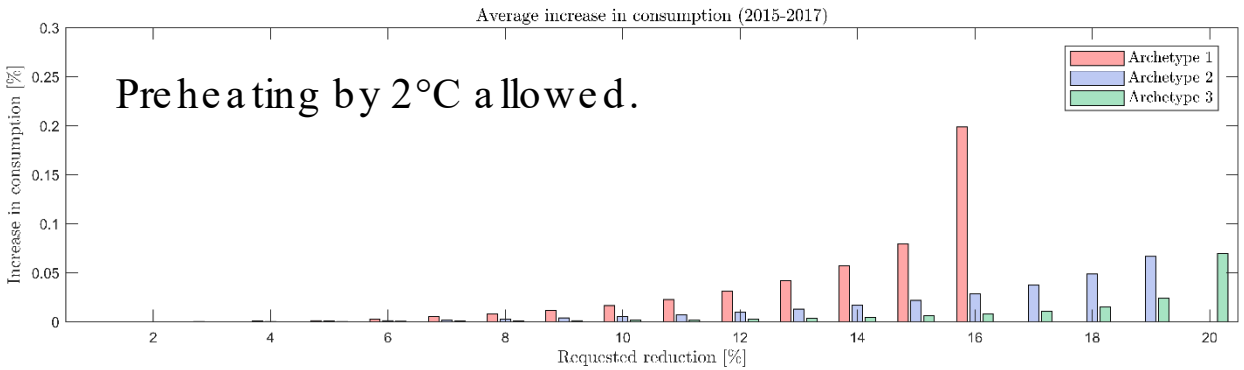
Energy retrofitting may benefit both **energy conservation** and **energy flexibility**.





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