Domestic Heat Demand Prediction and the Implications for Designing Community Heat Network

Miaomiao (Candy) He, Michele Tunzi, David Allinson, Kevin Lomas, Mark Gillott, Lucelia Rodrigues, Nick Ebbs, John Lindup

Copenhagen, 12-13 September 2017

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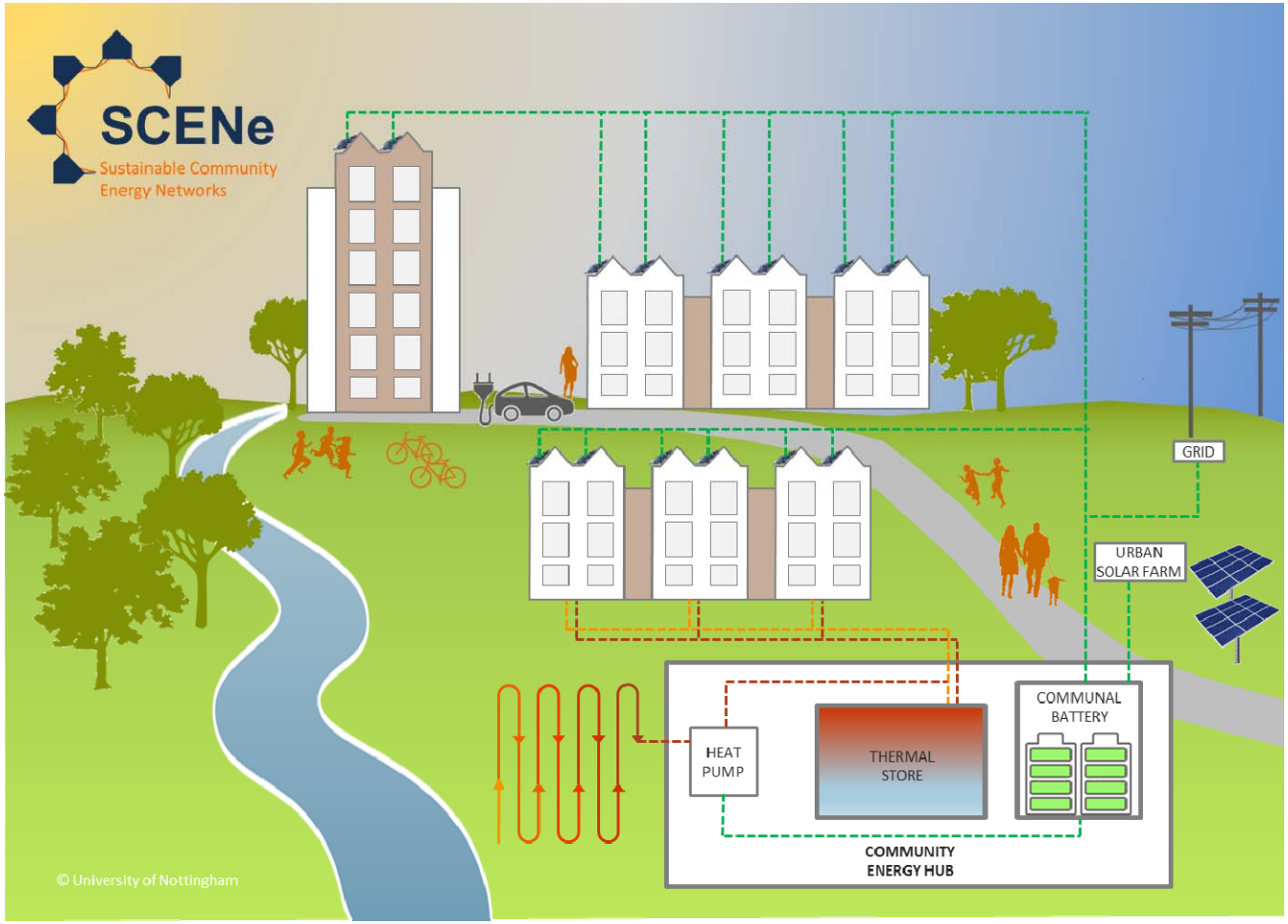
Project SCENe



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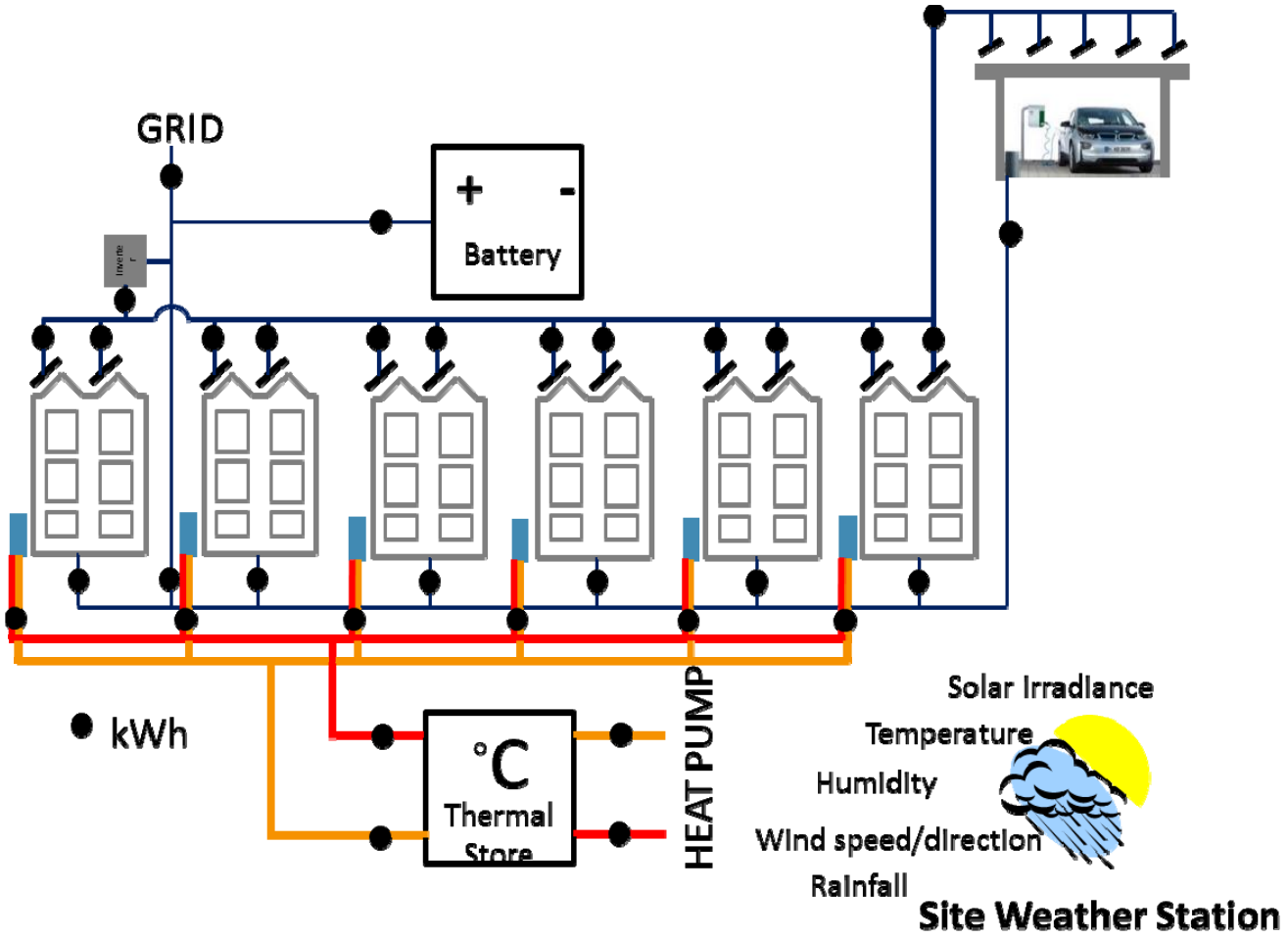
SCENe: monitoring at community



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SCENe: monitoring at home

Temperatures

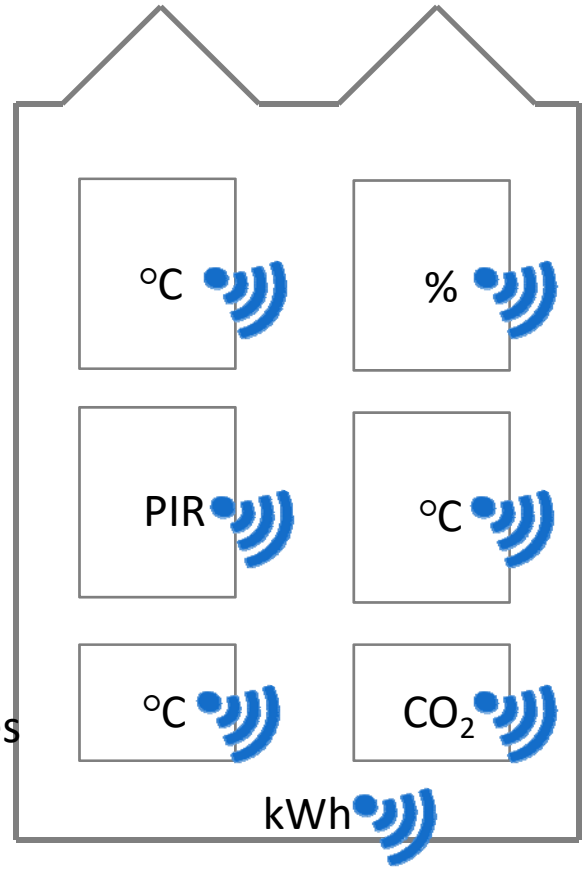
Relative Humidity

Carbon Dioxide

Occupancy

Electrical Energy
- Total Electricity
- Circuits
- Significant Appliances

Thermal Energy
- Hot Water
- Space Heating



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Aim & Objectives

Aim: to improve the prediction of heat demand of a community for designing a communal heat network

- **Objective 1**: a model for space heating of a community
- **Objective 2**: a model for hot water of a community
- **Objective 3**: validation of the models

State of the art: Stochastic models

- Archetype approach
  - Limited archetypes
  - Representative of building stock

Limitations of current models

- Archetype approach
  - Limited archetypes
  - Representative of building stock
- Lumped capacitance model
  - Based on simplified hourly method
  - Pre-calibrated capacitances and coefficients

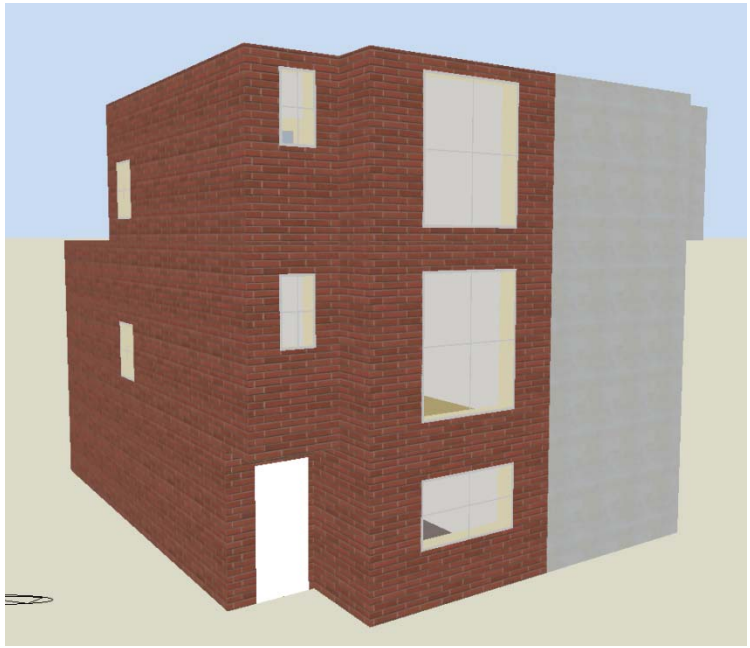
Limitations of current models

- Archetype approach
  - Limited archetypes
  - Representative of building stock
- Lumped capacitance model
  - Based on simplified hourly method
  - Pre-calibrated capacitances and coefficients
- Validation datasets
  - Annual average values / rule-of-thumb
  - A specific archetype
  - Measured datasets not for the simulated dwellings

SCENe Model: space heating

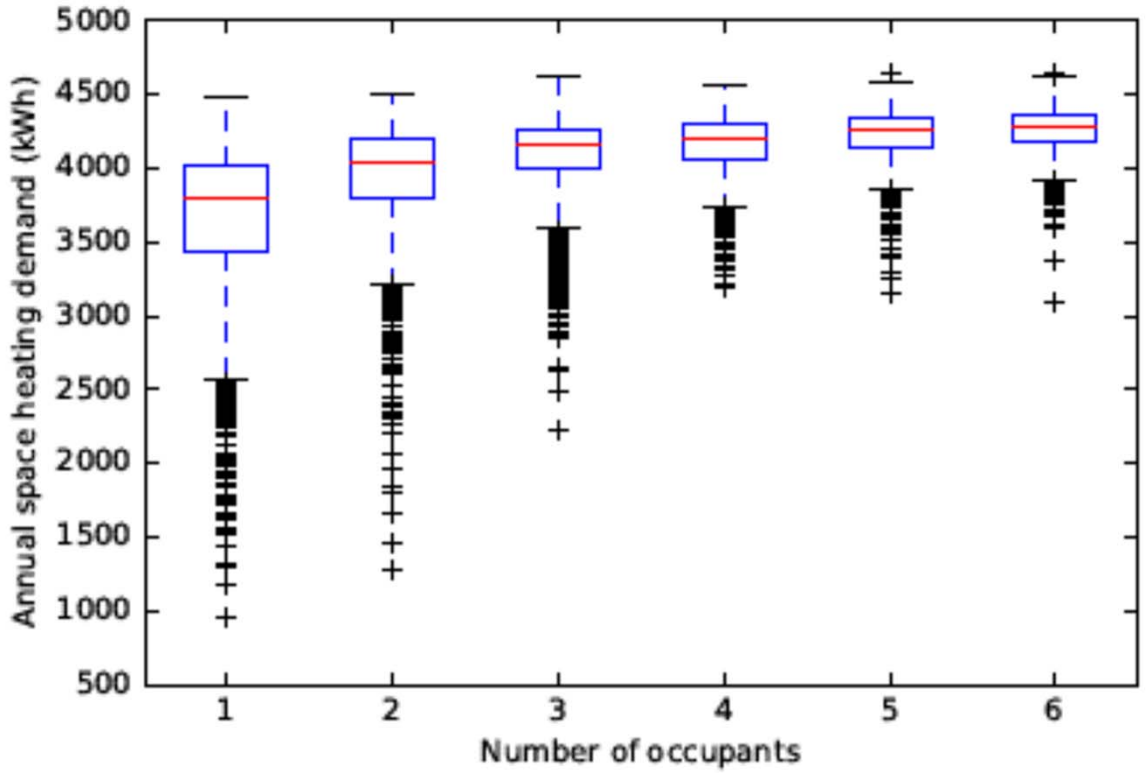
- Dynamic thermal modelling: EnergyPlus

- Stochastic heating schedules: Richardson's model



Result: annual space heating demand

2,000 stochastic heating schedules



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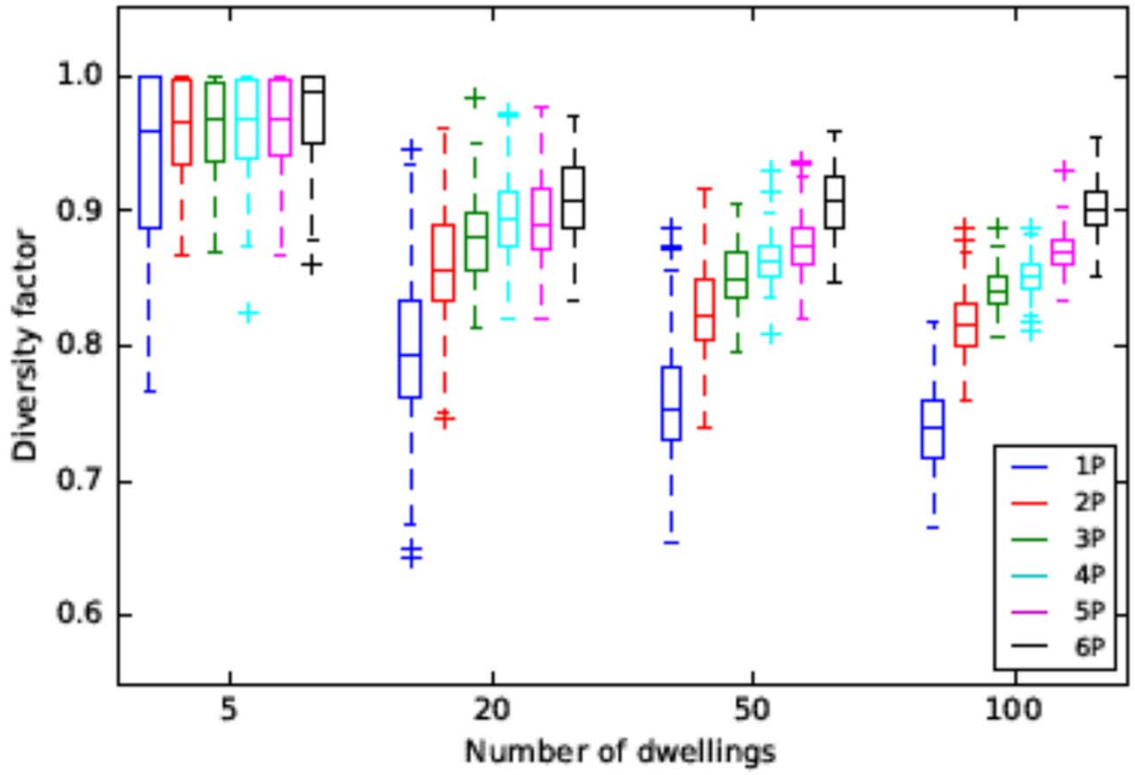
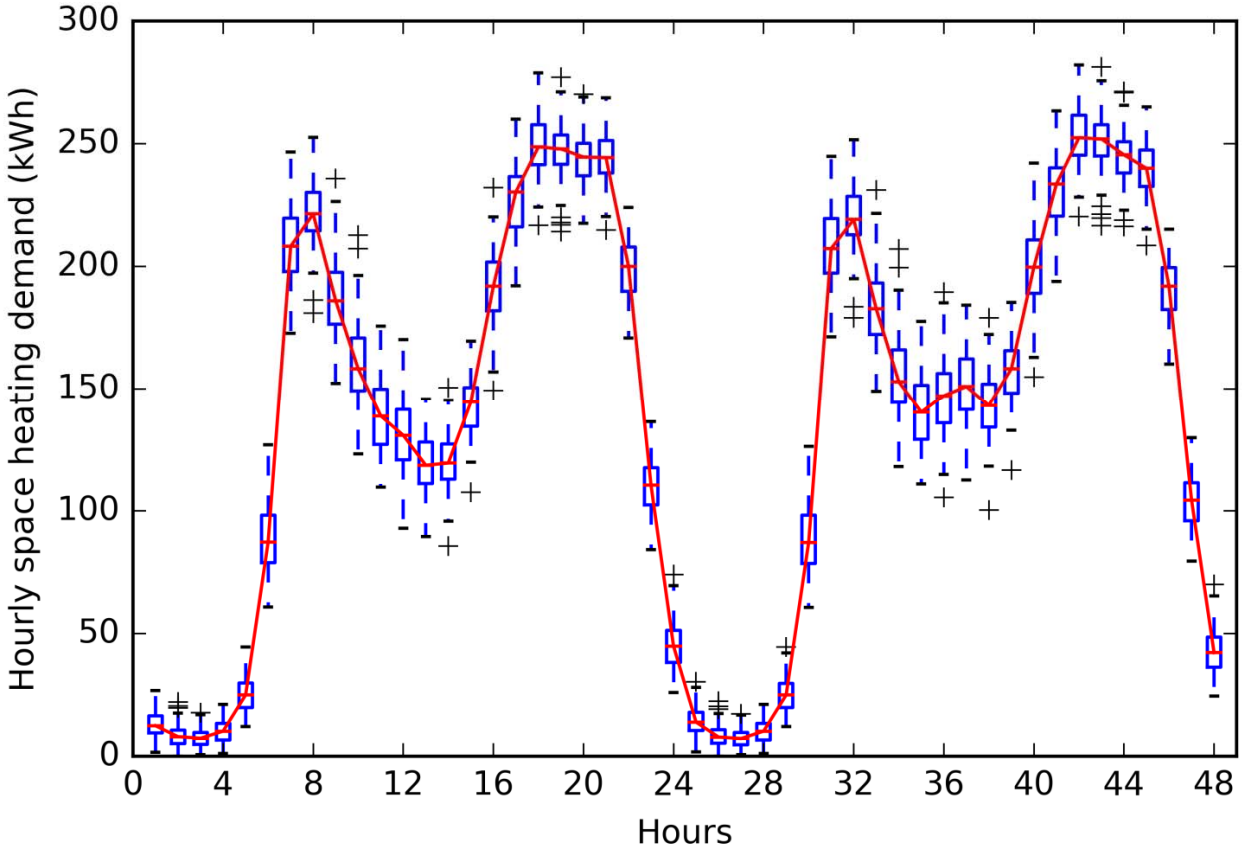
Result: space heating diversity factor

No. of simulation = 100



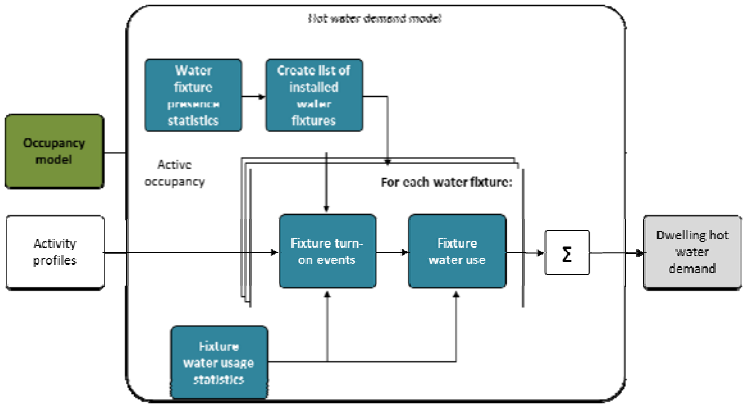
Result: hourly space heating demand

No. of dwellings = 100; No. of simulations = 100



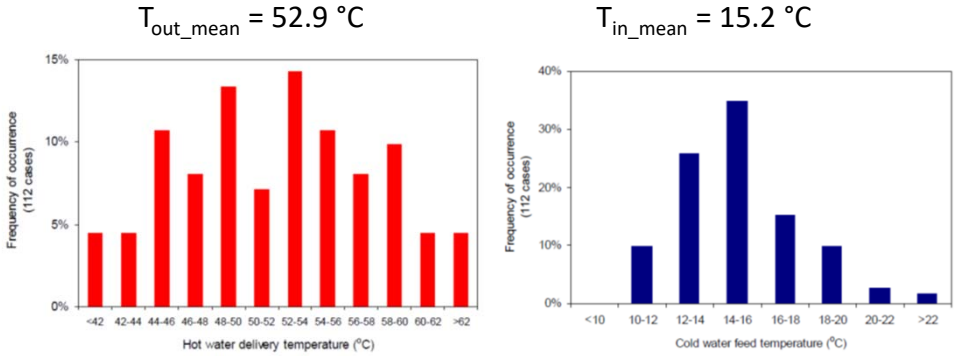
SCENe model: hot water

- Volume prediction: stochastic CREST Demand Model



(McKenna et. al., 2016)

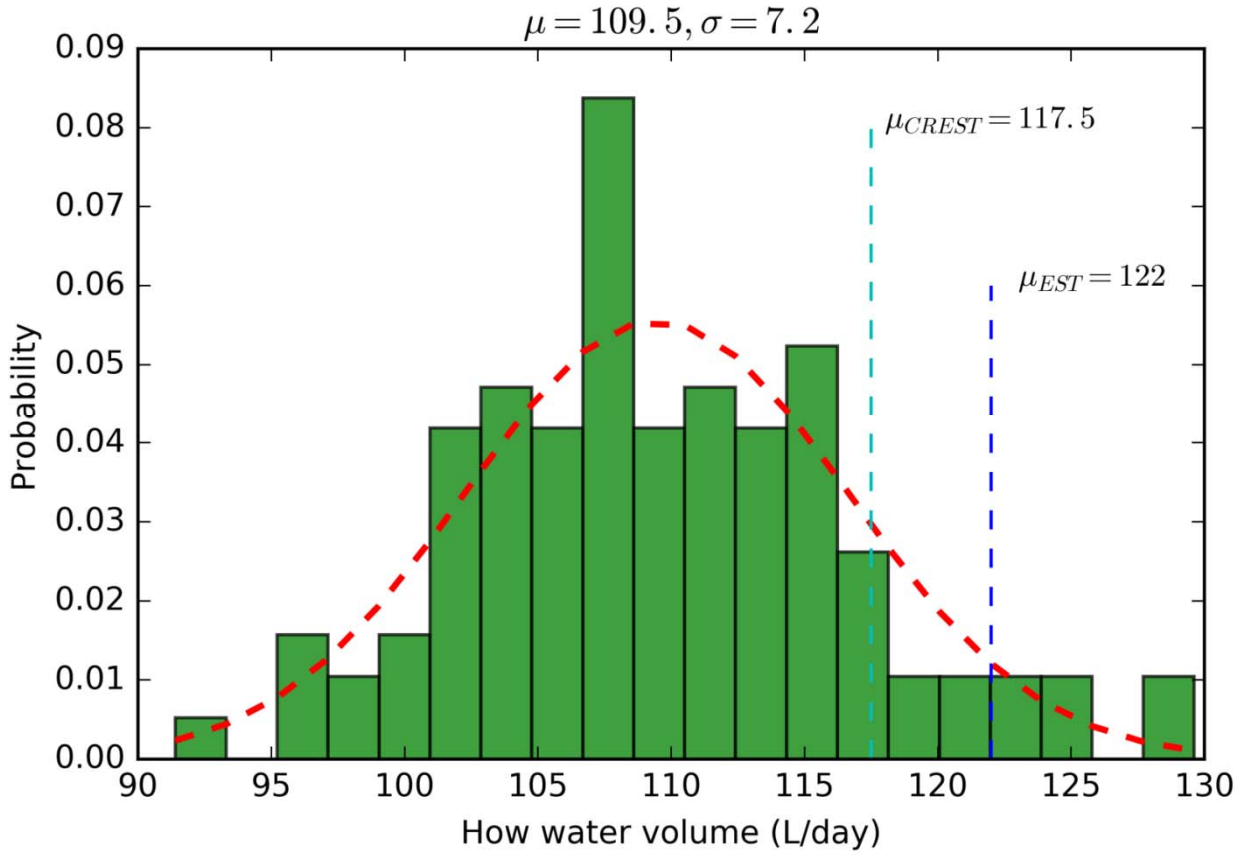
- Energy calculation: stochastic sampling measured outlet and inlet water temperatures



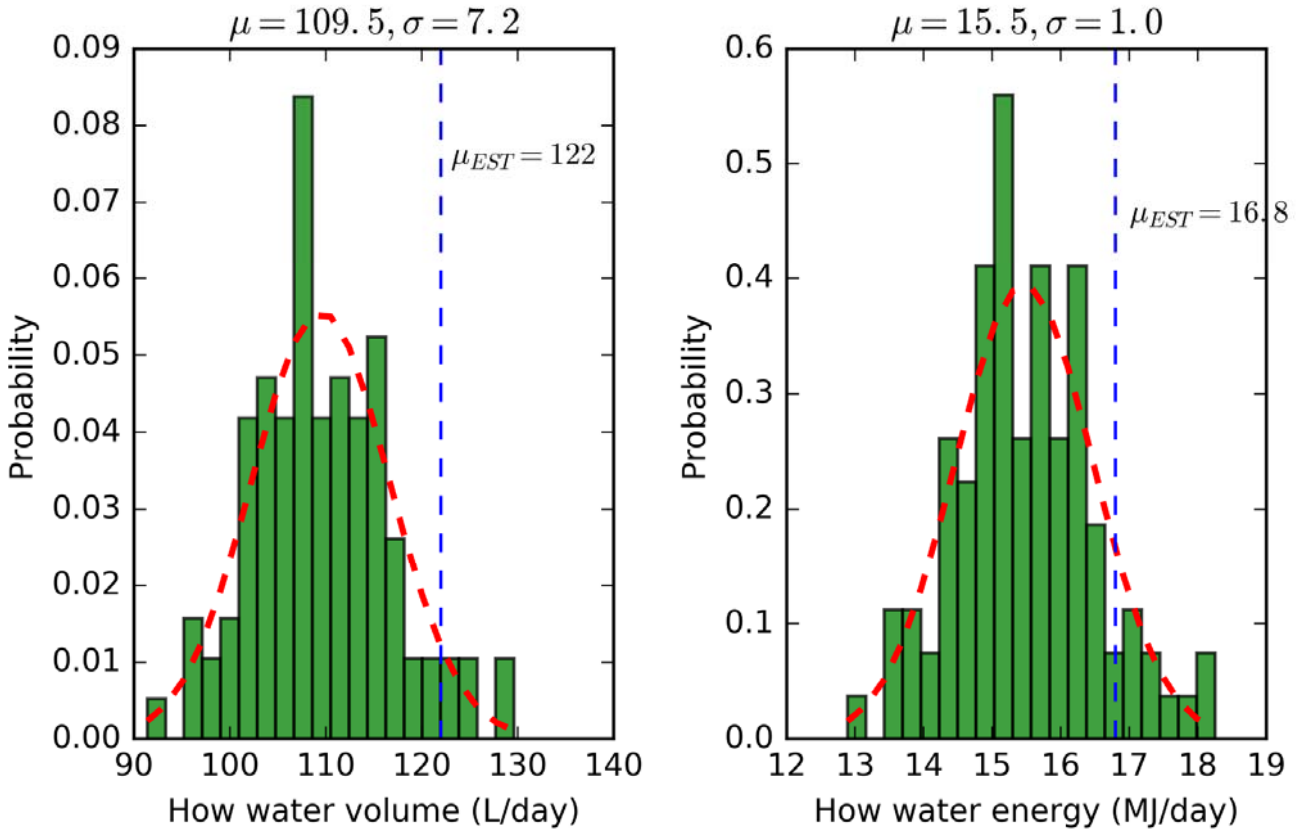
(Energy Saving Trust, 2008)

Result: hot water daily volume

No. of simulation = 100

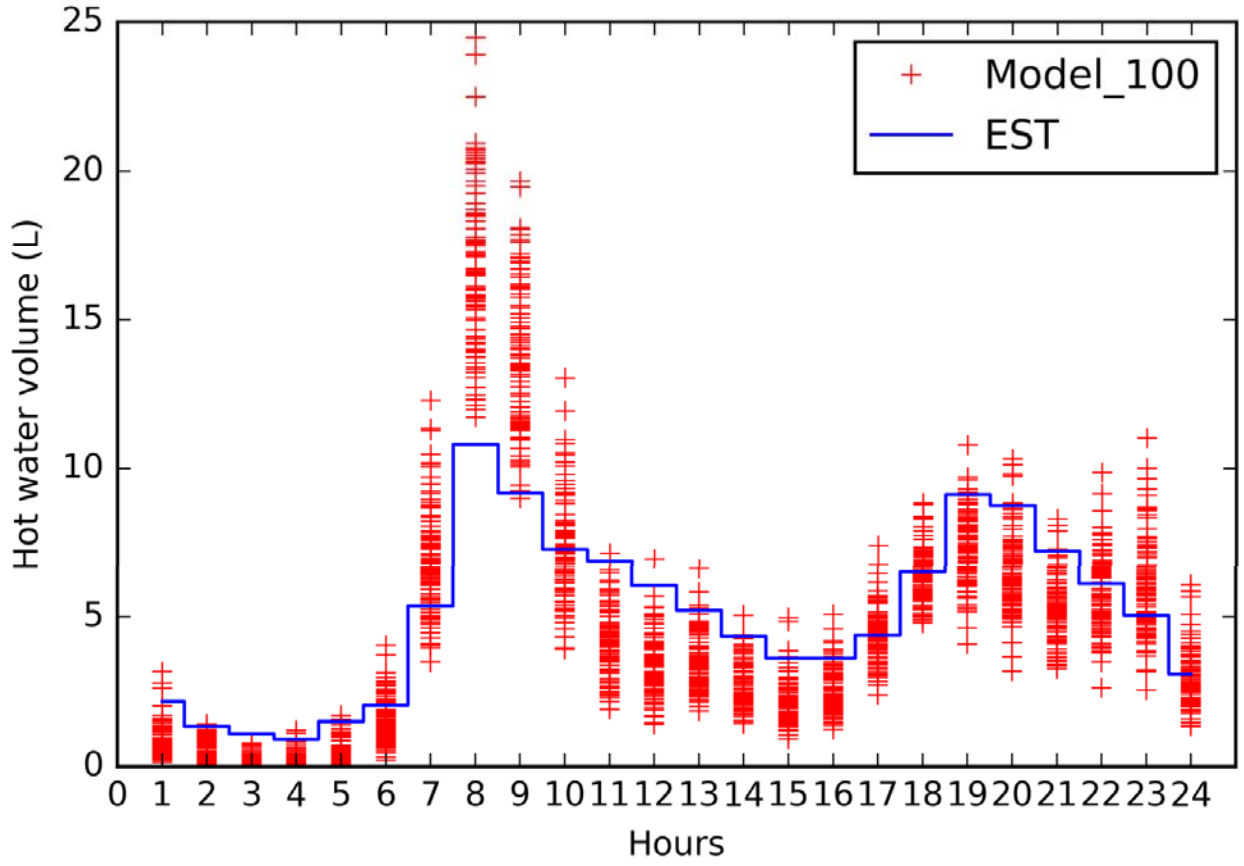


Result: hot water daily volume & energy



Result: hot water hourly volume

No. of dwellings = 100; No. of simulations = 100



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Result: hot water hourly energy

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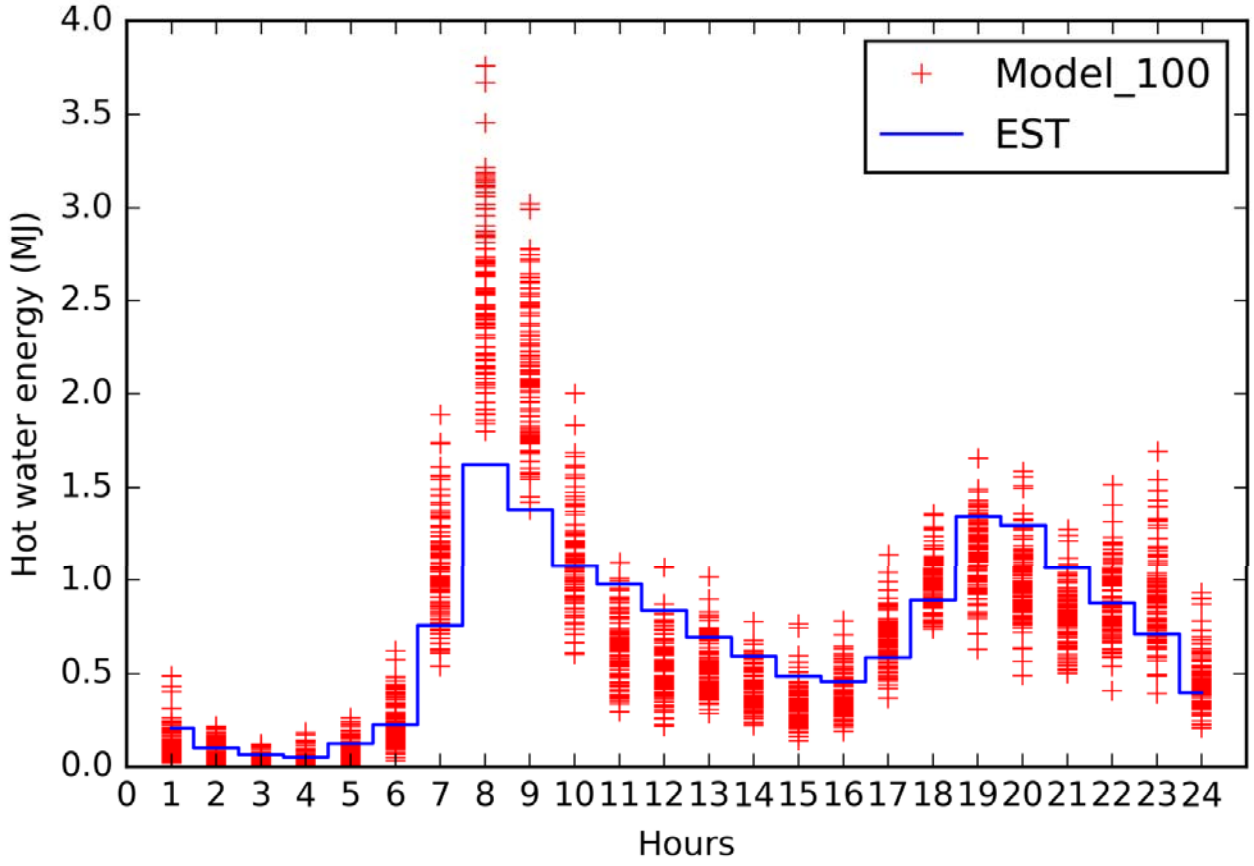

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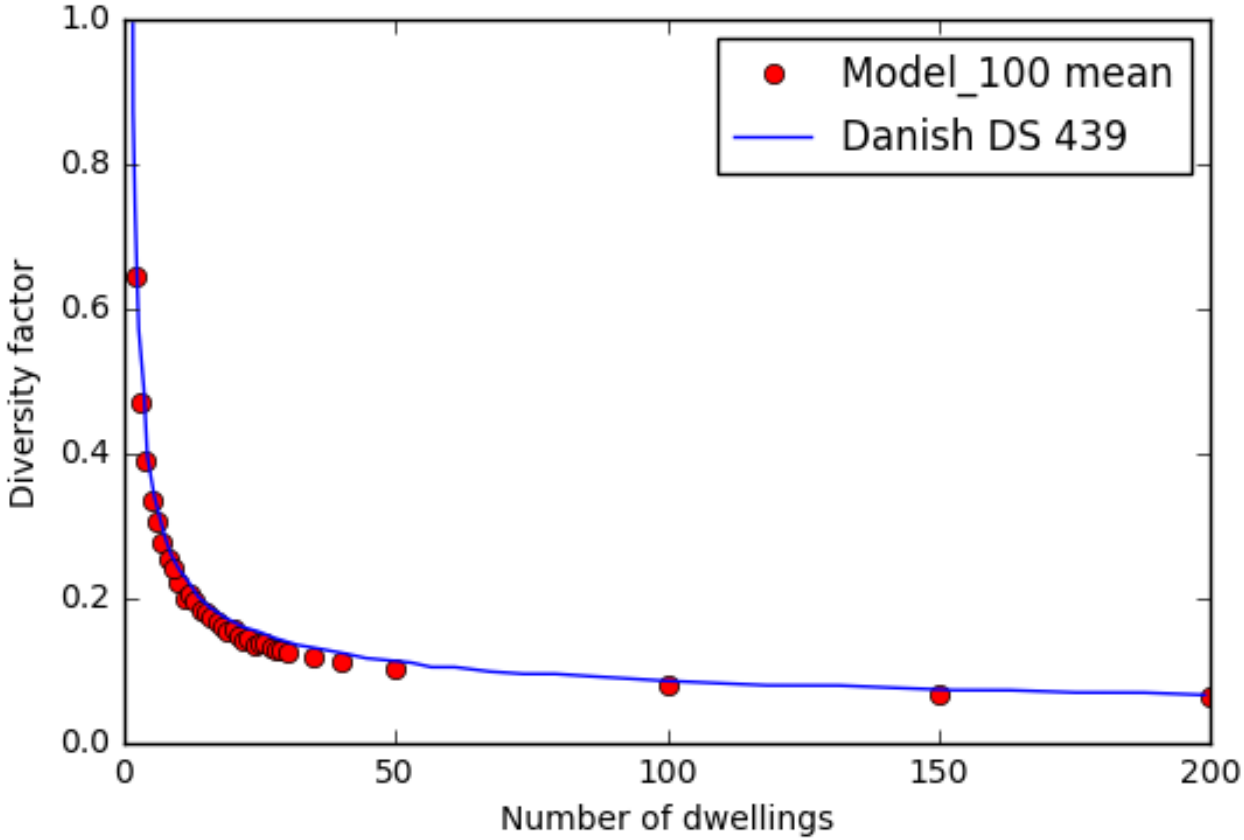
Result: hot water diversity factor

No. of simulation = 100



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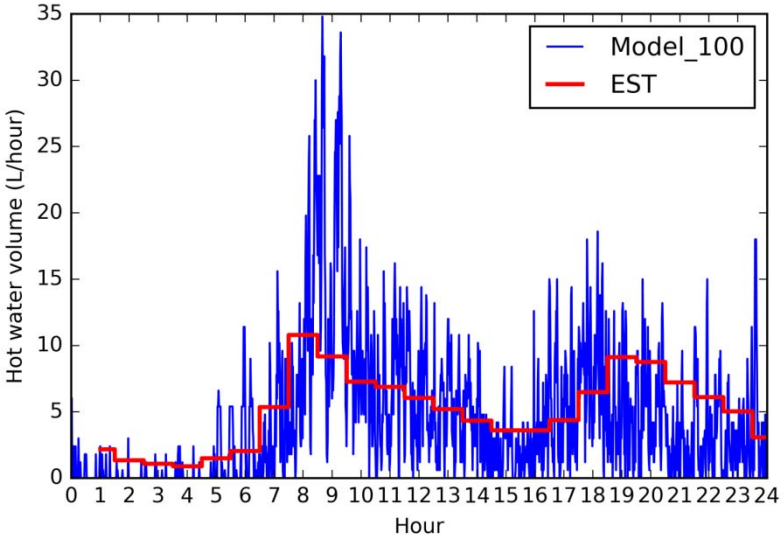
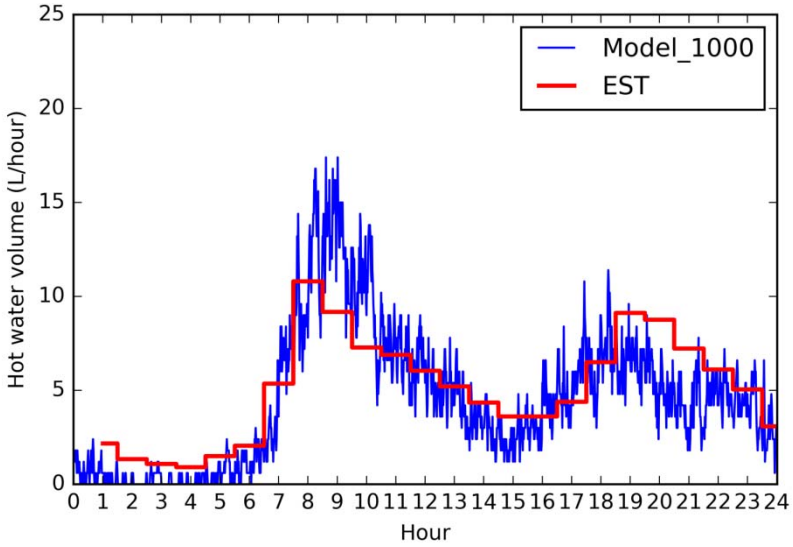
Result: hot water minutely volume



No. of simulation = 100



No. of simulation = 1000

Validation of models

- Using data measured at community and dwelling levels – future work

Summary

Aim: to improve the prediction of heat demand for designing a community heat network

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