

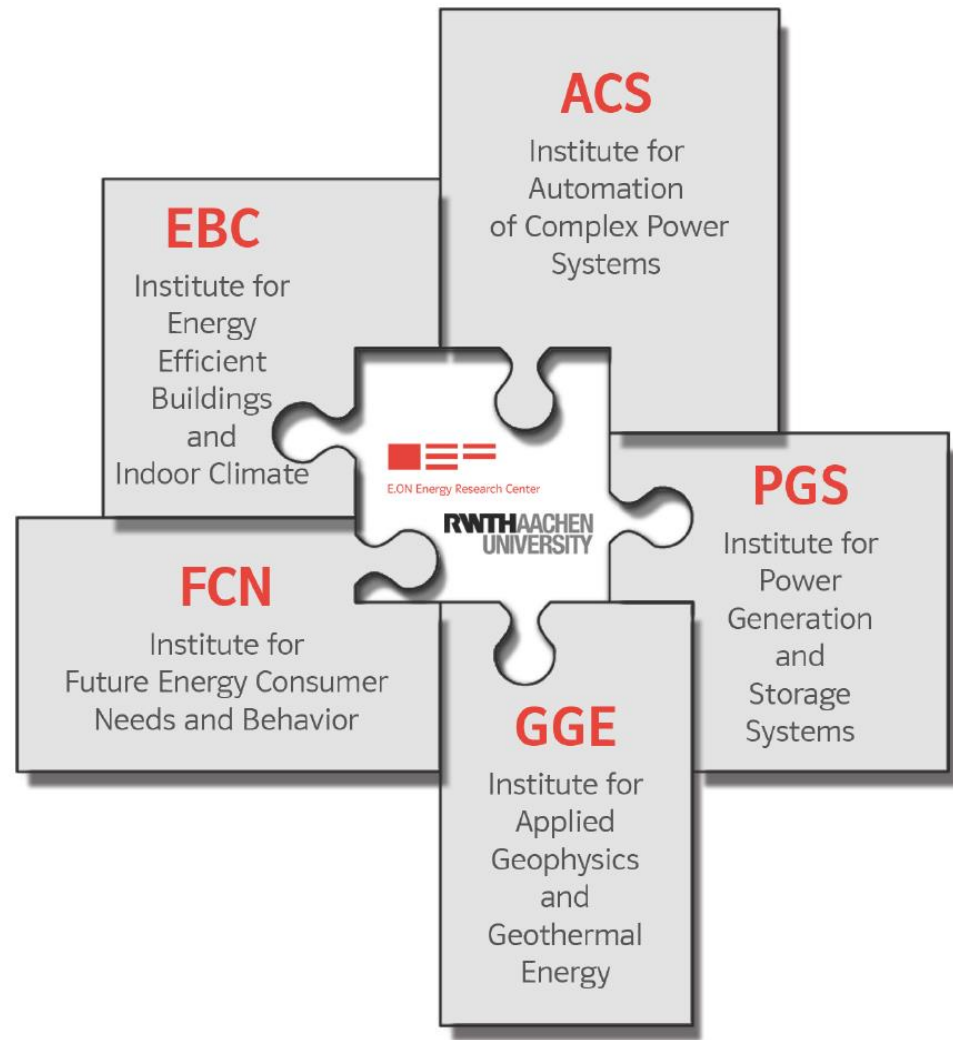


Dynamic Uncertainty Analysis of the Building Energy Performance in City Districts

4ème université de la Chaire éco-conception
PERFORMANCE DES OUTILS D'ECO-CONCEPTION
Sebastian Stinner

E.ON Energy Research Center

- June 2006: the largest research co-operation in Europe between a private company and a university was signed
- Five new professorships in the field of energy technology were defined across 4 faculties
- Main Research Areas:
 - Grids and Storage
 - Buildings and City Districts
 - Heat and Power Generation



E.ON Energy Research Center

Energy Concepts for Buildings
and Communities

Room Air Flows, Thermal Comfort
and Indoor Air Quality

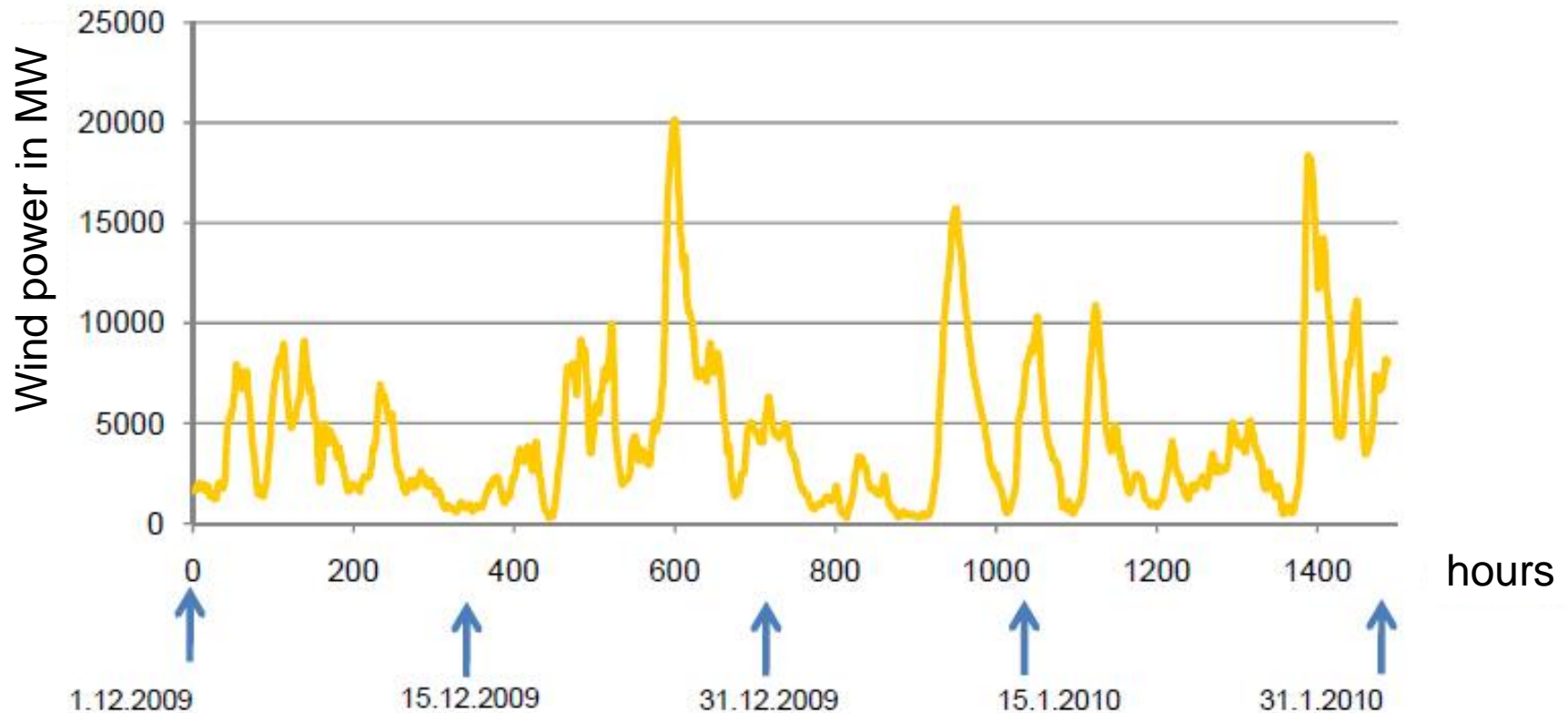
Heating and Air-conditioning components

Generation and Storage Systems

Energy Efficient Cities



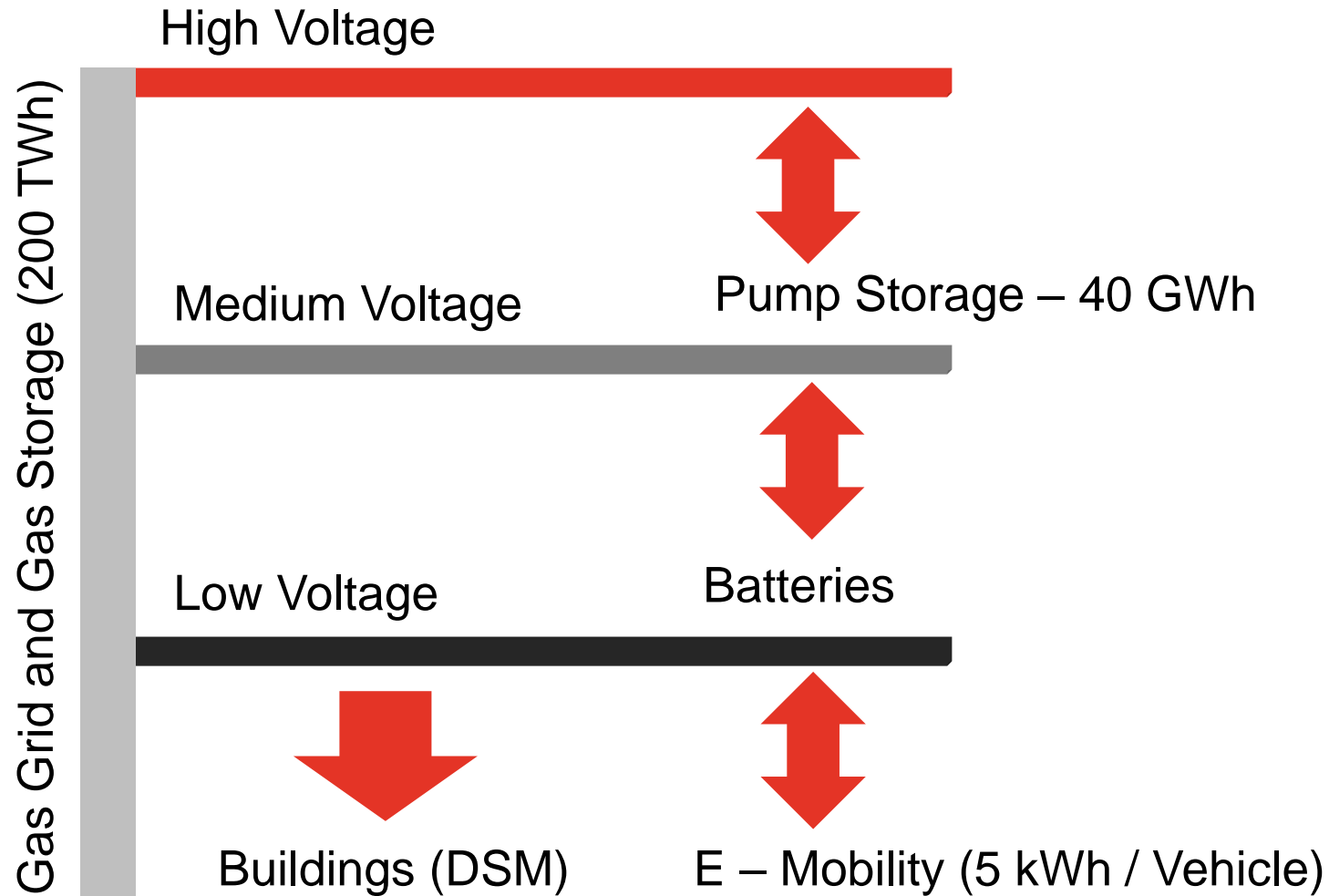
Future Power Generation – „Energiewende“



Wind power max. 20.000 MW, min. 270 MW

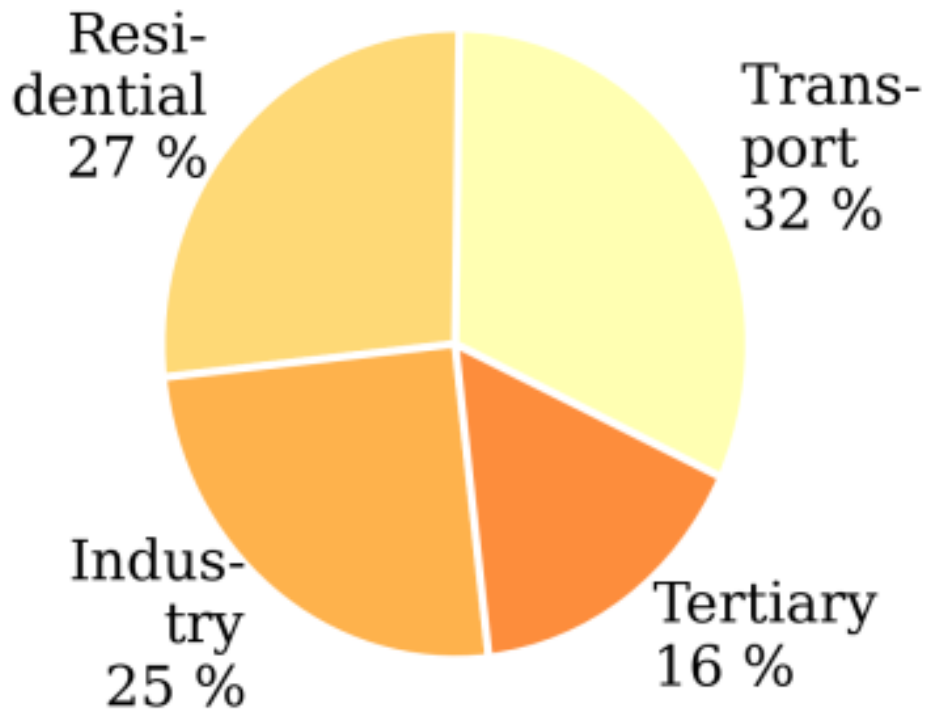
Source: Erneuerbare Energien 2010. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), 2010 / DENA – presentation at the energy operators meeting 2010 in Heiligendamm

Energy Storage Systems in Germany

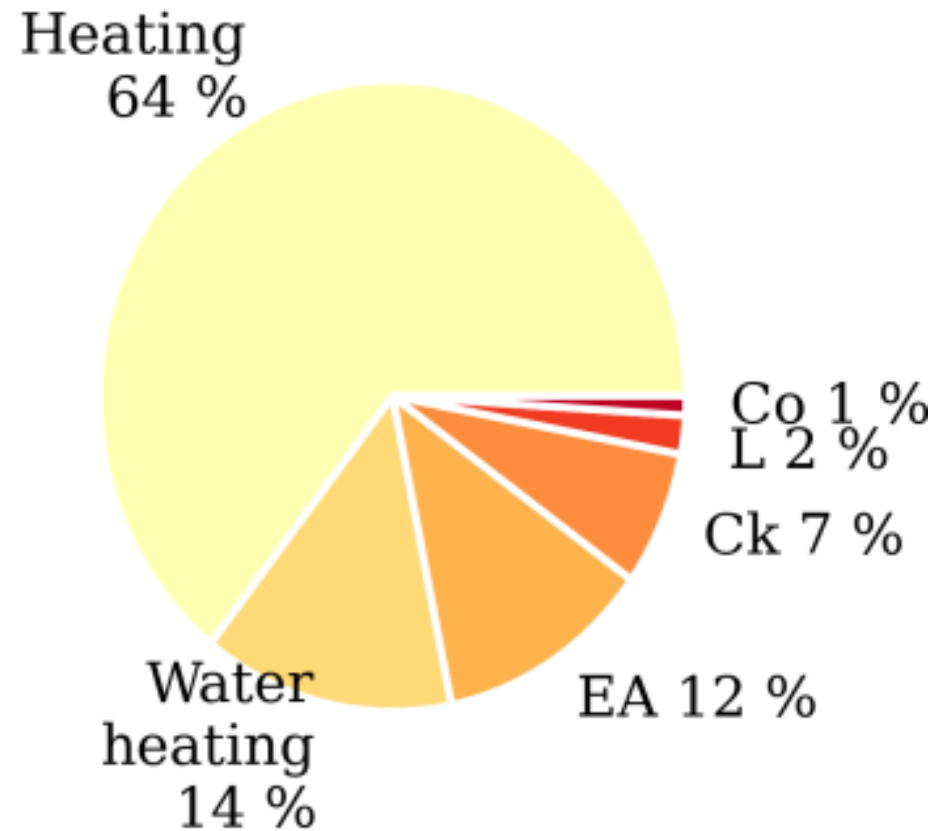


Energy Demand in Germany

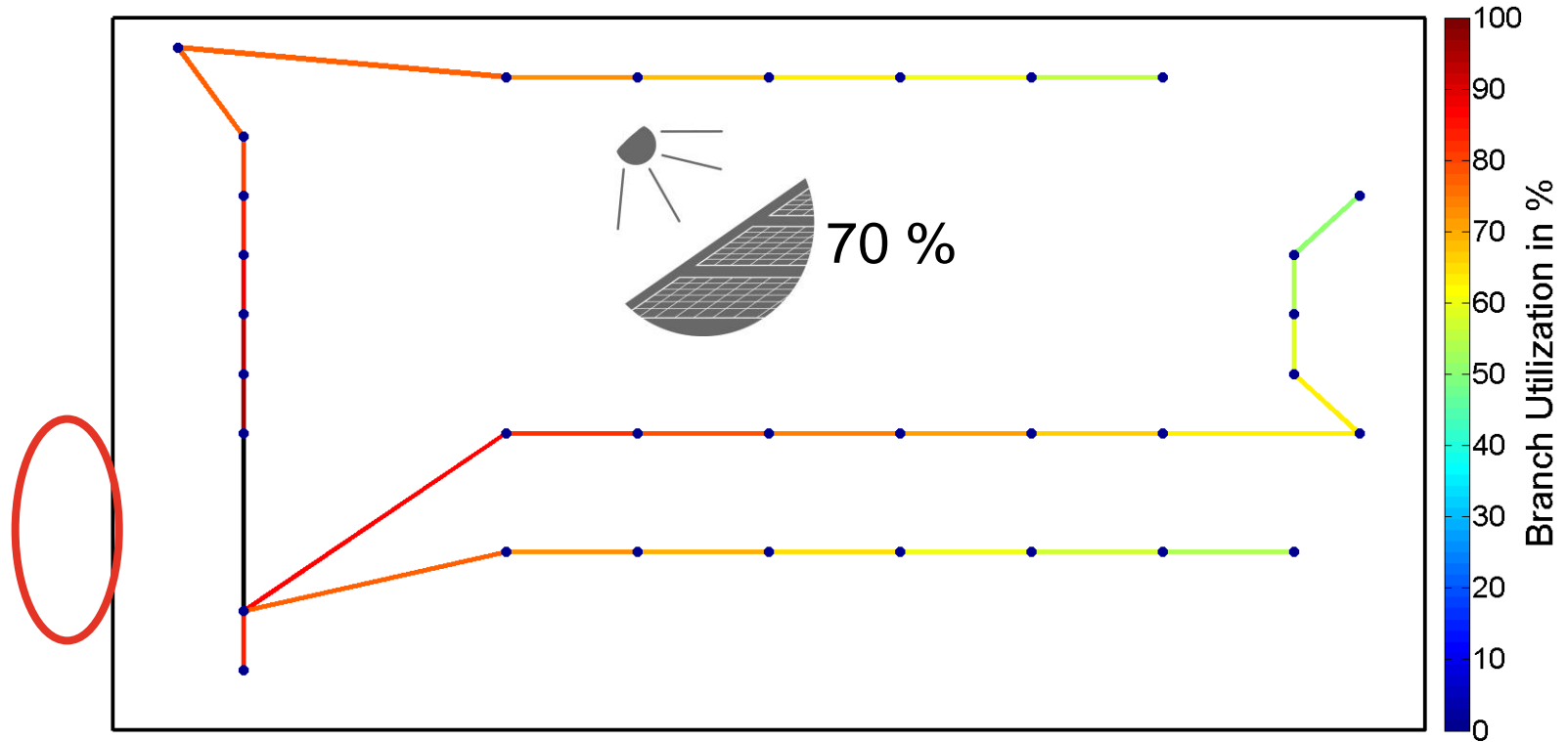
FED by Sector



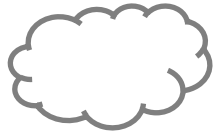
Residential Use



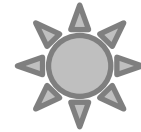
Why are we interested in City Districts?



What did we analyze?

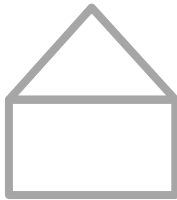


Weather conditions
(hot, medium, cold)



Indoor air temperature
Air exchange rate
Inner loads
Dynamics

100



Thickness of insulation
Material properties
Nr. of buildings in class
Refurbishment status

100



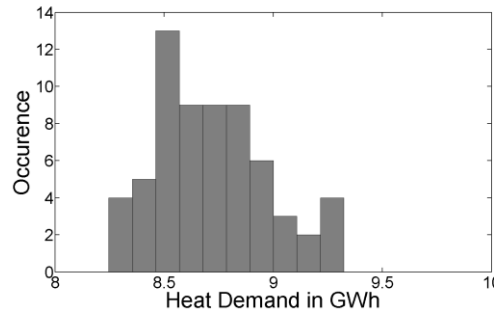
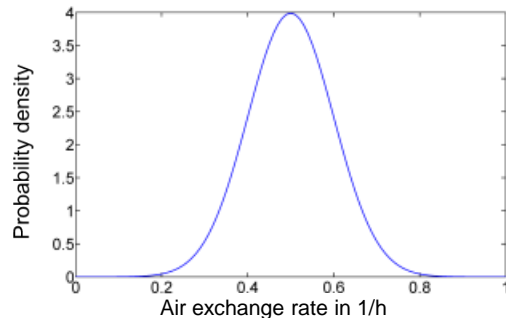
Basics – Quasi Monte Carlo (QMC) Method

Classical Monte Carlo

Estimate
Uncertainties in
Parameters

Draw Random
Numbers

Do a **High**
Number of
Simulations



Get Uncertainty
in Target Figure

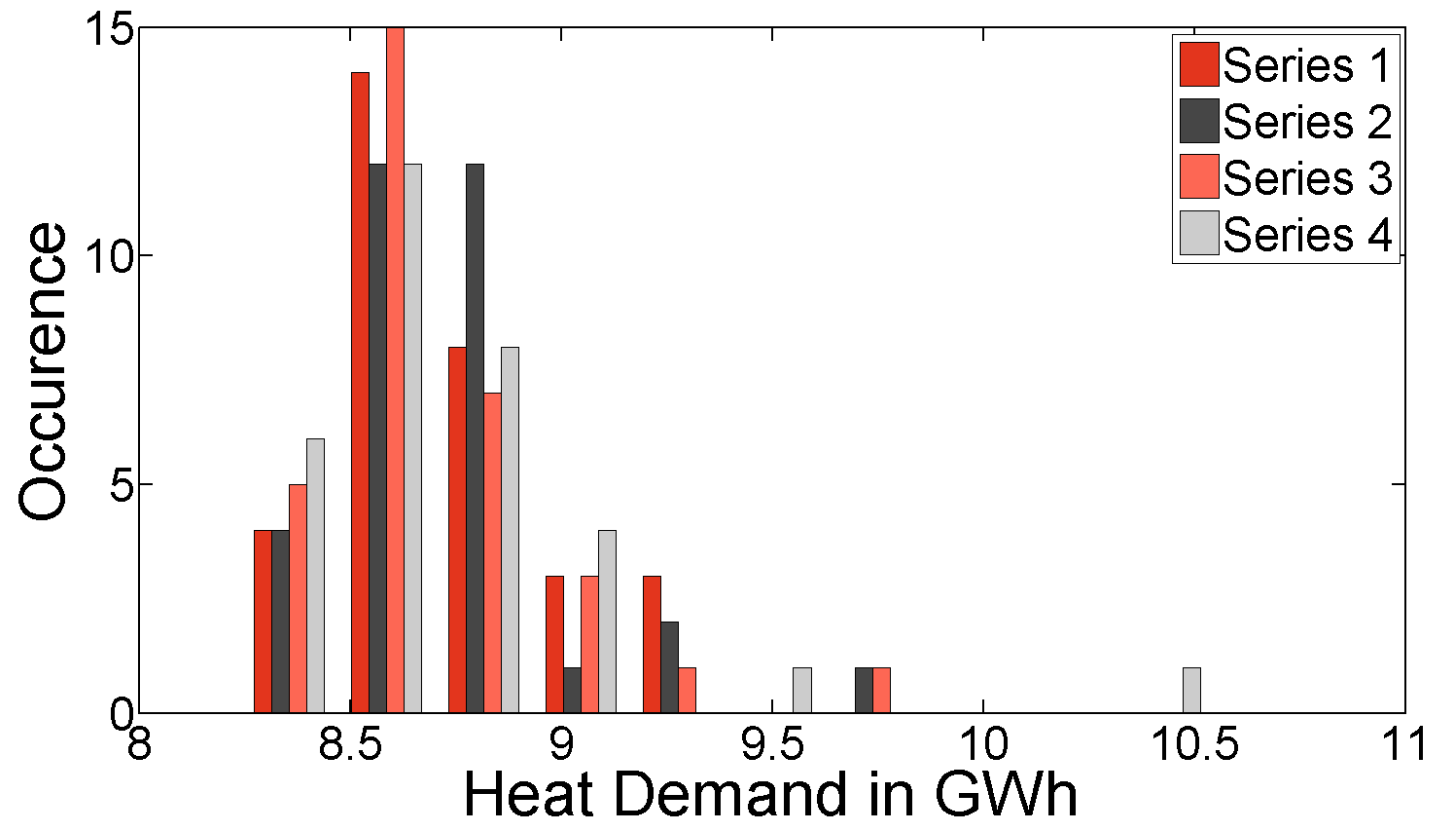
Estimate
Uncertainties in
Parameters

Sampling
Algorithm

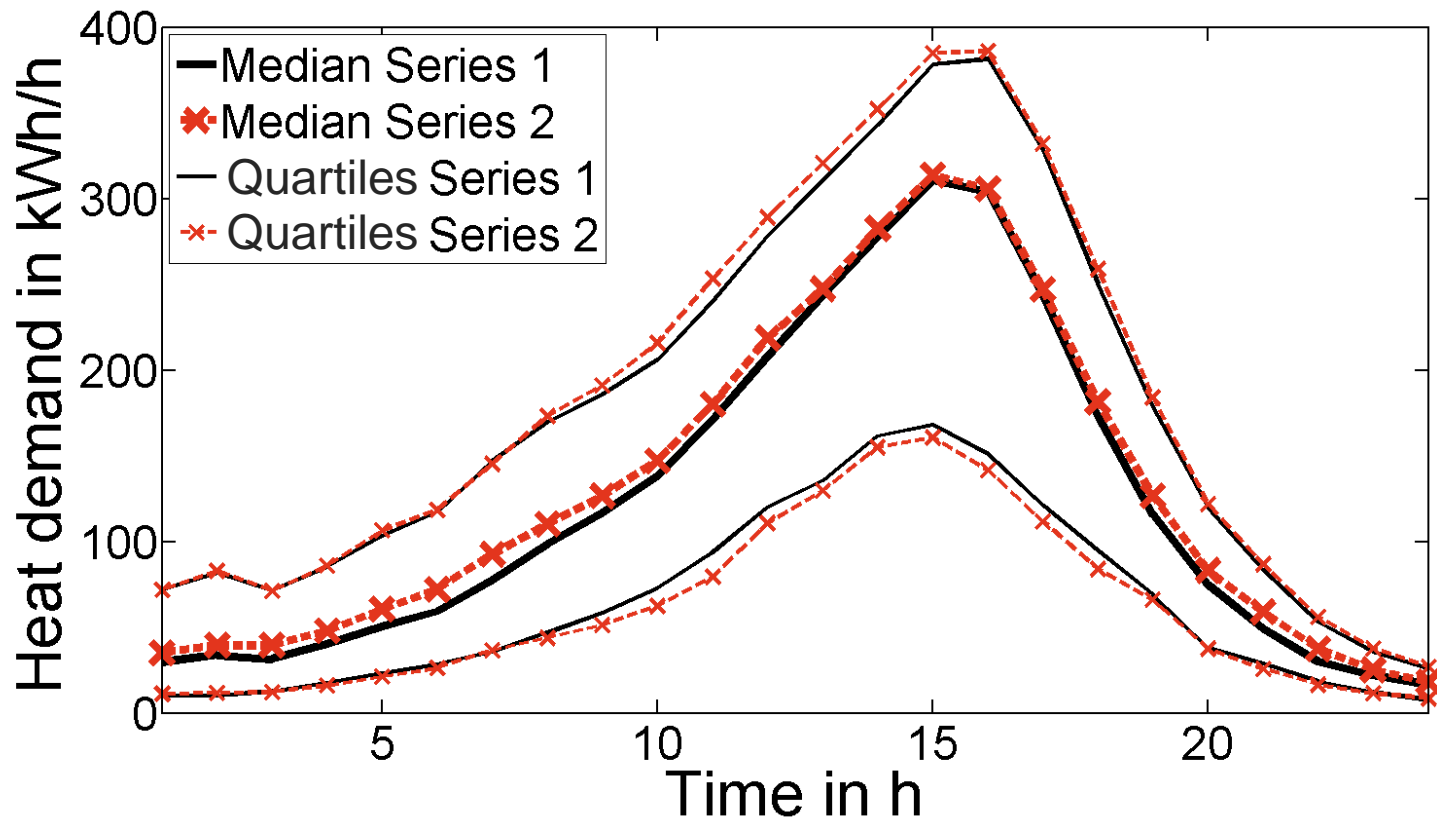
Do a **Low**
Number of
Simulations

Quasi Monte Carlo

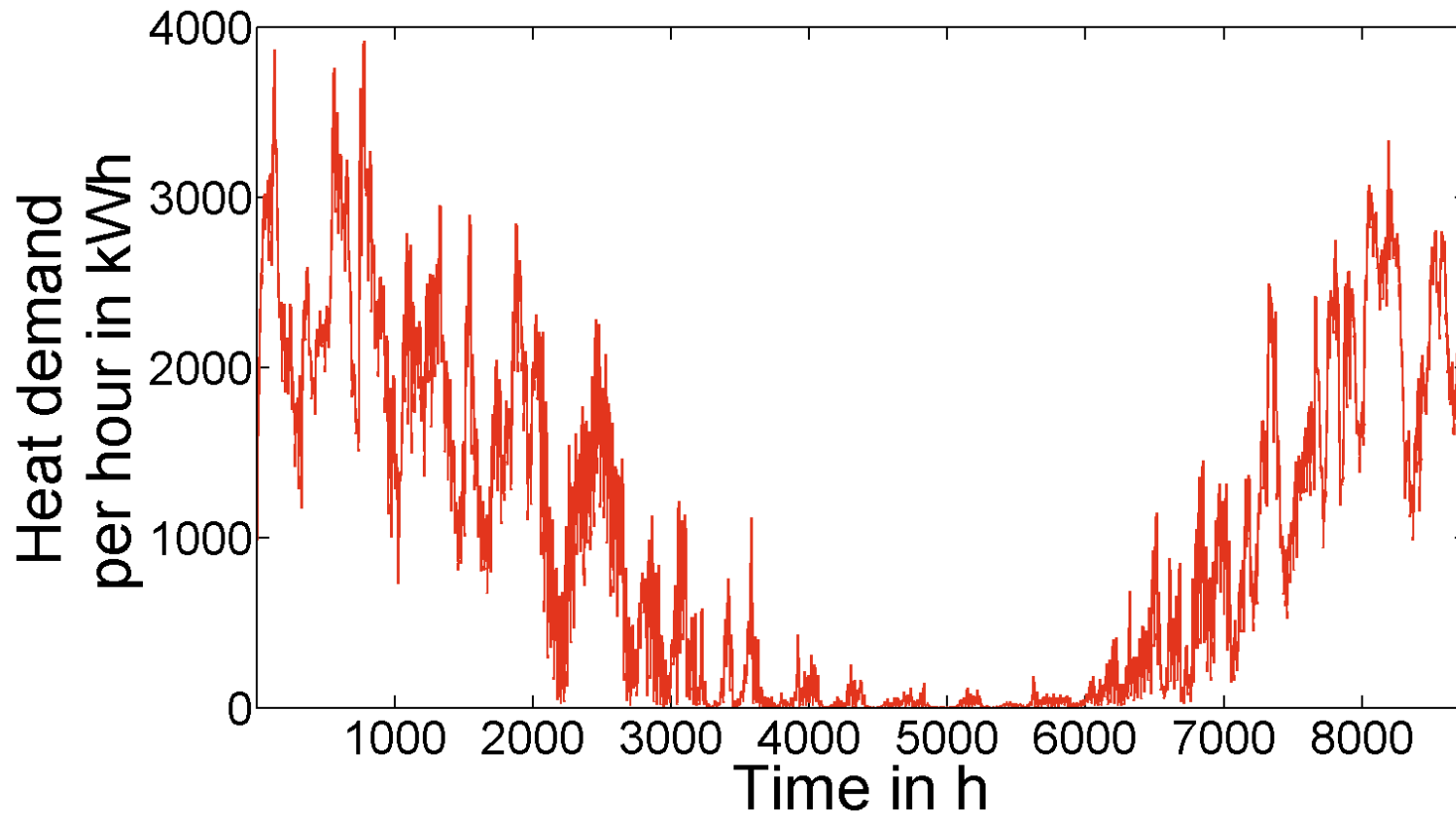
Challenge – Total Annual Heat Demand



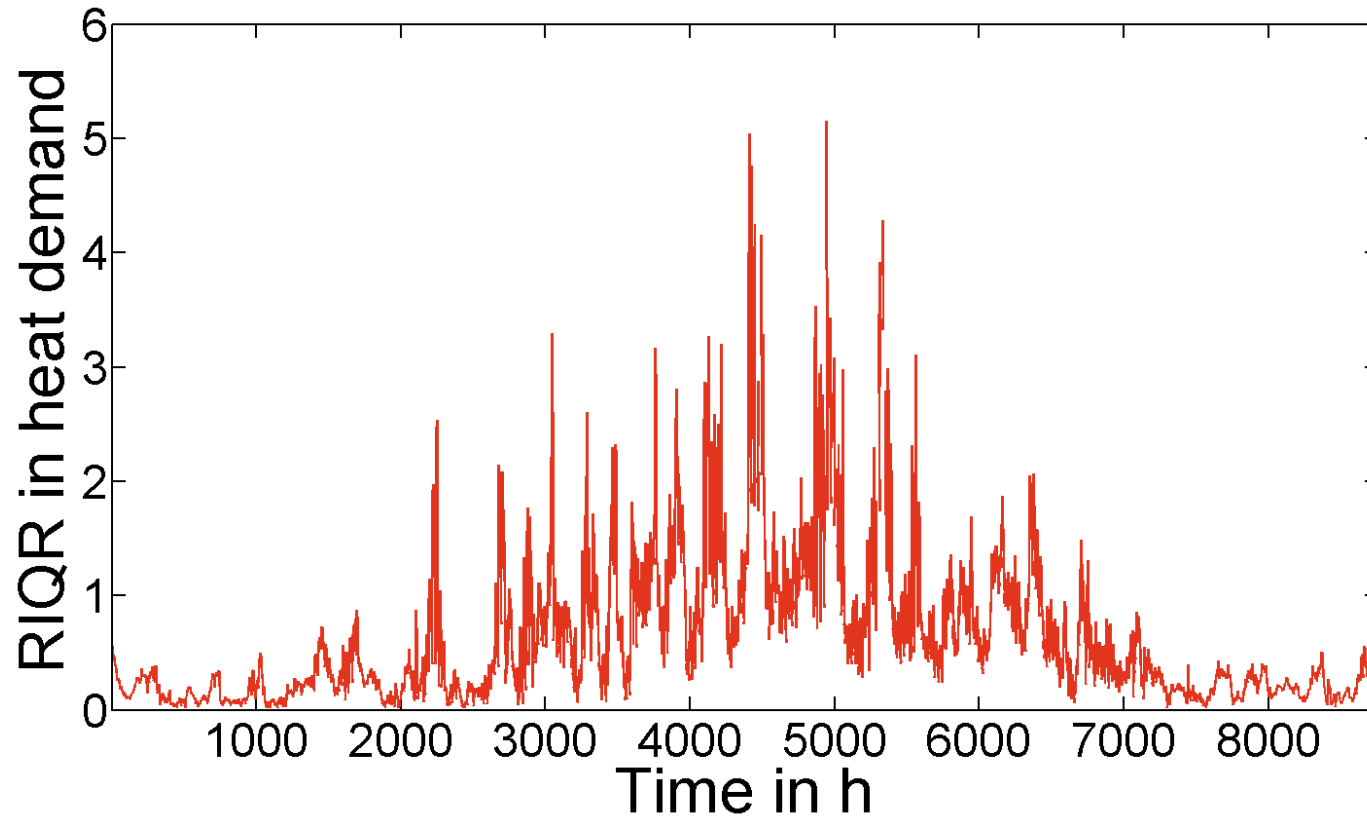
Challenge – Dynamic Heat Demand („Summer“ Day)



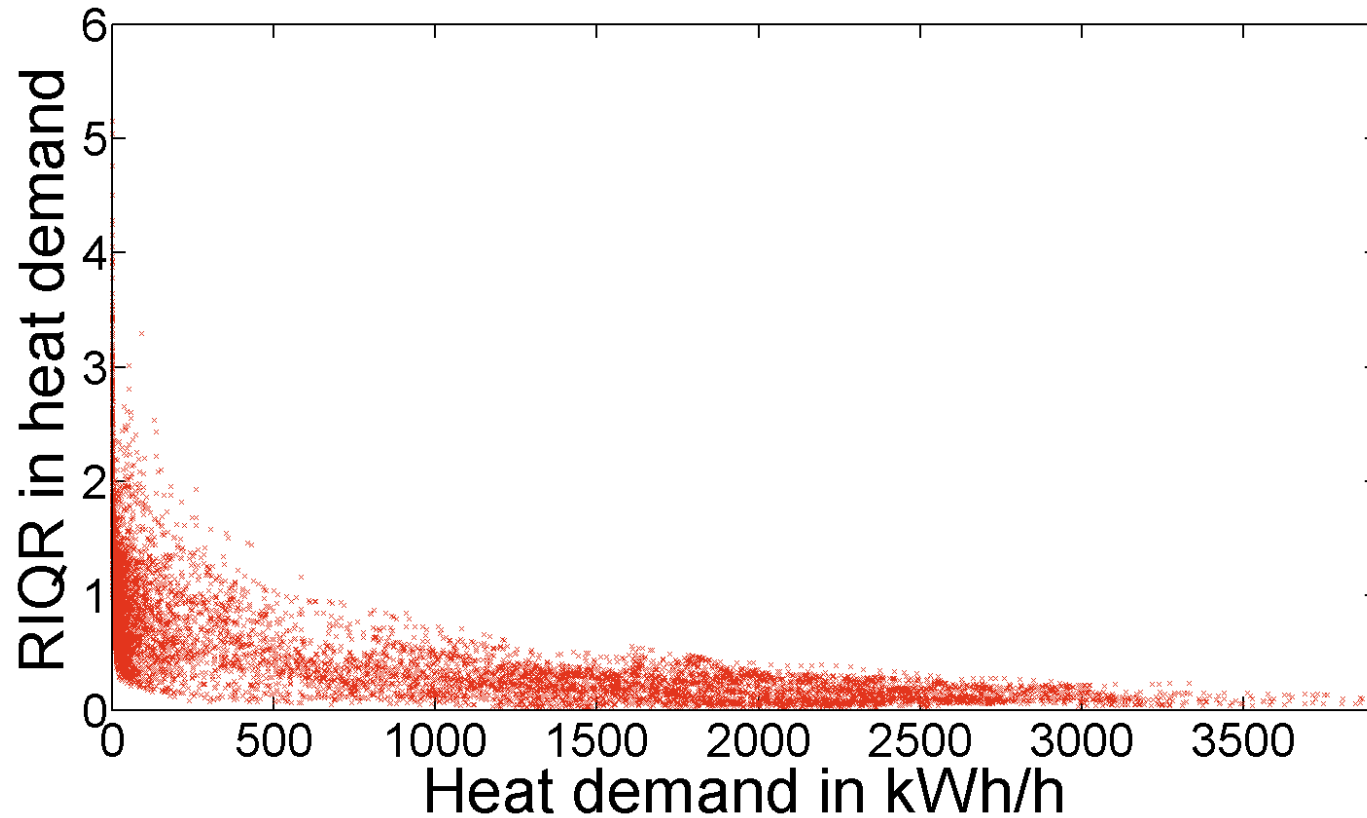
Median of Dynamic Heat Demand



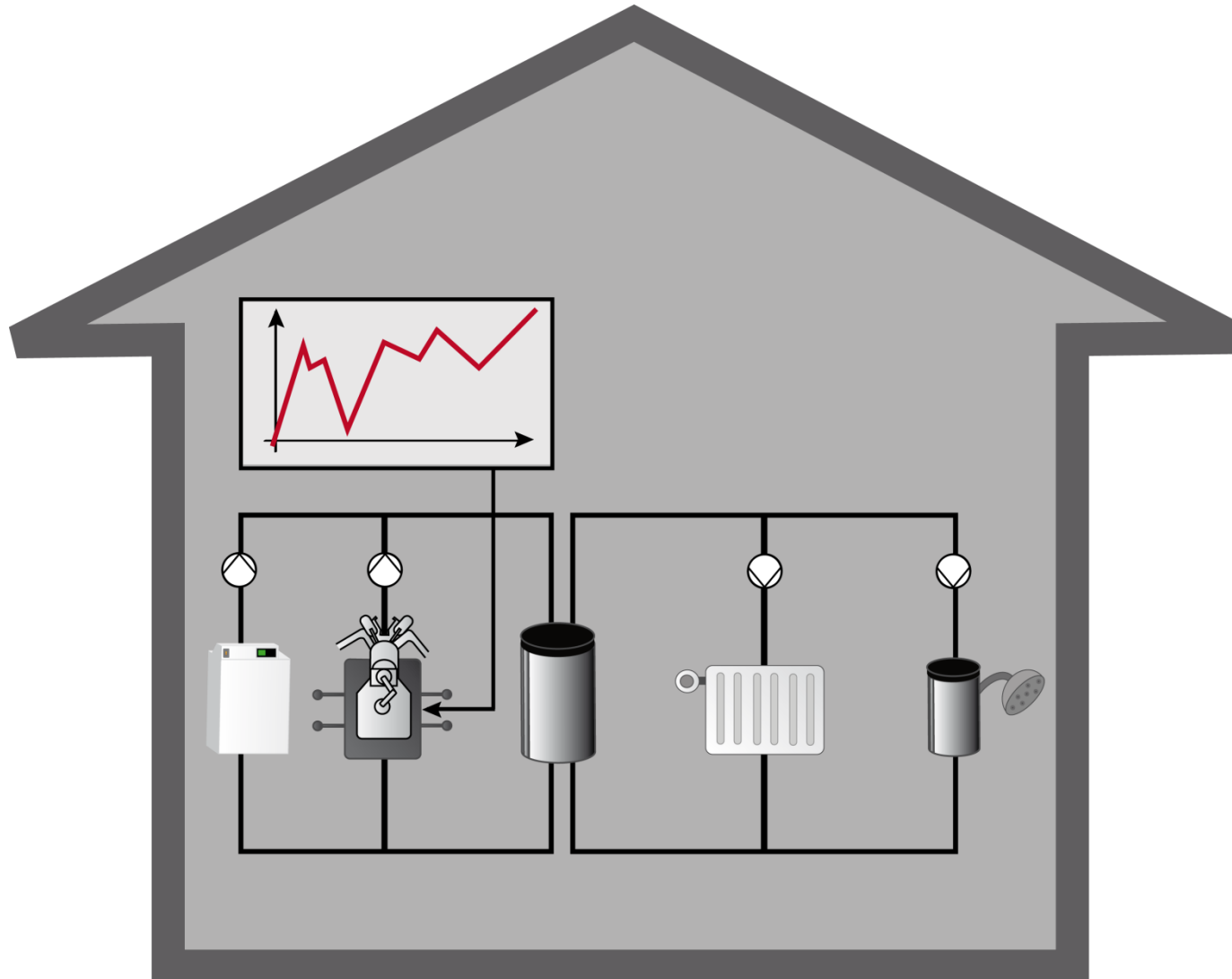
RIQR of Dynamic Heat Demand



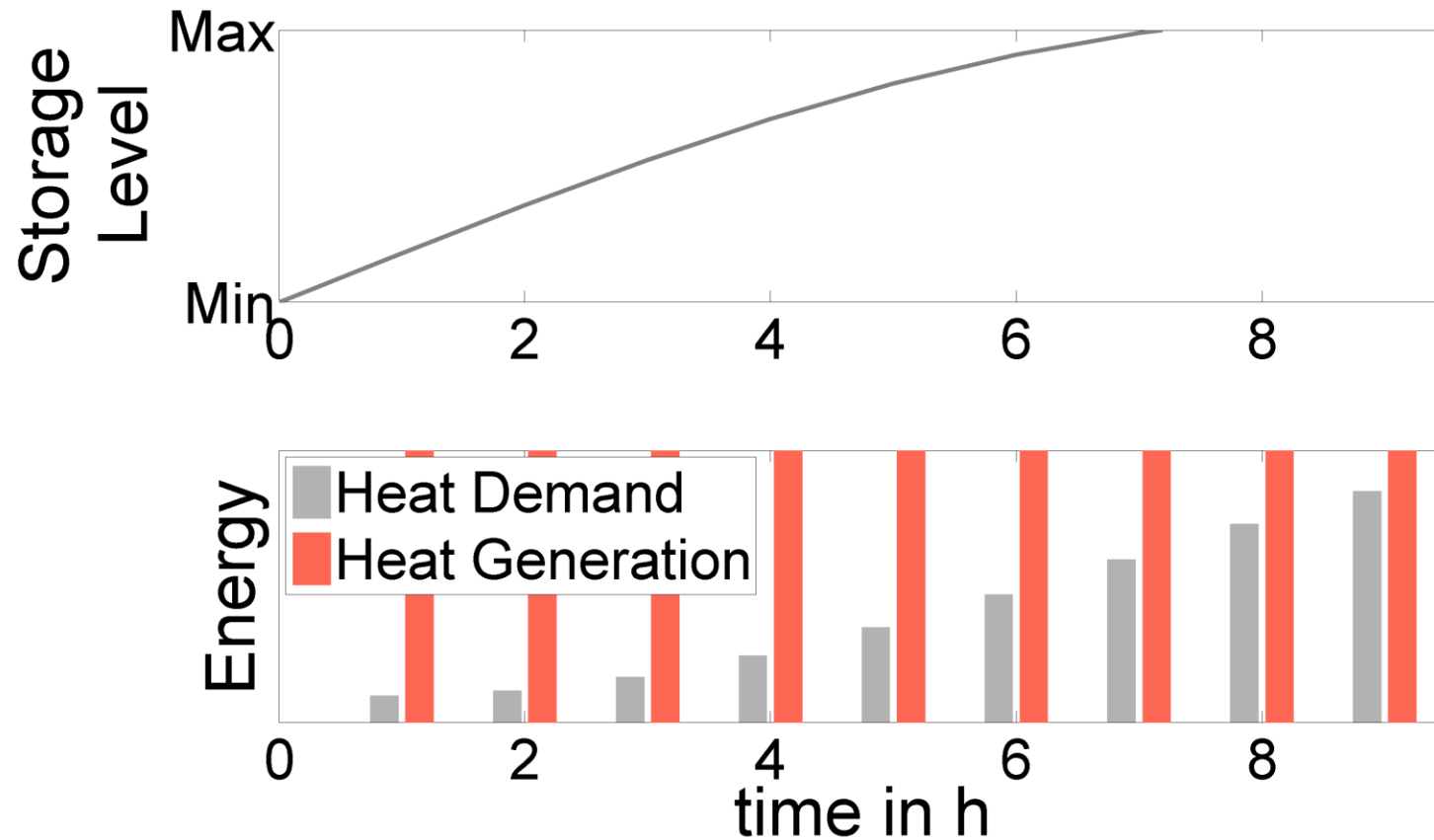
Influence of Heat Demand on RIQR



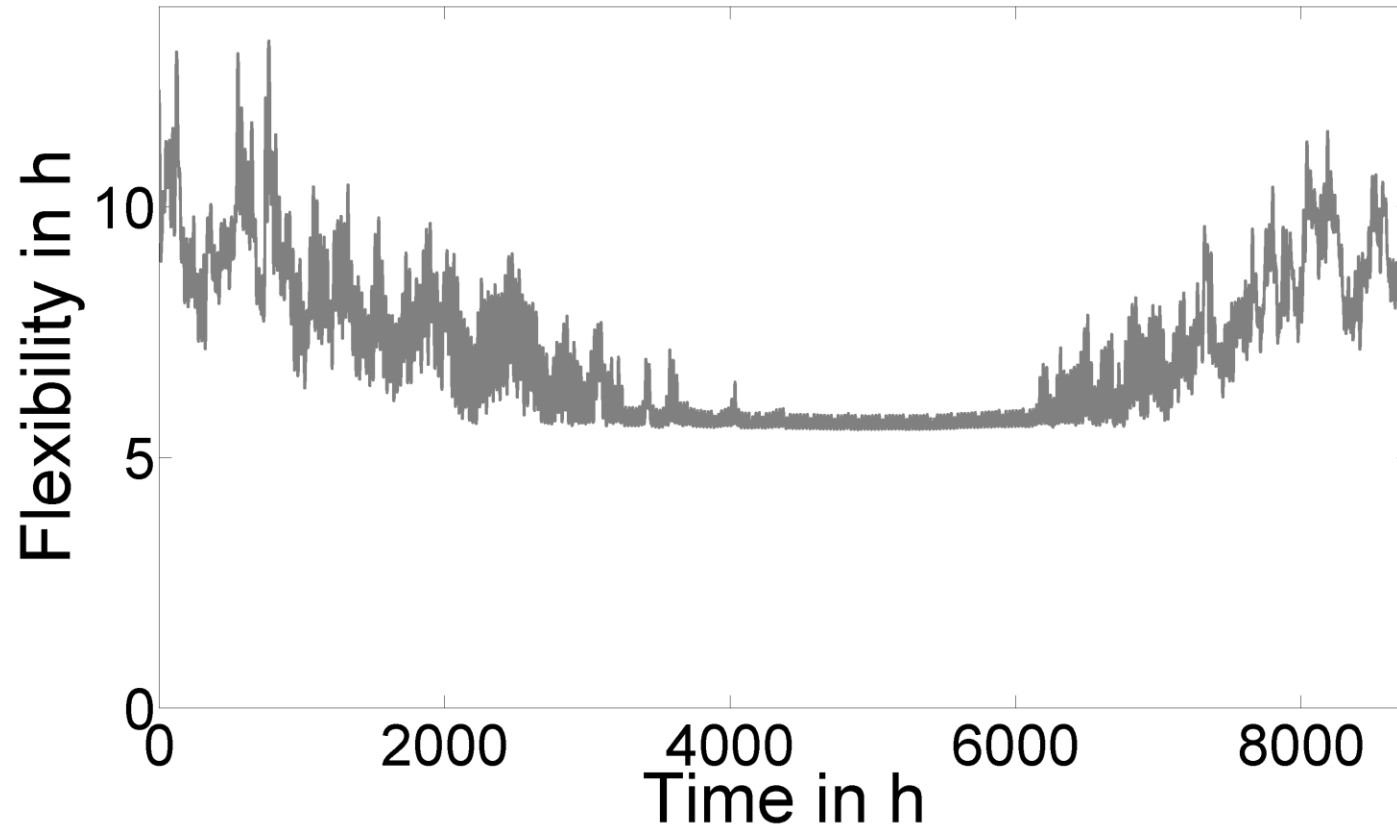
Integration of HVAC technologies



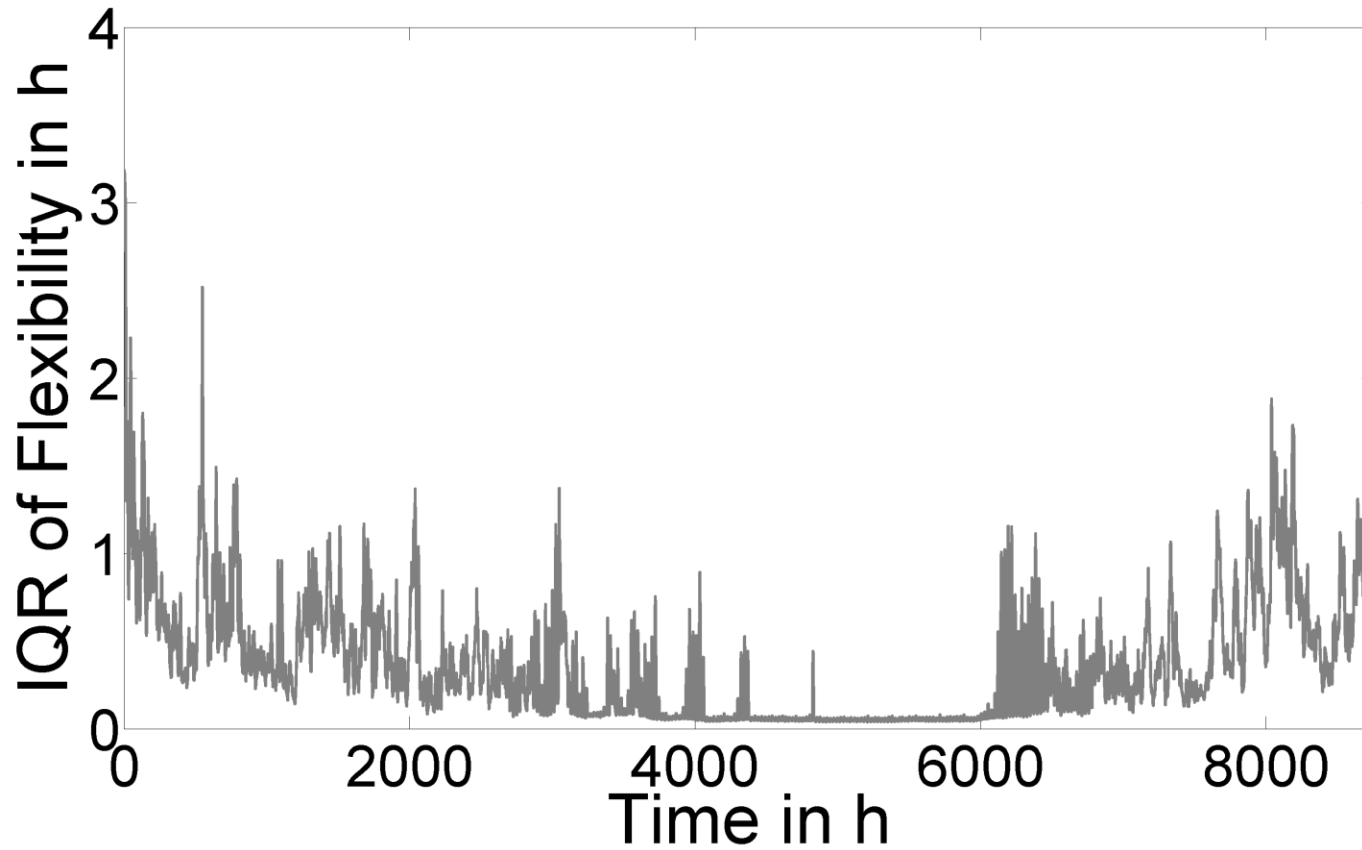
Offering flexibility to the electrical grid



Median of Flexibility



IQR of Flexibility



Conclusions & Further Work

Conclusion

- Extension of global uncertainty analysis to city district level
- Dynamic uncertainty analysis
- Decreasing relative uncertainty with higher heat demand
- Uncertainties do not disappear due to the analysis of city districts
- Quantification of uncertainties in flexibility important for future integration of renewables

Further Work

- Statistical tests
- Influence of composition of district
- Integrate City District and Flexibility applications
- Influence on available storage capacity

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Application to Every Type of Distribution

