POOLING OF HEAT PUMPS

Short Overview and Simulation Results

Danny Günther, David Fischer

Fraunhofer-Institute for Solar Energy Systems ISE, Freiburg

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Workshop on Smart HPs

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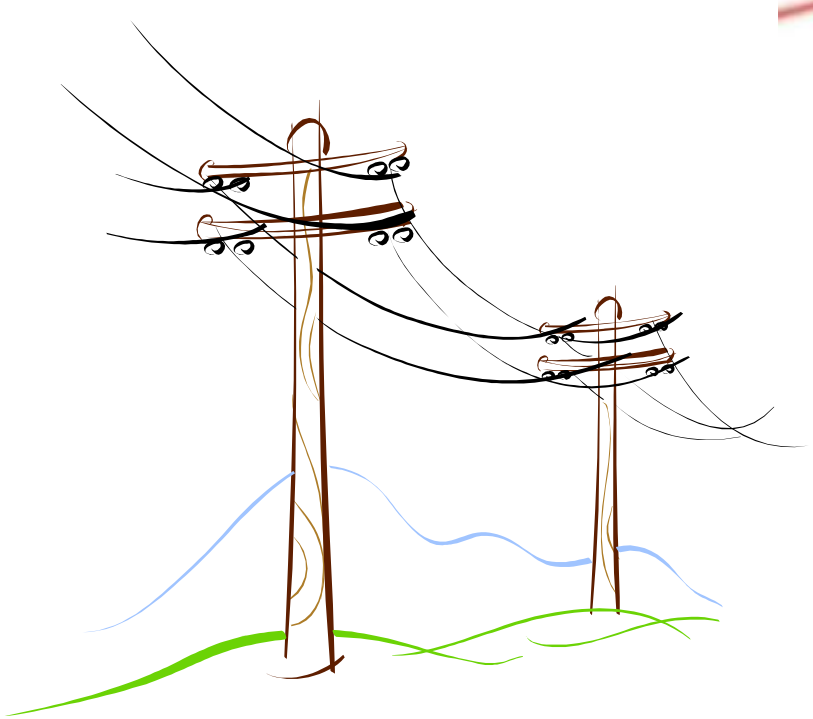
Why do we need smart grids and smart devices

Demand priority vs. supply priority



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Reasons for Pooling
Business Cases and Restrictions

- Examples for Business Cases
  - Reserve Markets (e.g. primary, secondary)
  - Intraday or Spotmarket (day ahead)
  - Reduced Grid Fees

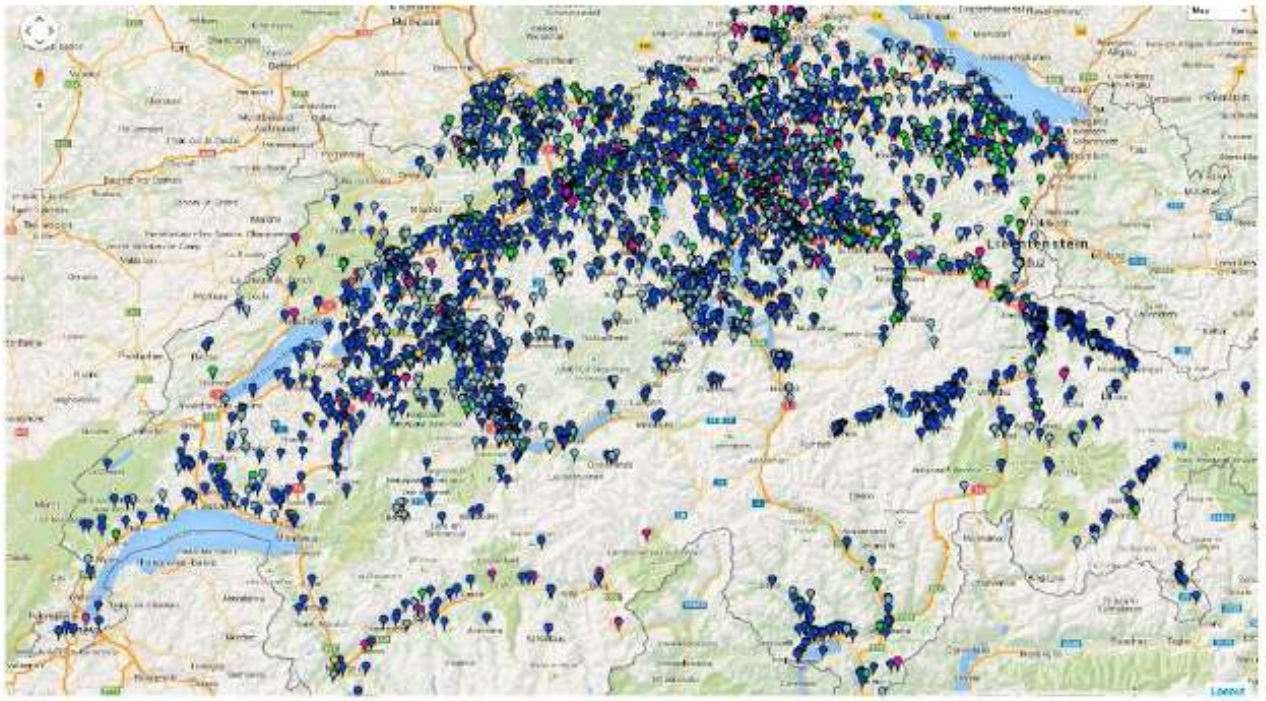
- Minimum capacities for reserve markets (in Germany)
  - 5 MW for secondary (5 min) and tertiary (15 min)
  - 1 MW for primary (30 sec) reserve market

Pooling of Heat Pumps
Few Questionmarks (on the Way to Standardization)

- Communication (unidirectional vs. bidirectional)
- Interfaces and protocols
- Shared Information (e.g. what knows an aggregator?)
- Demand response strategy of the HP
- Impact on HP´s operation behavior (efficiency, cycling, …)
- Flexibility of HP-Pools
- …

Example for Established HP-Pool
Storage Network Tiko (Switzerland)

- Swisscom Energy Solutions are participating with around 10.000 Devices (mostly HPs) on the reserve market



swisscom

Förderkennzeichen: 03ET1272A

“Smart HPs in Existing Buildings”

- Efficiency of heat pumps in existing single family houses (field trial with around 60 HPs)
- Loadmanagement with heat pumps on single system and pooling level considering “SG ready” (field trial with around 10 HPs and simulation)

Pool composition
Used for this study

- Pool composition
  - 284 building / heat pump combinations
  - 4 different building ages / energy standards
- Abbreviations
  - SFH: Single Family Houses
  - TH: Terraced Houses

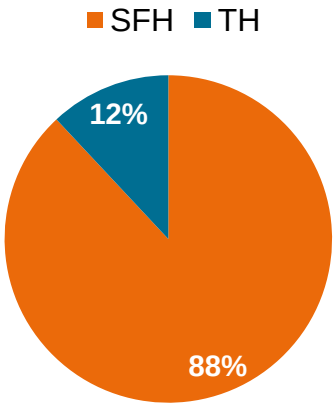


Figure 1. Building types

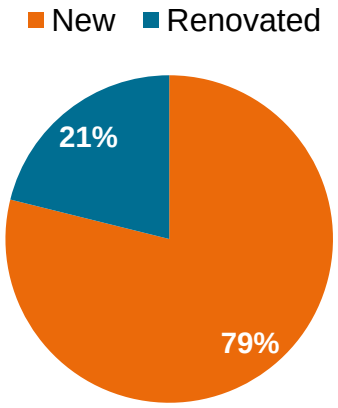


Figure 2. Building age / energy standard

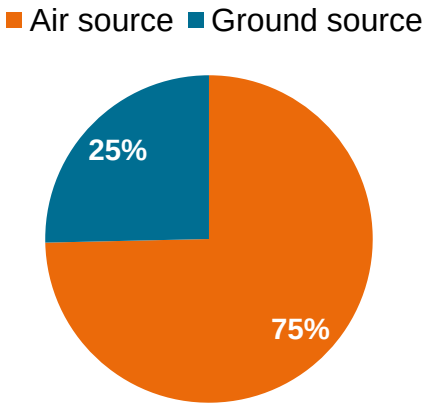


Figure 3. Heat pump type

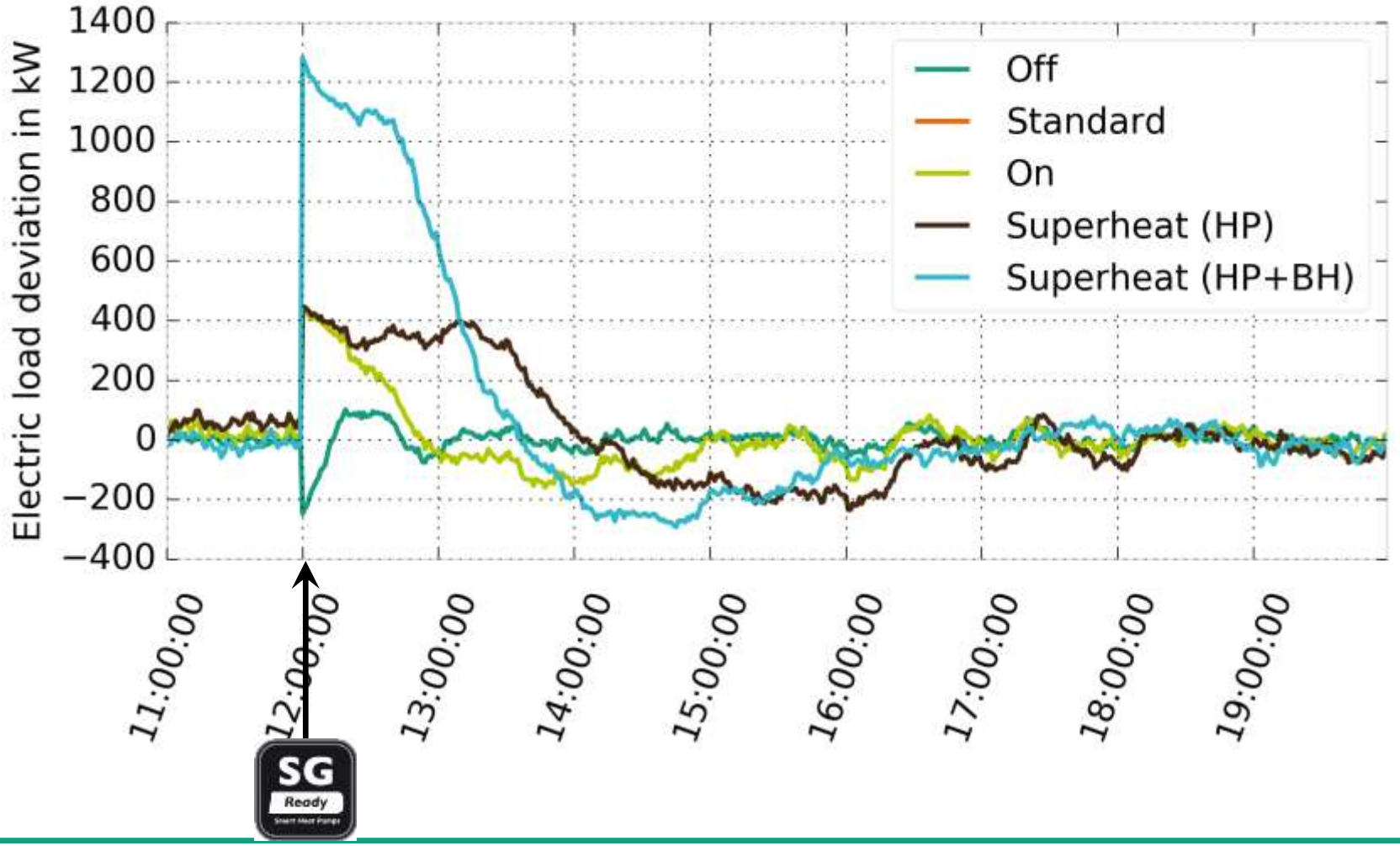
SG Ready
Implemented Signals

	Signal	Implementation	Restriction
1	Off	Switch of HP	Min. Runtime (6 Minutes), Min Pausetime (3 Minutes)
2	Standard	Normal operation	
3	On	Switch on HP; Increase set temperature by 10K	
4a	Superheat (HP)	Switch on HP; Heat storage to 60°C	
4b	Superheat (HP+BH)	Switch on HP; Heat storage to 60°C; Use el. Back-up heater	

- Trigger signal sent to pool at the beginning of each hour in the year for 1 Minute

Flexibility Analyses

Characteristic Response – Difference Plot



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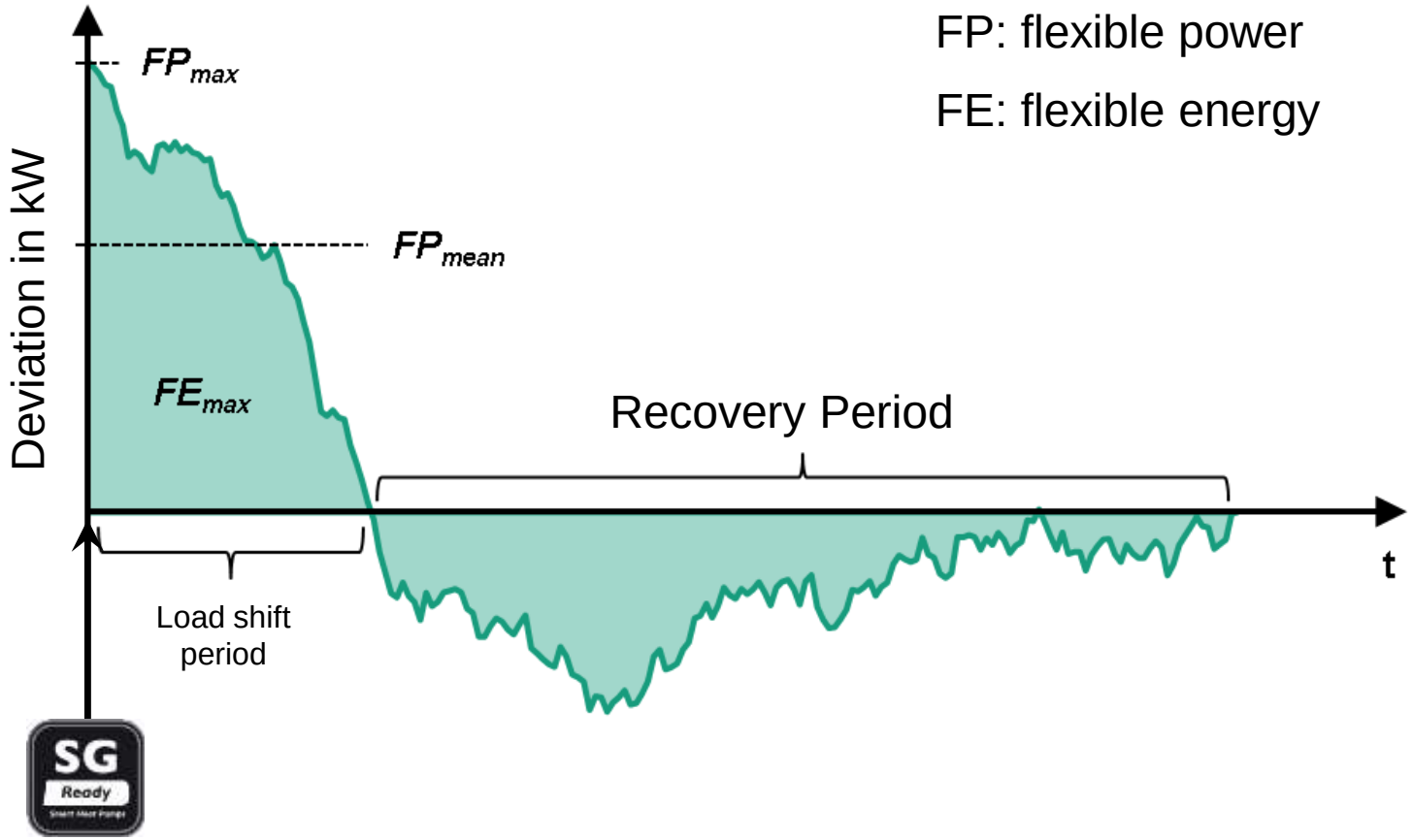
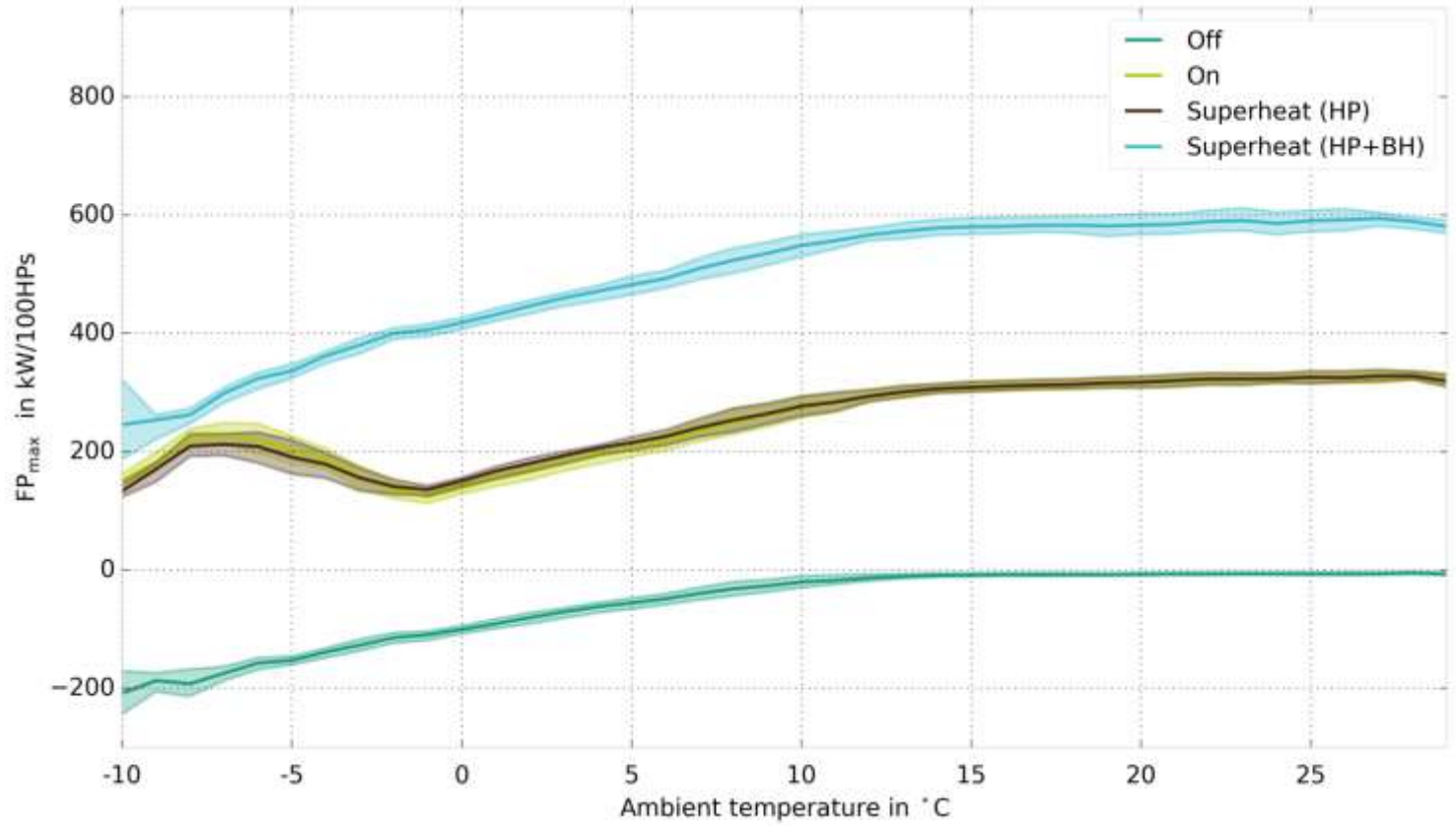
Flexibility
Characteristic Values



Results

Max. Power (FPmax)



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Conclusion

- Potential business cases require pooling of heat pumps
- Only few realized HP-Pools so far (missing infrastructure, standardization, the “critical” number of heat pumps, …)
- Pool flexibility has clear limits and depends strongly on load situation and DR-strategy
- HP-Pools need recovery periods after triggering
- Load deviation of triggered HP-Pool is not constant (Poolmanagement is required)

Further Reading
Included Publications

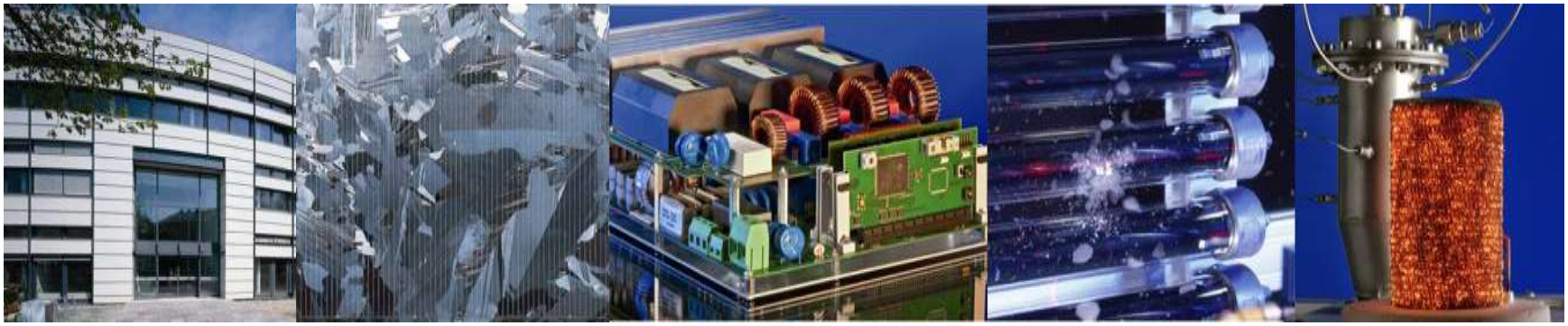
Fischer, D., Härtl, A., & Wille-Haussmann, B. (2015). **Model for electric load profiles with high time resolution for German households**. Energy and Buildings, 92, 170–179. http://doi.org/10.1016/j.enbuild.2015.01.058

Fischer, D., Wolf, T., Scherer, J., & Wille-Haussmann, B. (2016). **A stochastic bottom-up model for space heating and domestic hot water load profiles for German households.** Energy and Buildings, 124, 120–128. http://doi.org/10.1016/j.enbuild.2016.04.069

Fischer, D., Scherer, J., Haertl, A., Lindberg, K. B., Elci, M., & Wille-haussmann, B. (2014). **Stochastic Modelling and Simulation of Energy Flows for Residential Areas.** Proceedings Internationaler ETG-Kongress.

More about Pooling and Business Models on Wednesday in the Smart Grid Session:

9:15: O.2.3.2 Flexibility of heat pump pools: The use of SG-Ready from an aggregators perspective
12:05: O.2.4.5 Business Models using the Flexibility of Heat Pumps - A Discourse
Mr. David Fischer, Fraunhofer - Institute for Solar Energy Systems (ISE)



Fraunhofer-Institut für Solare Energiesysteme ISE

Danny Günther, David Fischer

www.ise.fraunhofer.de

danny.guenther@ise.fraunhofer.de