Workshop 3 - 15th IEA Heat Pump Conference
Vienna, 2026-05-26

Monitoring and assessment toward PED “Campagne Innsbruck”

Fabian Ochs, Elisa Venturi, Samuel Breuss

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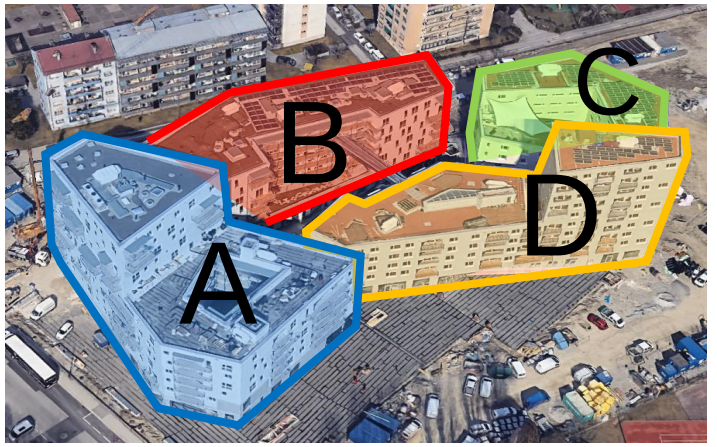
innsbruck

„Towards PED“ Innsbruck Campagne – Block 1

	IIG		NHT	
	A	**B**	**C**	**D**
No. floors [-]	11	7	6	10
GFA [m²]*	9635	8392	4623	6803
AT (PHPP) [m²]	6686	6525	3587	5479
SHD [kWh/(m²a)]	**15.3**	**15.0**	**20.0**	**16.0**
HL [W/m²]	**11.9**	**11.5**	**15.1**	**12.8**



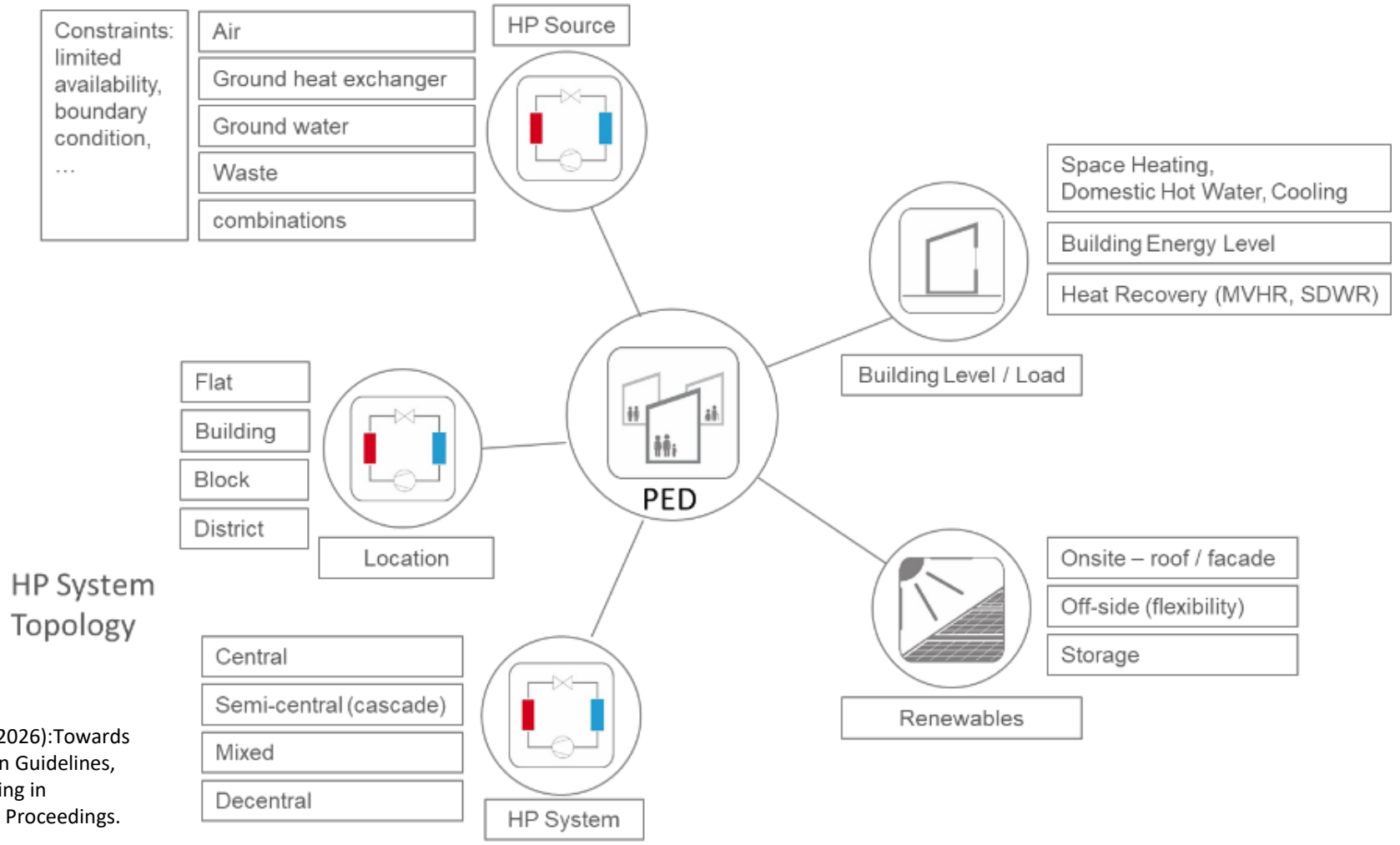
Google Earth

NHT

Innsbruck Informiert

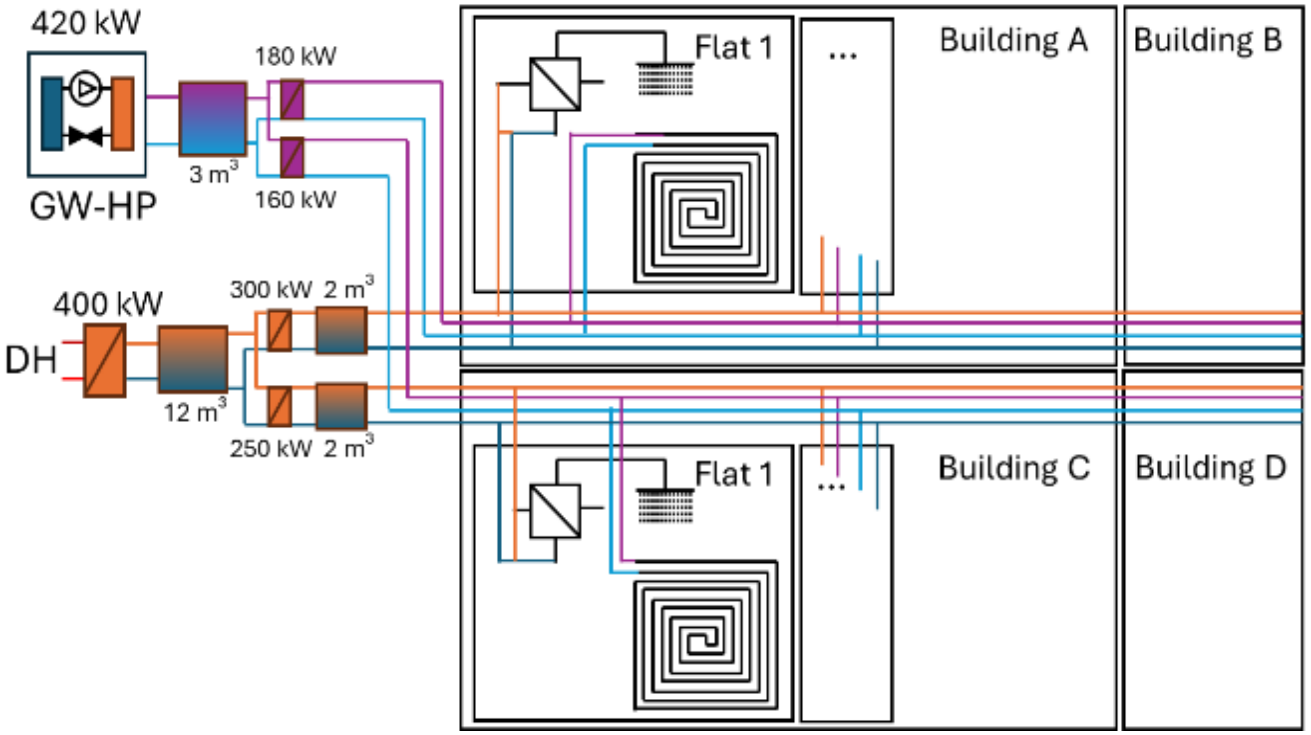
Ochs, Fabian; Breuss, Samuel; Venturi, Elisa; Magni, Mara; Dermentzis, Georgios (2024): Towards Positive Energy Districts - Innsbruck “Campagne Areal”. 3rd International Conference on Renewable Heating and Cooling in Integrated Urban and Industrial Energy Systems - Conference Proceedings. 10 - 11 April 2024, Graz. Gleisdorf: AEE INTEC., S. 131 - 132.

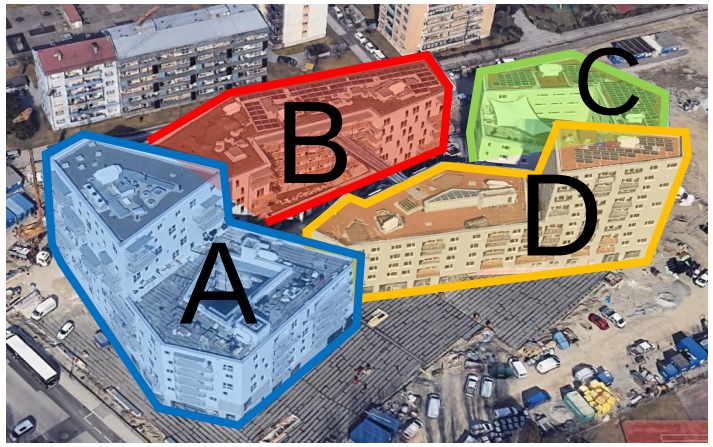
PED Design Options and HP System Topology (IEA HPT A61)



Ochs, Fabian; Bockelmann, Franziska; Wemhoener, Carsten (2026):Towards Positive Energy Districts – Heat Pump System Topology Design Guidelines, 4th International Conference on Renewable Heating and Cooling in Integrated Urban and Industrial Energy Systems - Conference Proceedings. 15 - 17 April 2026, Graz. Gleisdorf: AEE INTEC

HVAC System –
GW-HP for SH + DH for DHW





Google Earth

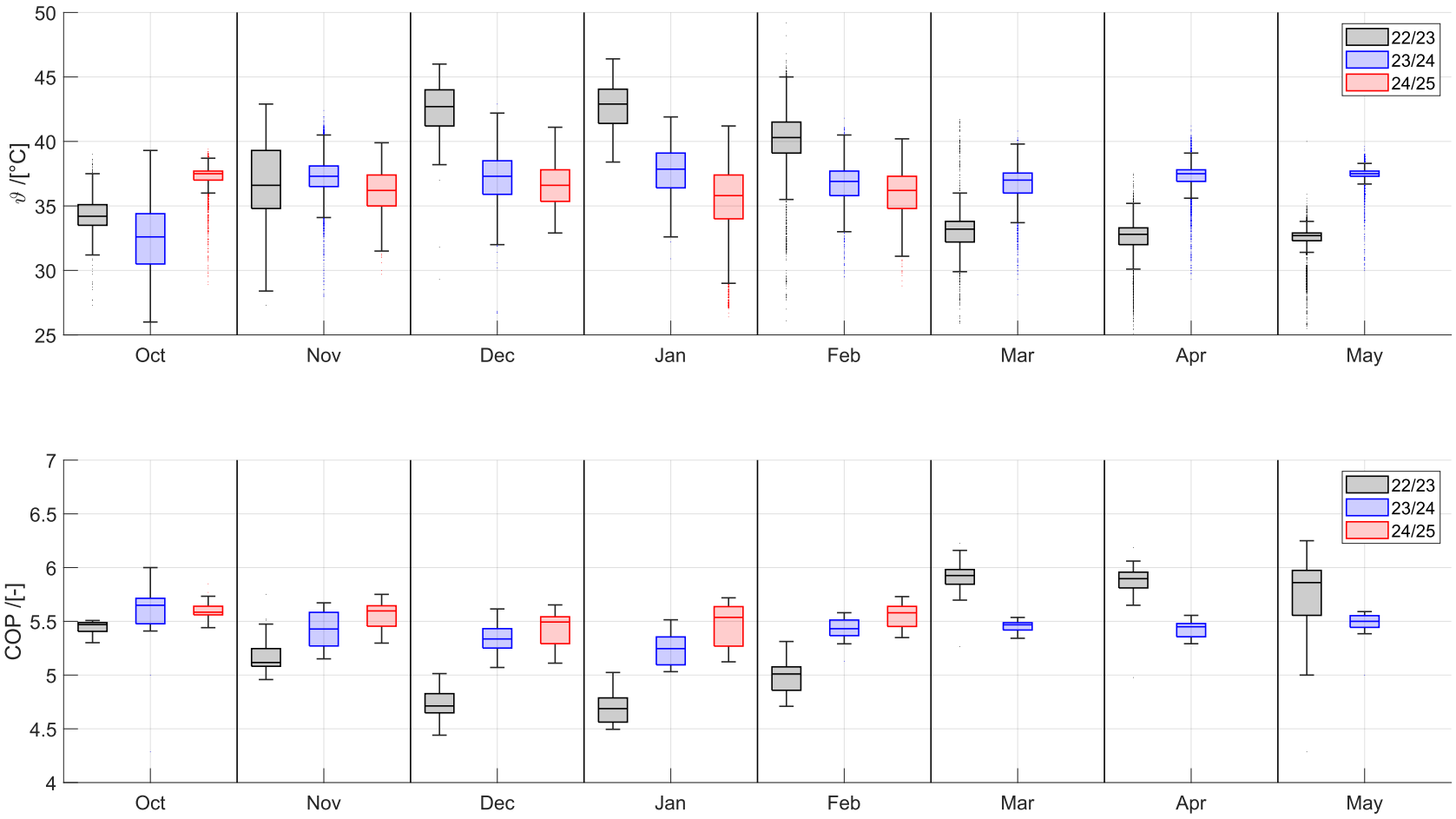
NHT

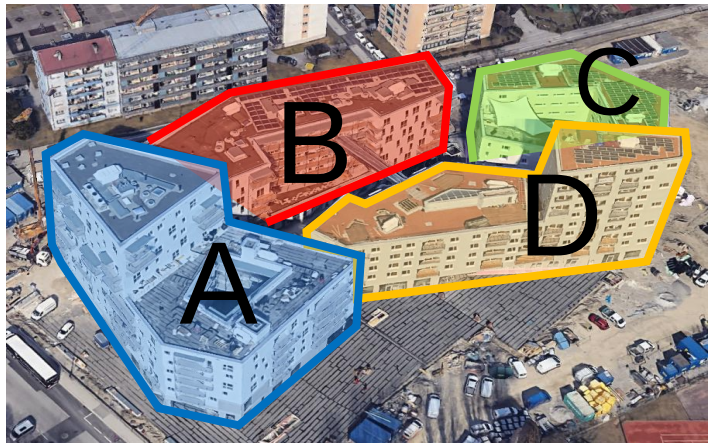
Innsbruck Informiert

Breuss, Samuel; Venturi, Elisa; Monteleone, William; Dermentzis, Georgios; Ochs, Fabian (2026): Optimization of a Multi-apartment HVAC System Using Simulation and Monitoring Data. Proceedings of the 15th REHVA HVAC World Congress - CLIMA 2025. Conference proceedings, Volume 1, Milan, Italy, June 4-6, 2025. Cham: Springer, ISBN 978-3-032-06806-4, S. 998 - 1007.

Venturi, Elisa; Ochs, Fabian; Breuss, Samuel; Magni, Mara; Dermentzis, Georgios (2026): Monitoring-Based Analysis of Decentralized Domestic Hot Water Preparation in Large Multi-Family Buildings. Proceedings of the 15th REHVA HVAC World Congress - CLIMA 2025. Conference proceedings, Volume 1, Milan, Italy, June 4-6, 2025. Cham: Springer, ISBN 978-3-032-06806-4, S. 443 - 452.

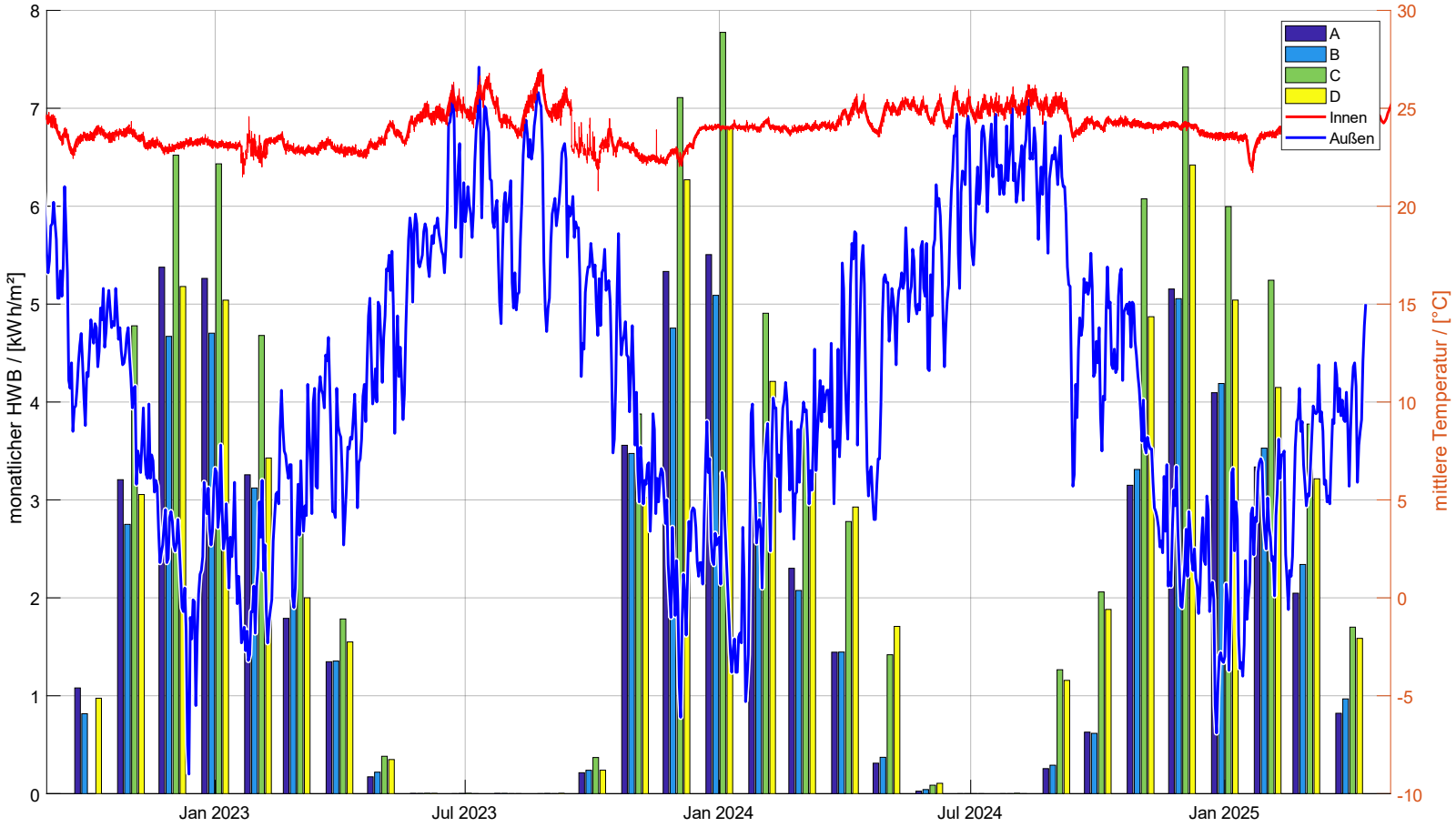
HP Performance (Monitoring)

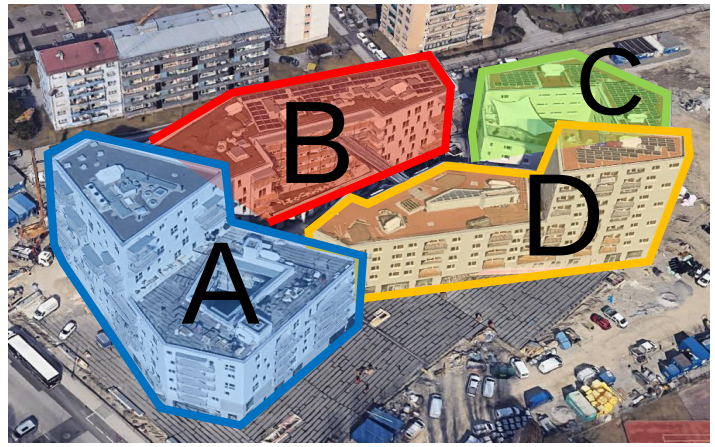




Google Earth

Space Heating Demand



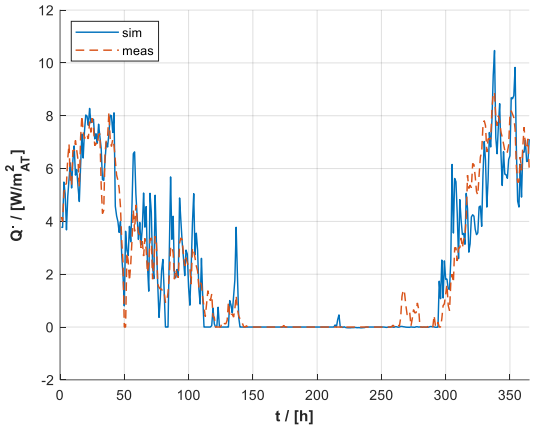


Google Earth

	HD/ [kWh/(m²a)]			
	A	B	C*	D
22/23	21.5	19.6	27.3	21.6
23/24	22.0	20.5	32.1	28.8
24/25	19.5	20.3	33.5	28.3
av	21.0	20.1	31.0	26.2

Building Level - Space Heating Demand

A



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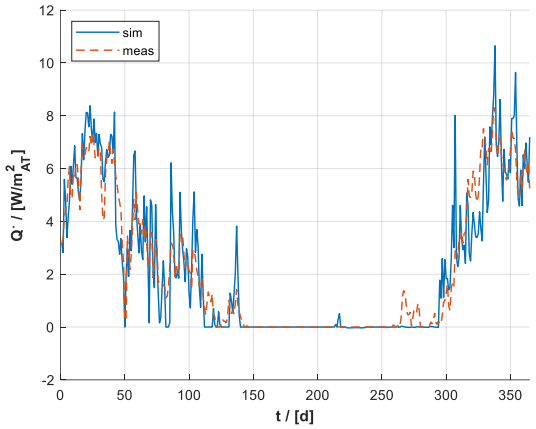

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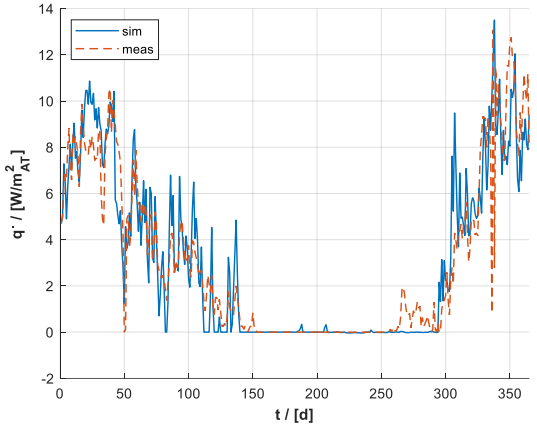
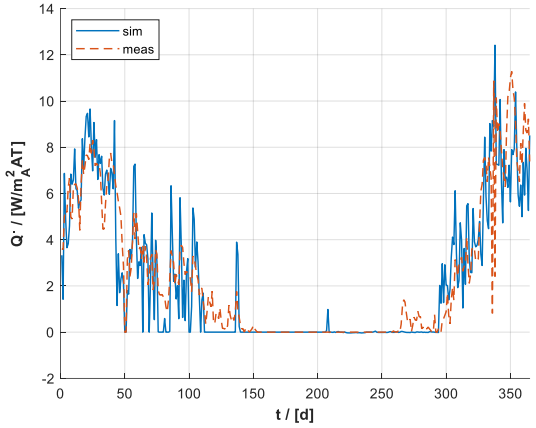
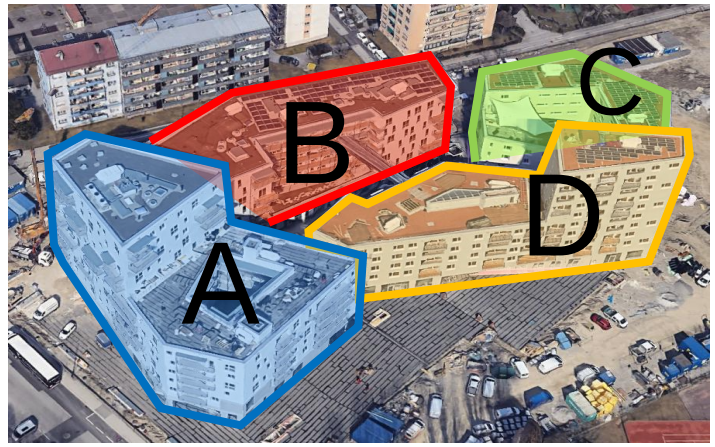


D





Google Earth

Many unknowns remain …

- „real“ overal HTC (thermal bridge, infiltration)
- User behaviour (ventilation, shading, int. gains)
- Internal distribution losses
  - Piping
  - HTS

Solar Energy Advances 5 (2025) 100081

Contents lists available at ScienceDirect

Solar Energy Advances

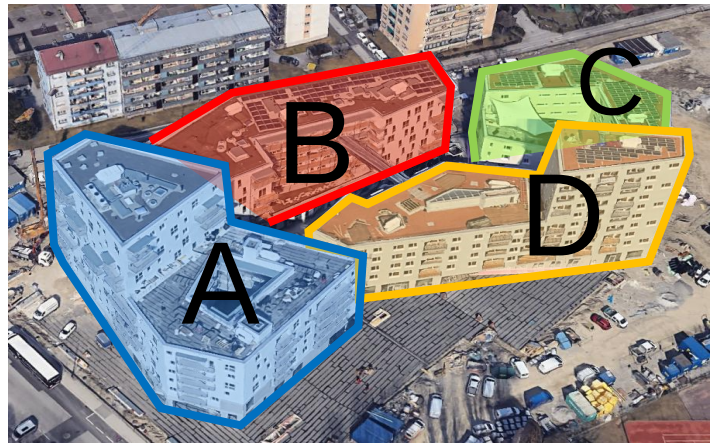
journal homepage: www.elsevier.com/locate/seja

Characteristic load curves of positive energy districts

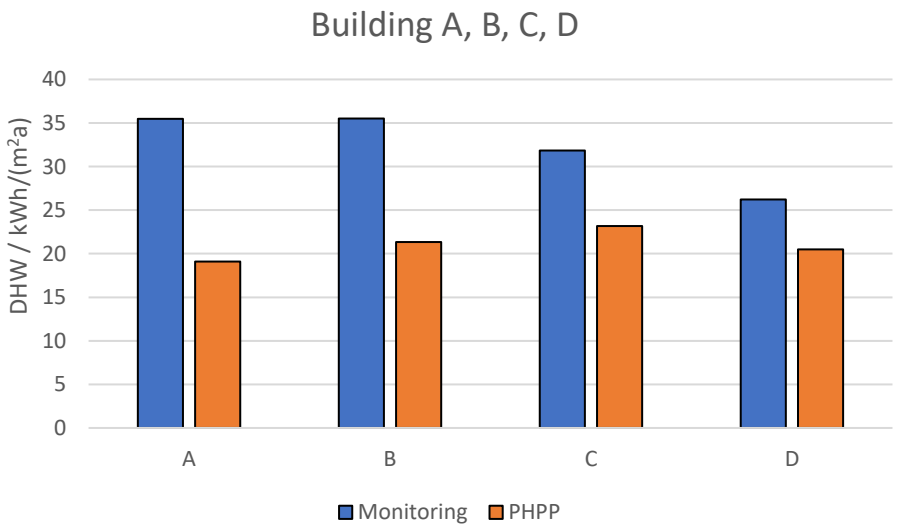
Fabian Ochs [a,*], Alice Tosatto [a], Elisa Venturi [a], Samuel Breuss [a], Mara Magni [a], Georgios Dermentzis [a], Carsten Wemhoener [b]

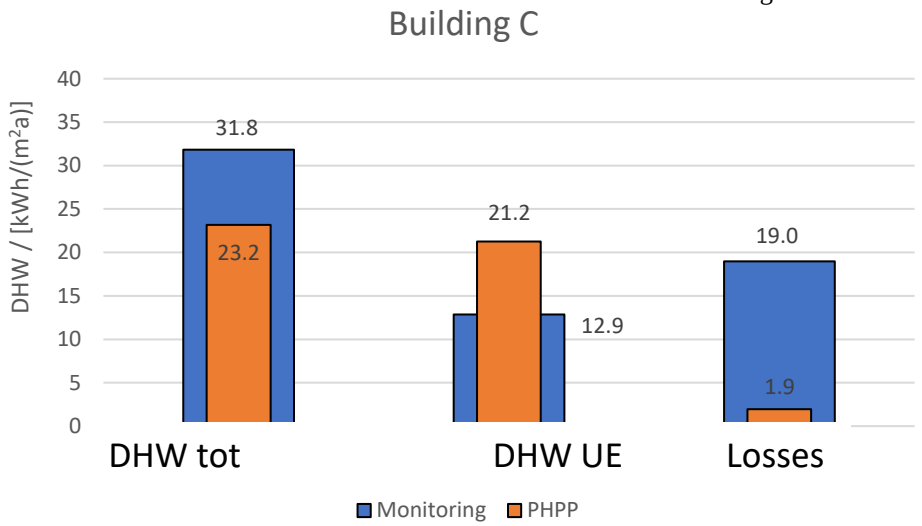
universität innsbruck

DWH - Monitoring



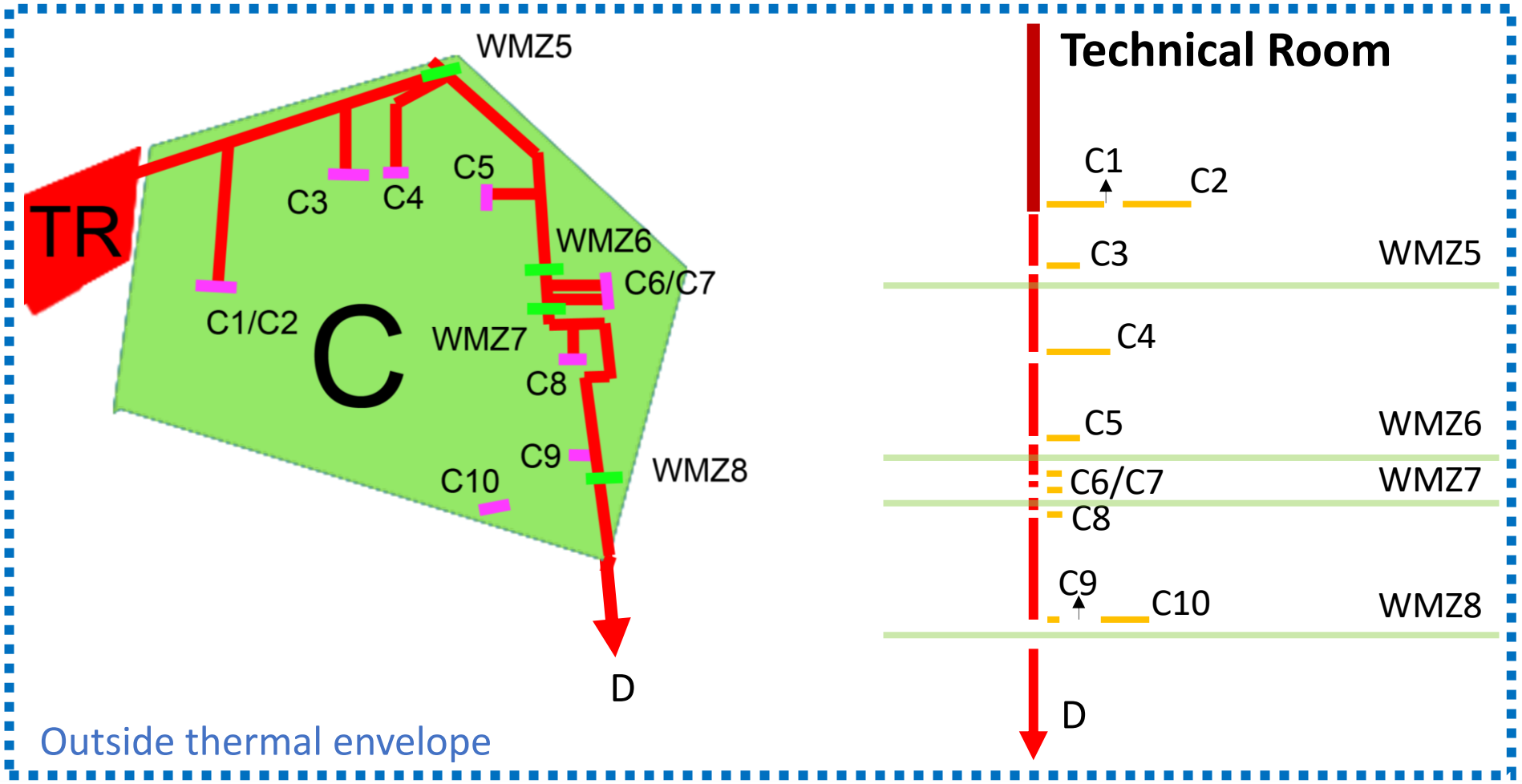
Google Earth

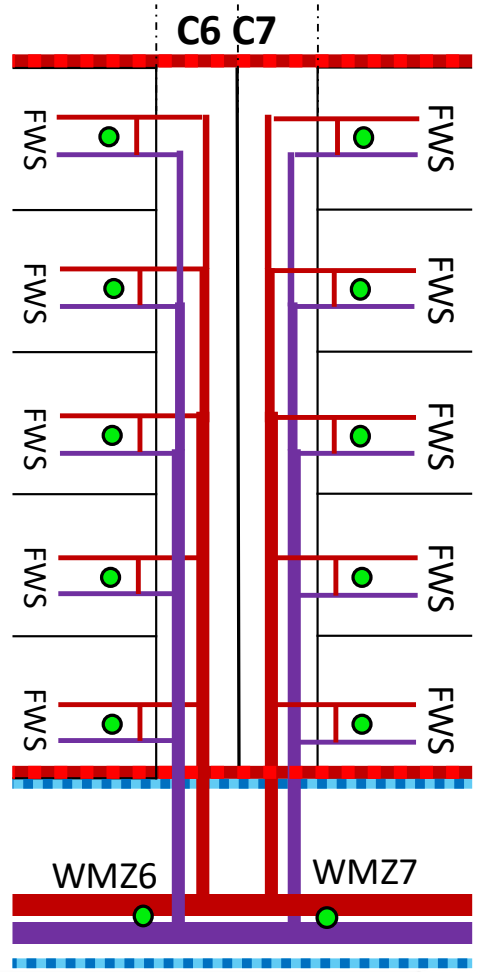




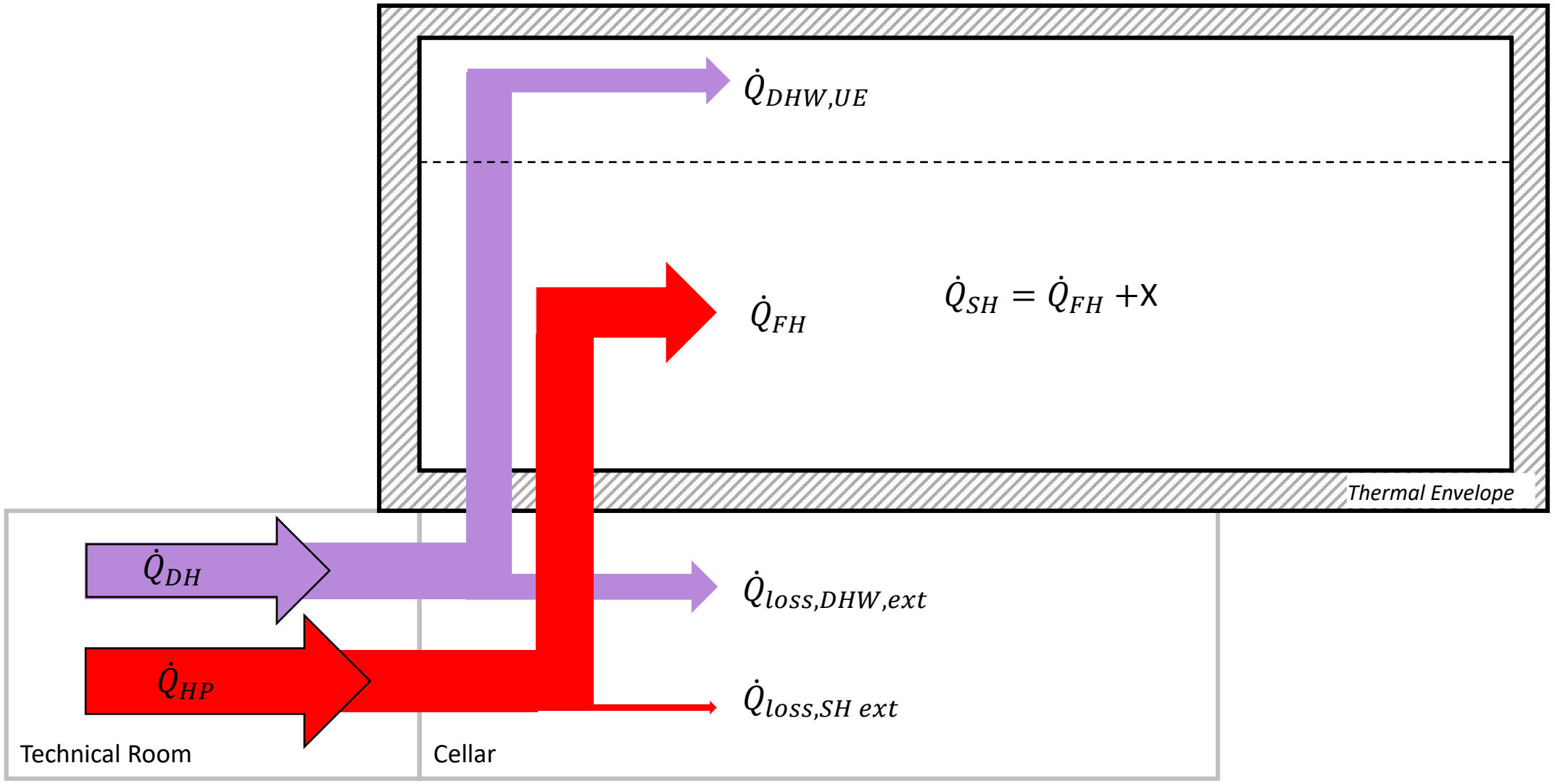
DHW Demand and Distribution Losses

Heat Meter

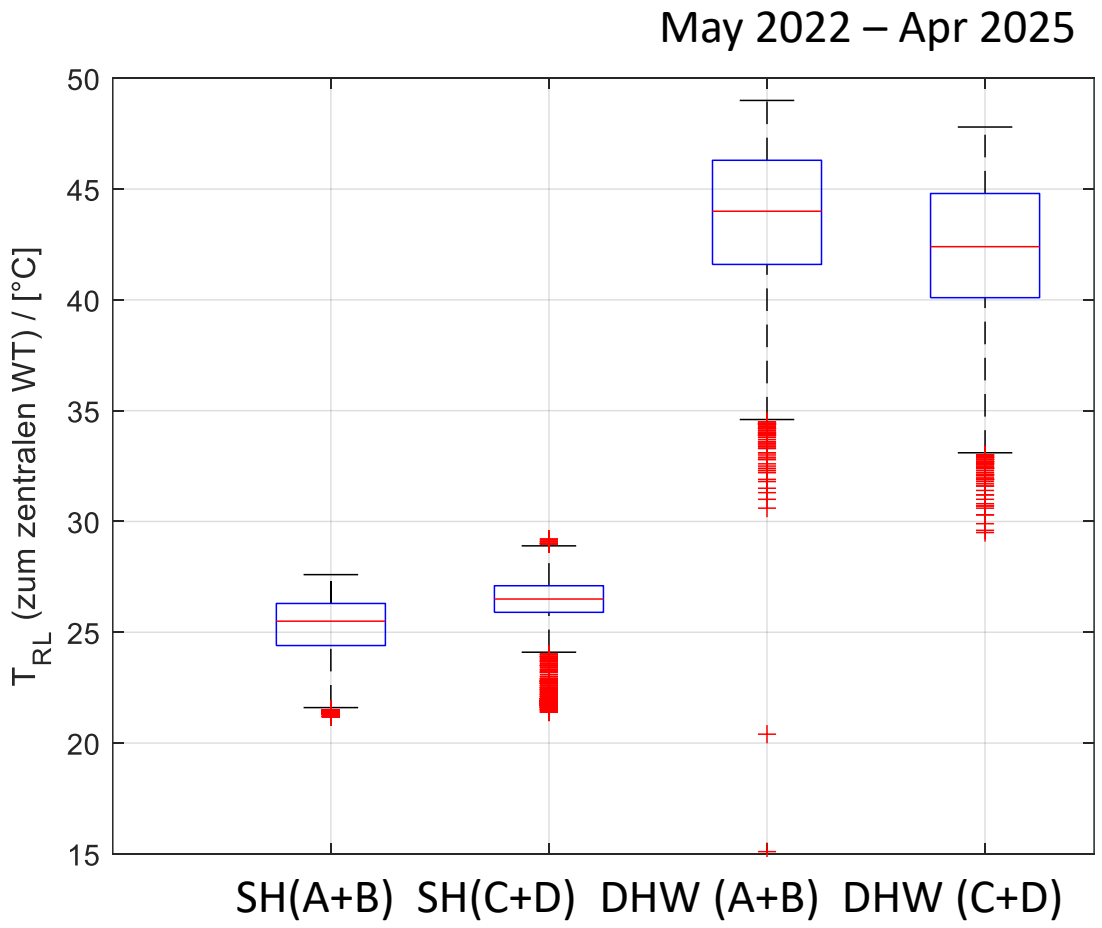


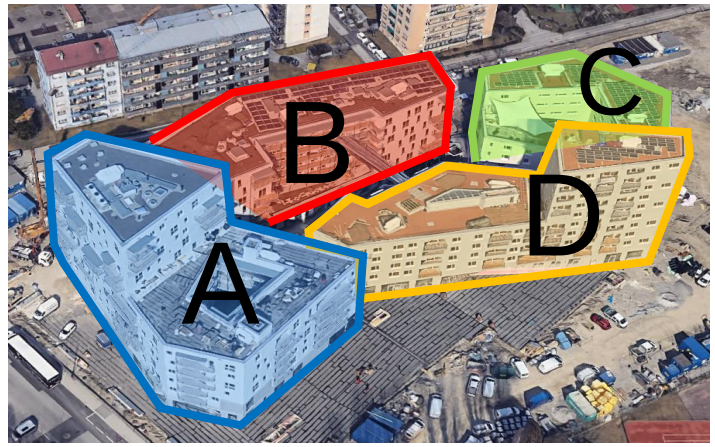


SH + DHW – uncontrolled heat



Flow and Return Temperatures

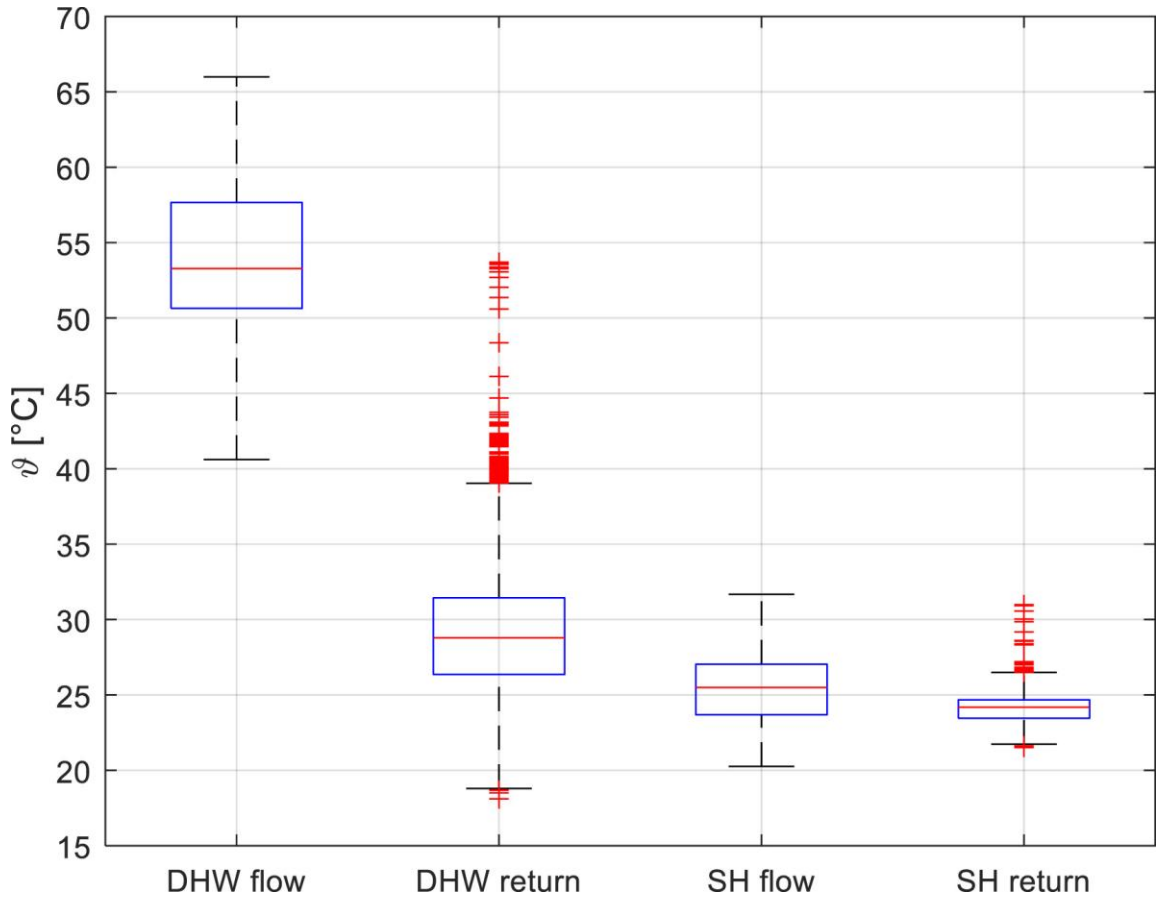




Google Earth

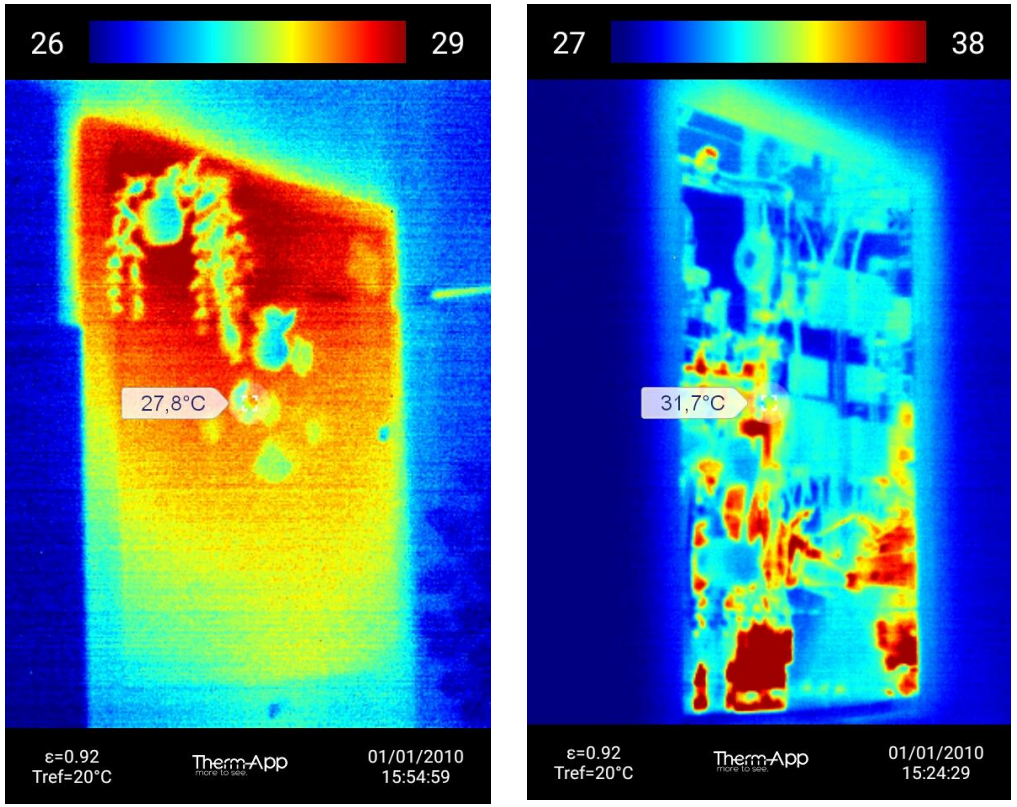
SH: space heating
DHW: domestic hot water

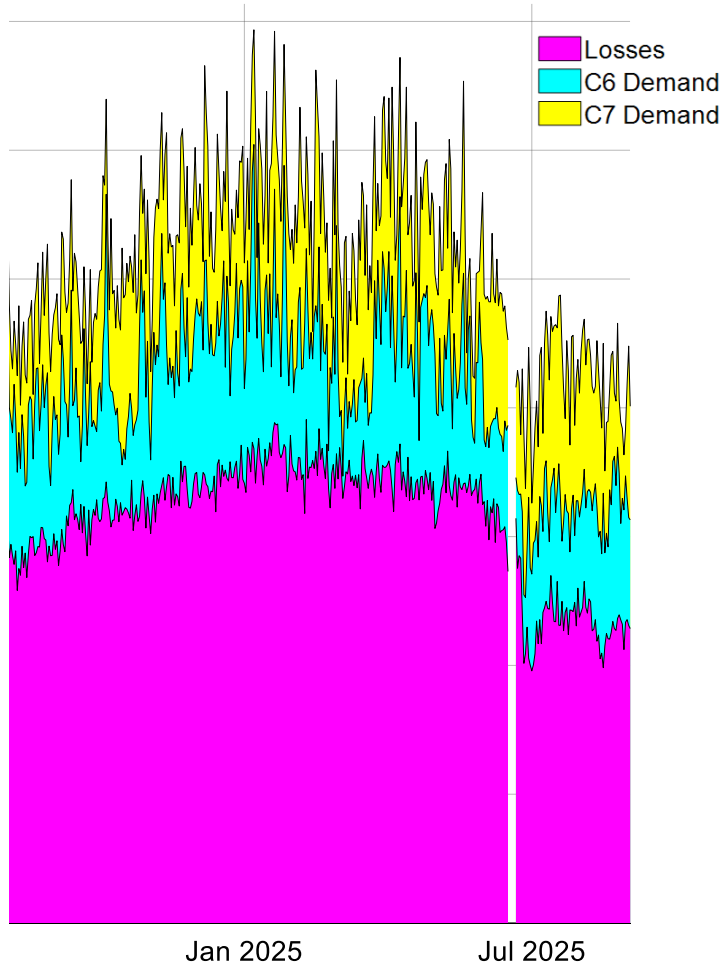
Flow and Return Temperatures Project – IBK Vögelebichl (NHT)



Dermentzis G., Ochs F., Franzoi N., Four years monitoring of heat pump, solar thermal and PV system in two net-zero energy multi-family buildings, 2021, Journal of Building Engineering

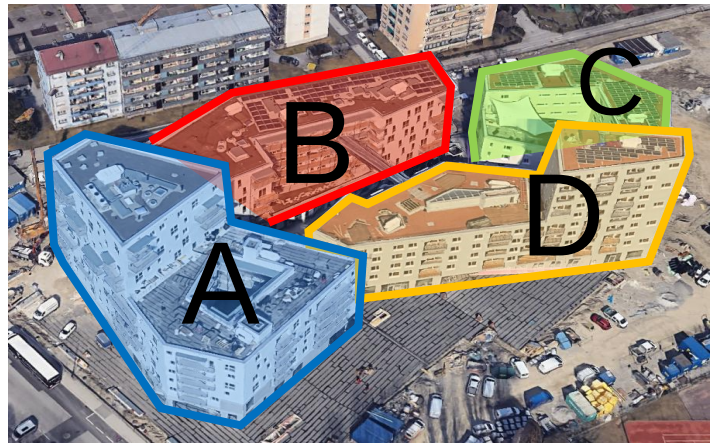
Improvement of the FWS bypass control



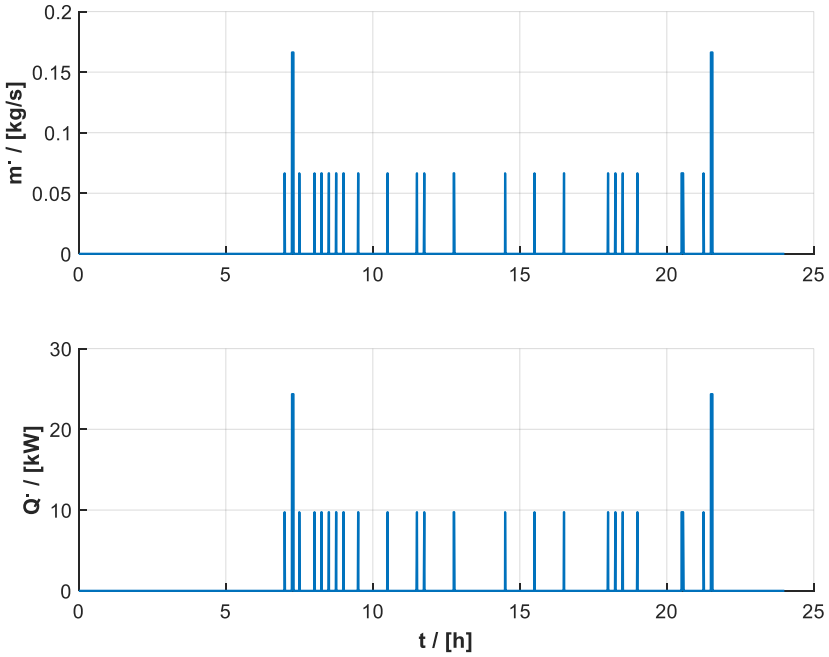


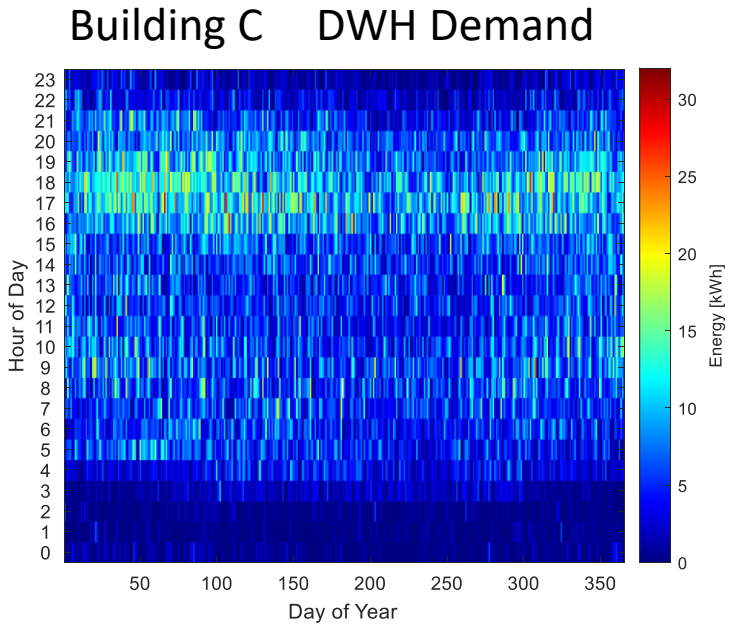
Building Level DHW – Monitoring

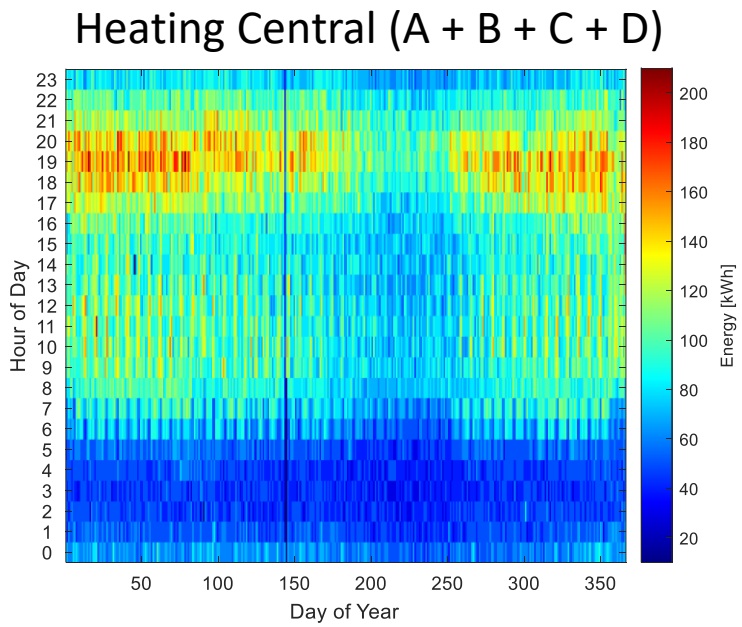
- Design: 25 l / d / P @ 60 °C (energy equivalent)
- Tapping profile acc. to 16147



Google Earth

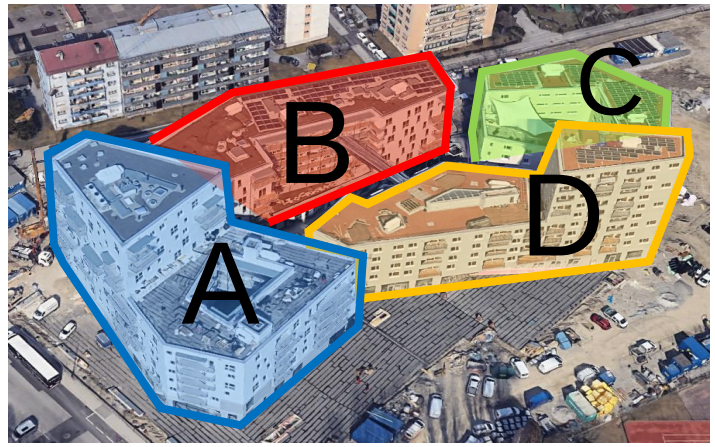


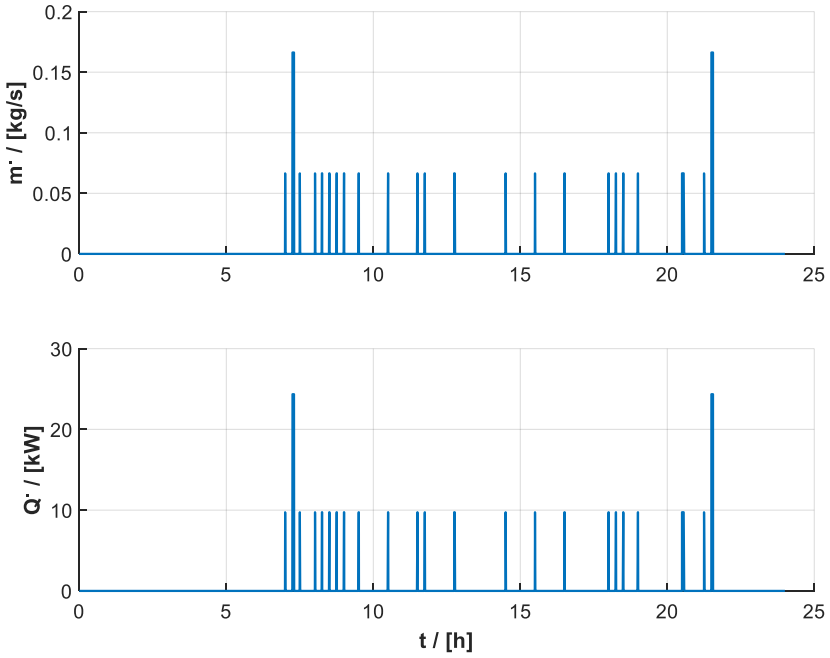




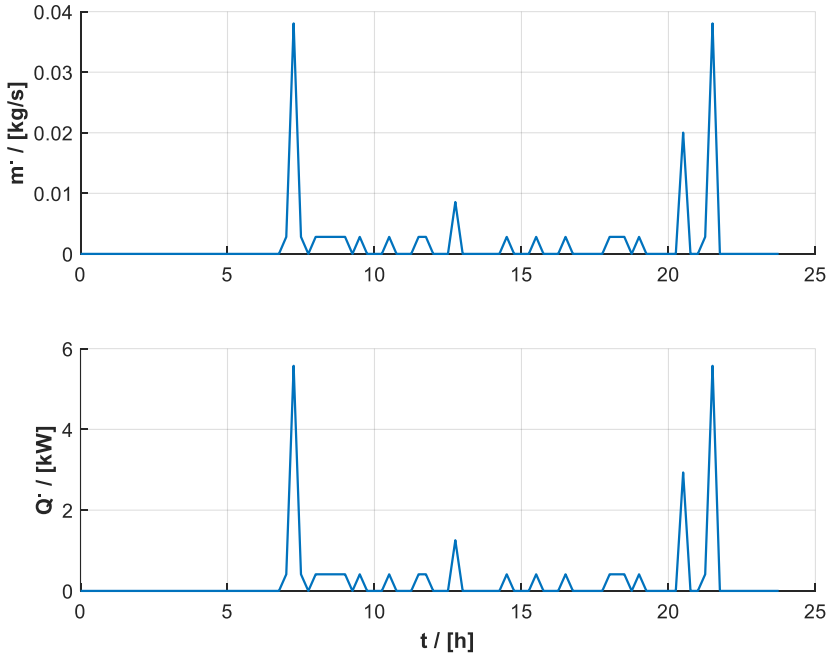
DHW Tapping Profile and Time Step

EN 16147 („M“ 4 Persons) 5.845 kWh/d @ 45 °C

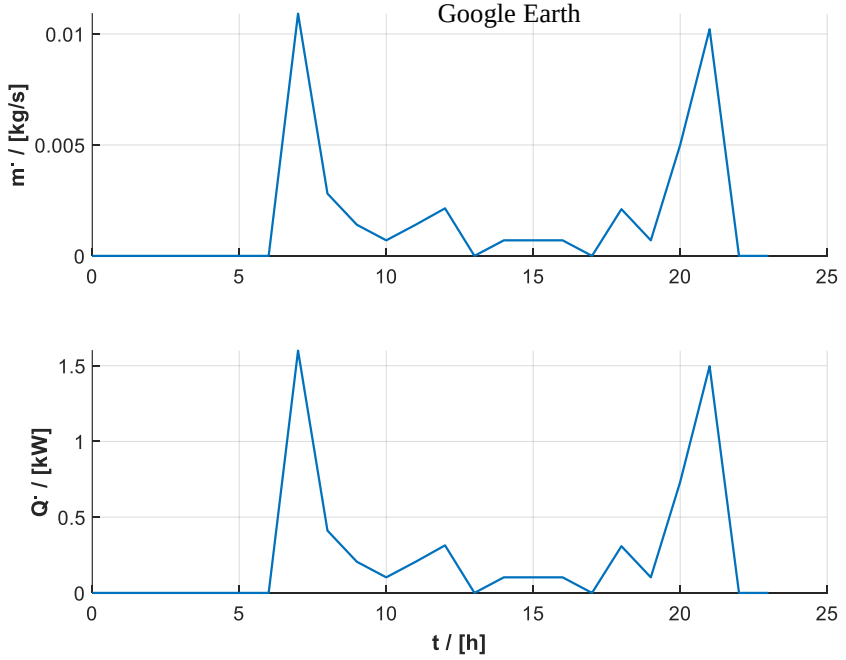




Tapping profile

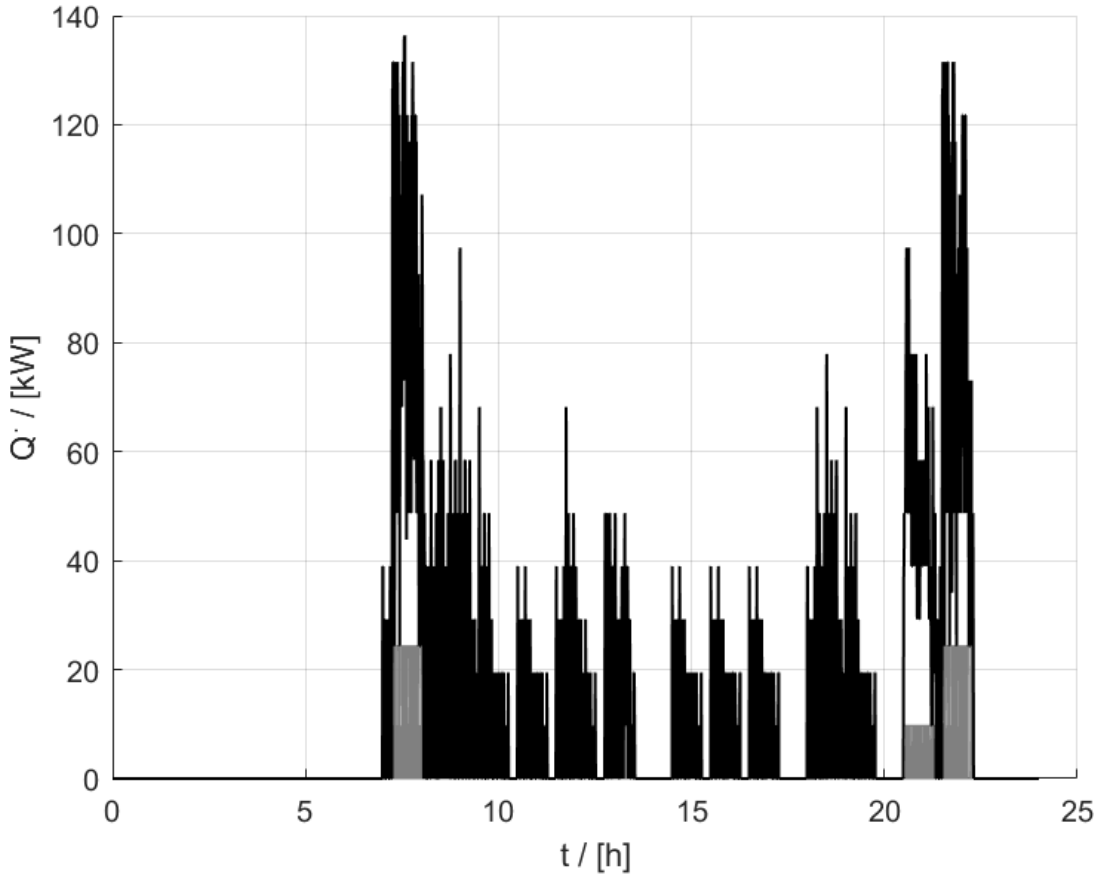


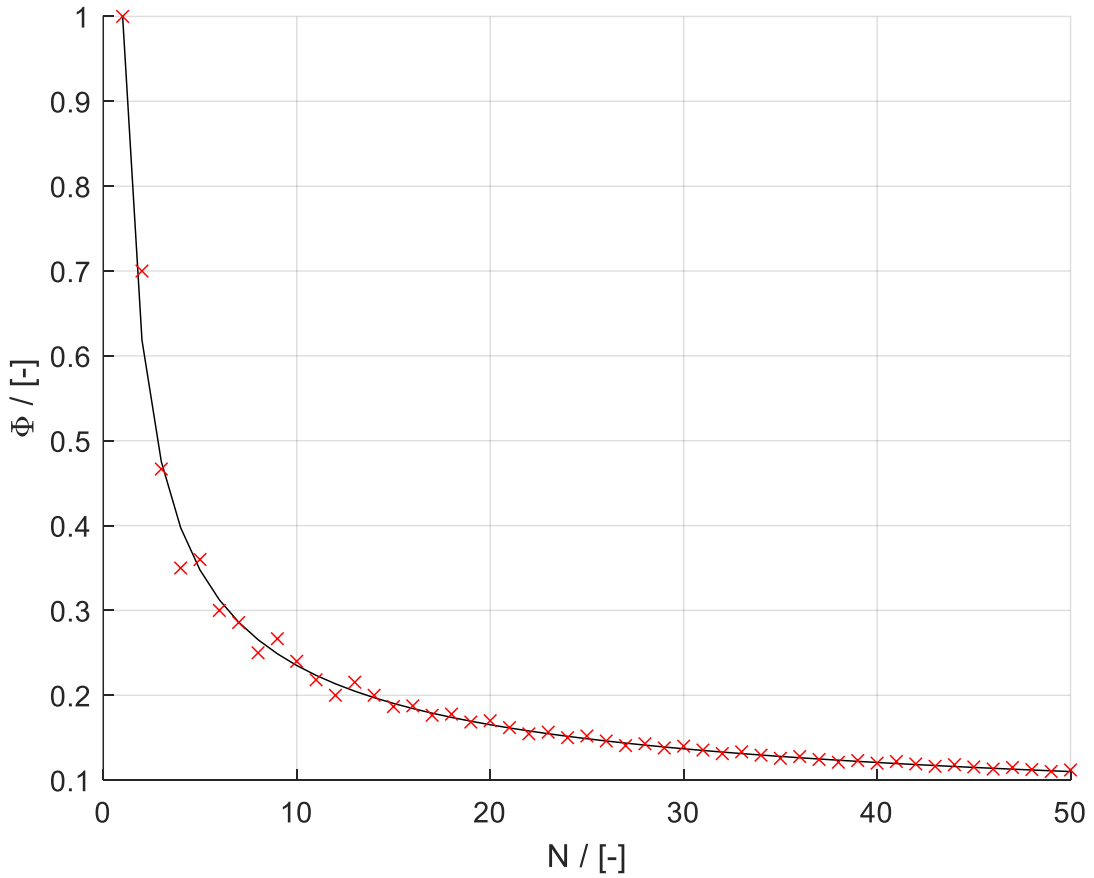
15 min average



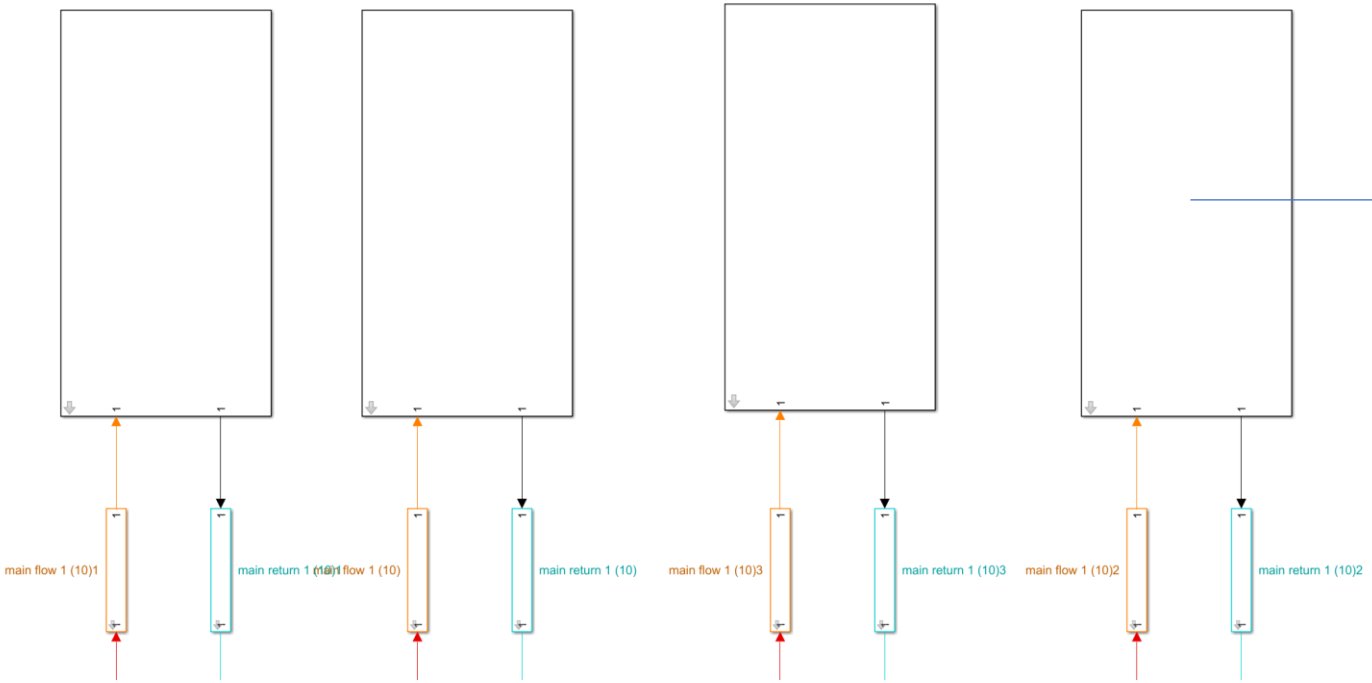
1 h average

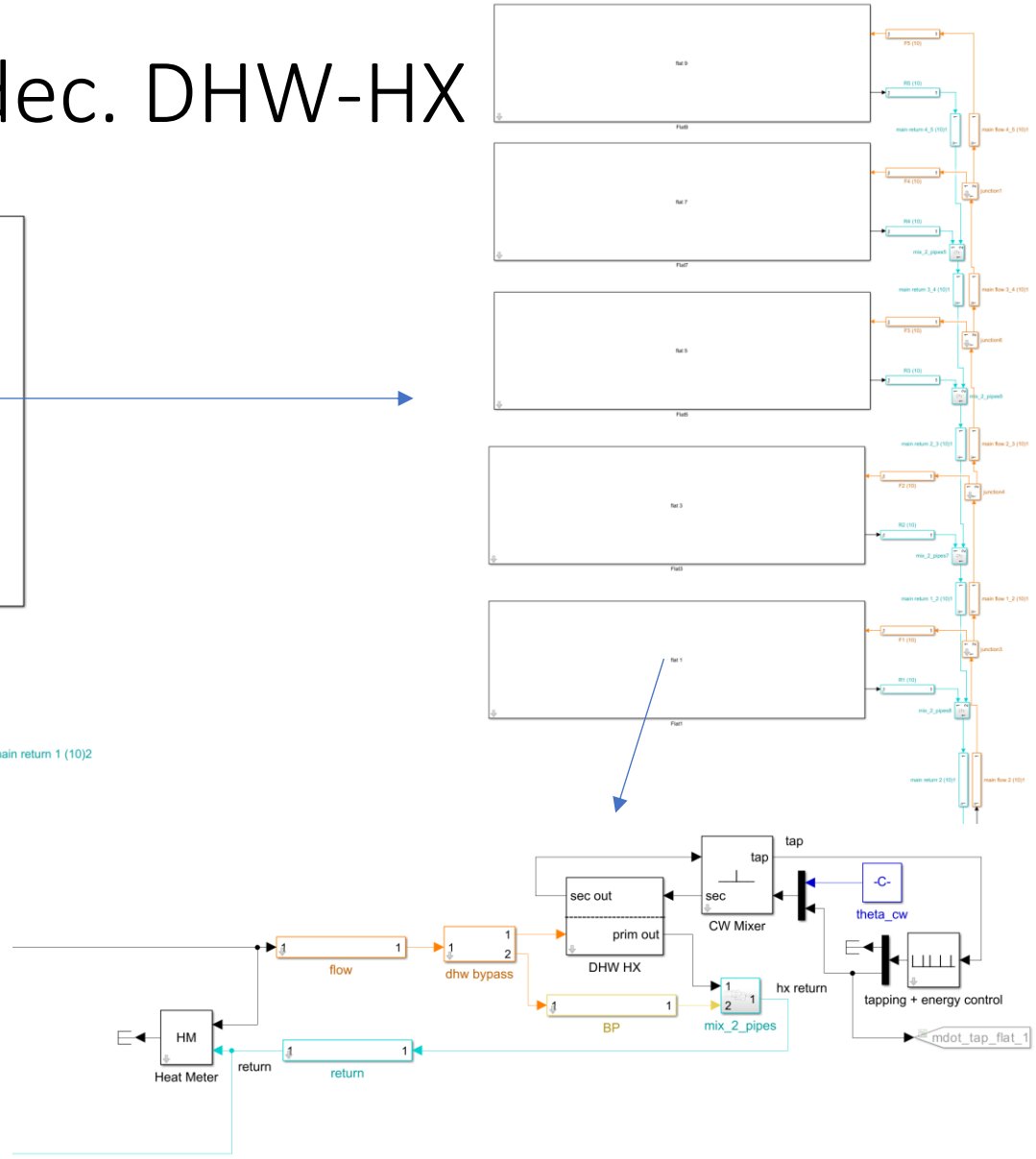
DHW – Simulation - Tapping profile and simulatneity





Simulink Model 4 x 5 flats with dec. DHW-HX

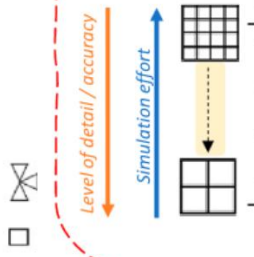




Building + HVAC

Modelling Approaches and Dynamic Simulations

Multi-apartment buildings and hydronic systems for Space Heating and Domestic Hot Water (2-pipe system with decentral Heat Transfer Stations (HTS)) simulated with 4 modelling approaches:



Modelling Approach	Number of Thermal Zones	Number of radiators	Piping modelling	Number of HTSs
"Physical"	multiple	multiple	detailed	multiple
"Semi-physical"	1	multiple	detailed	multiple
"Star"	1	1	lumped	multiple
"One-zone"	1	1	lumped	1

Sensitivity analysis:

Buildings:
- Building SHD
- Number of stories and apartments

Hydronic Systems:
- Number of rising pipes
- Return configuration
- Position of the rising pipes
- Pipe insulation

User and control:
- DHW tapping profile
- Supply temperature
- Radiator control
- Apartments with night setback

Lumped Parameters:
- Different properties of the lumped radiator
- Different properties of the lumped HTS

Research Article

Complex hydronic systems in multi-apartment buildings: modelling approaches and dynamic simulations

Elisa Venturi, Fabian Ochs, Georgios Dermentzis & Mara Magni

Received 13 May 2025, Accepted 02 Feb 2026, Published online: 16 Mar 2026

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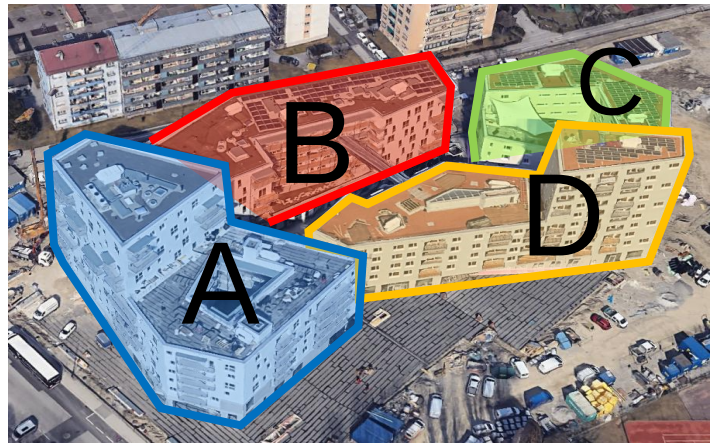
Conclusions and Outlook



Google Earth

- High performance buildings prerequisite for achieving PED
- Large degree of freedom of Design Parameters for (PE)Ds.
- HP System Topology significantly influences the system performance
  - Central (district level)
  - Decentral (building level)
  - Semi-central (booster-HP, medium T loop)
- Building level heating system has significant influence on the required temperature level and thus storage and distribution losses and heat pump efficiency
  - 4p-Circulation
  - 2+2 p FWS
  - 2p HTS …
- Significant contribution of DHW and strong coupling between SH and DHW
- Detailed Simulation of PED remains a challenge
  - Dynamic building simulation with single/multi –zone building models
  - DHW tapping profile with time shift to consider simultaneity (alternatively DHWCalc)

… further work to be done …

Thank you …

Acknowledgements

IEA HPT Annex 61 HP in PED (FFG)

Campagne Monitoring (FFG)

EU Life KnowHowHP