

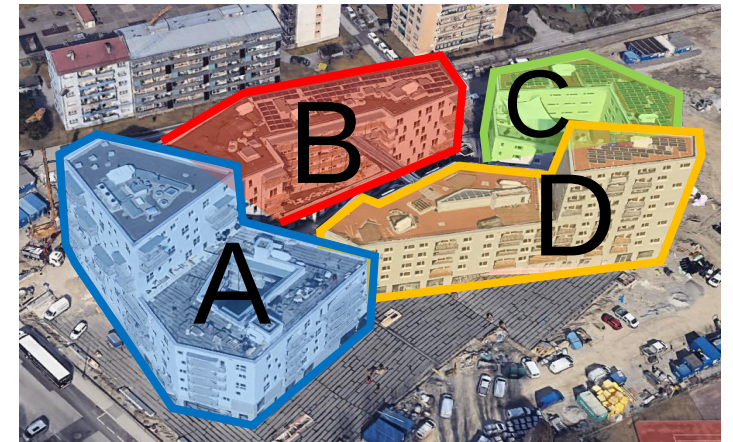
Workshop - Strombasierte Wärmeversorgung -
Meilenstein auf dem CO2-Reduktionspfad

Monitoring and assessment toward PED “Campagne Innsbruck”

Fabian Ochs, Elisa Venturi, Samuel Breuss

„Towards PED“ Innsbruck Campagne – Block 1

	IIG		NHT	
	A	B	C	D
No. floors [-]	11	7	6	10
GFA [m ²]*	9635	8392	4623	6803
AT (PHPP) [m ²]	6686	6525	3587	5479
SHD [kWh/(m ² a)]	15.3	15.0	20.0	16.0
HL [W/m ²]	11.9	11.5	15.1	12.8



Google Earth



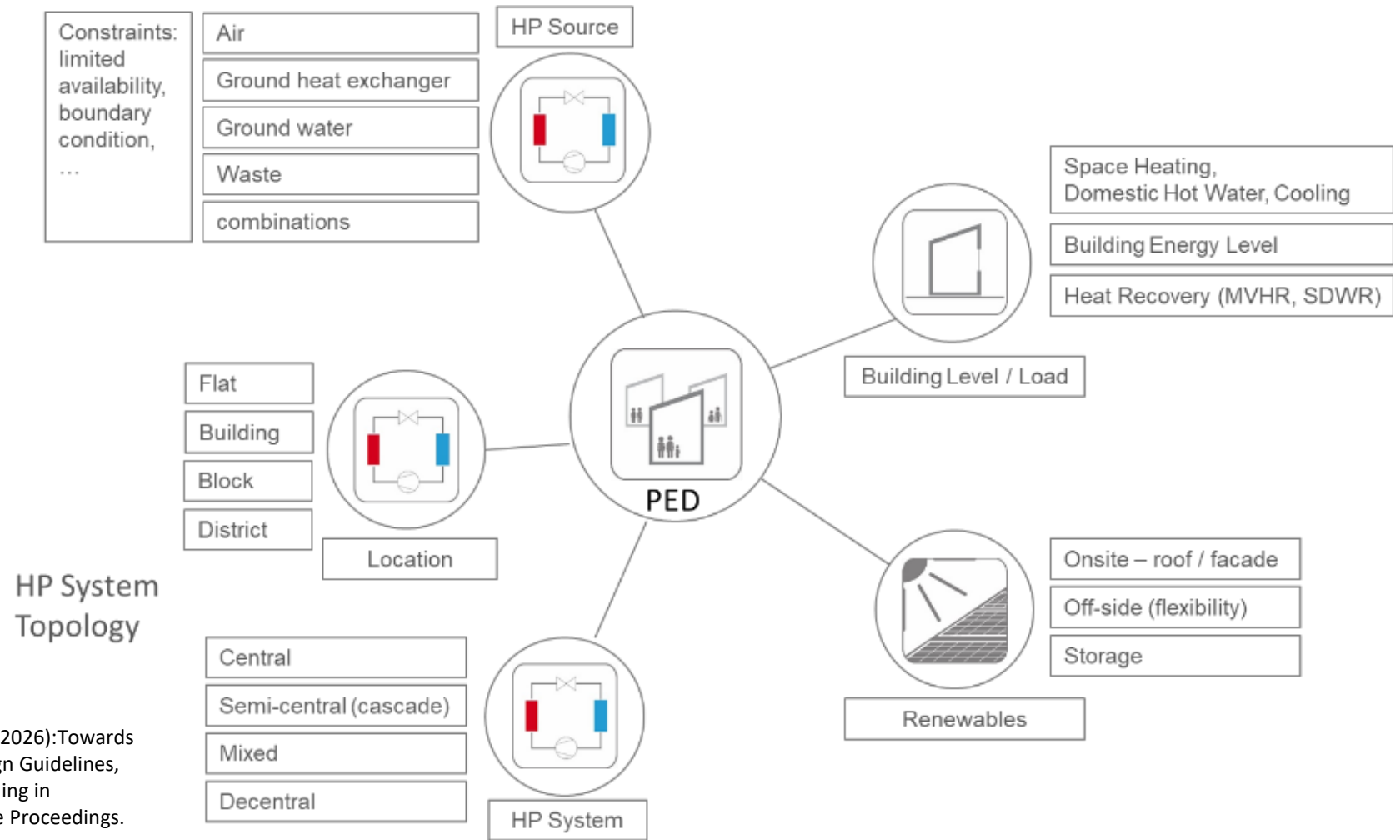
NHT



Innsbruck Informiert

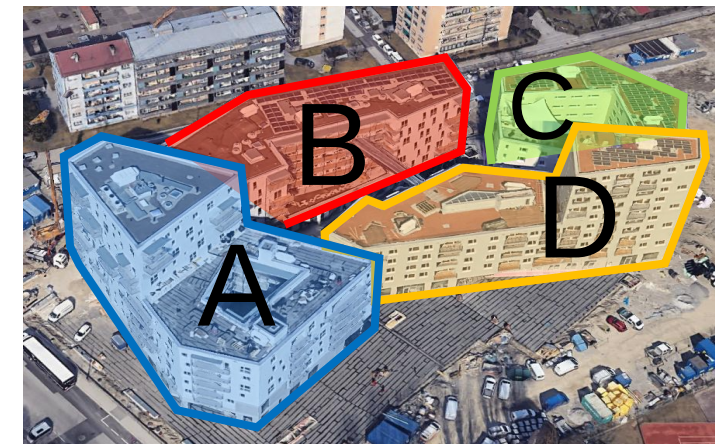
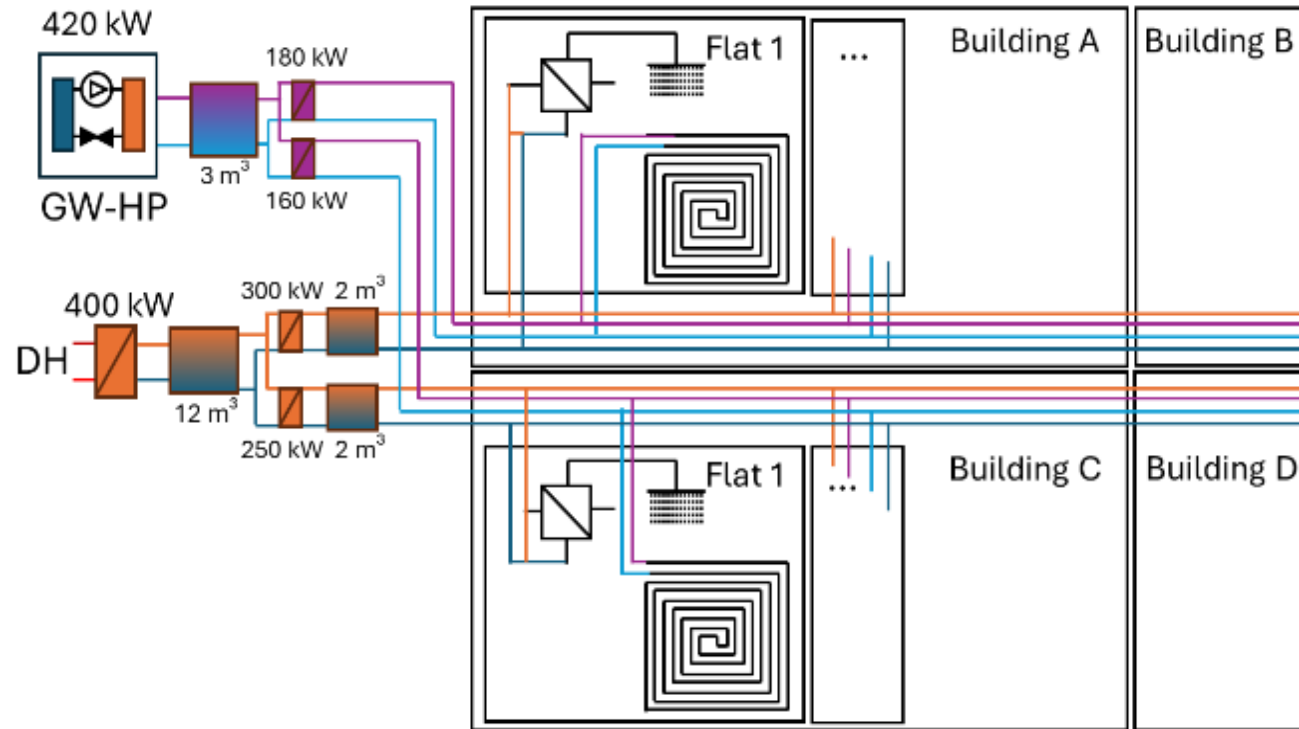
Ochs, Fabian; Breuss, Samuel; Venturi, Elisa; Magni, Mara; Dermentzis, Georgios (2024): Towards Positive Energy Districts - Innsbruck "Campagne Areal". 3rd International Conference on Renewable Heating and Cooling in Integrated Urban and Industrial Energy Systems - Conference Proceedings. 10 - 11 April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

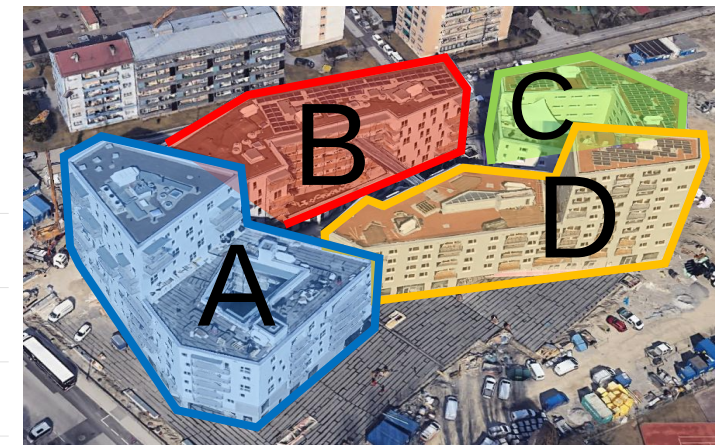
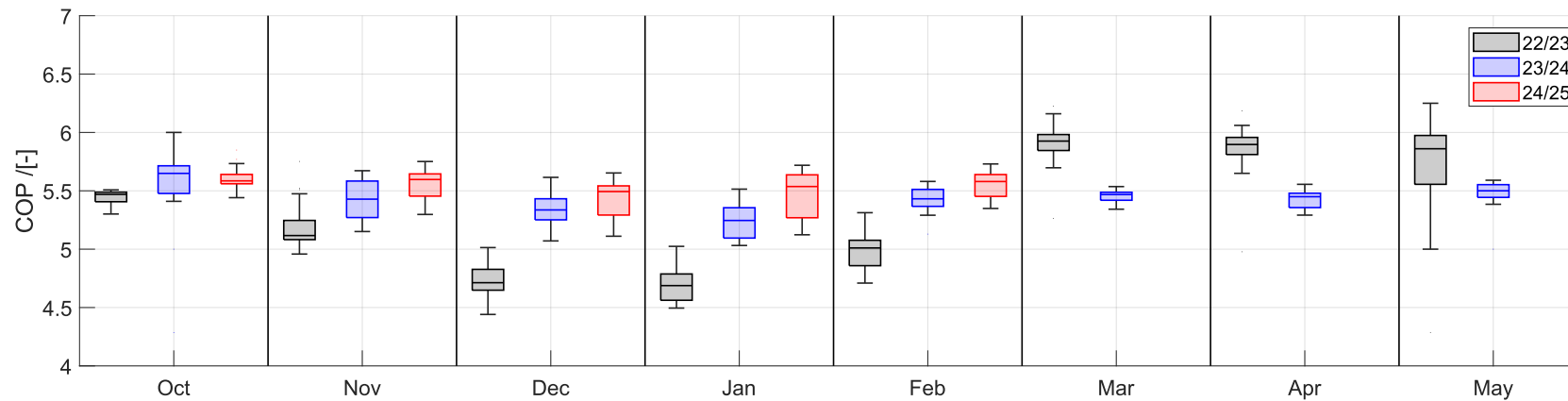
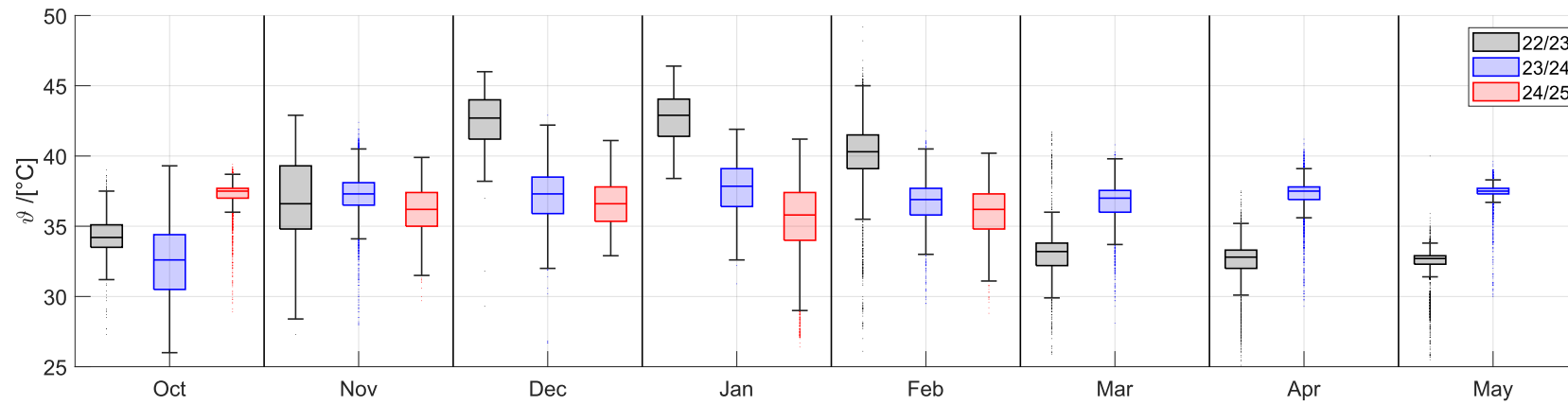


Innsbruck Informiert

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.

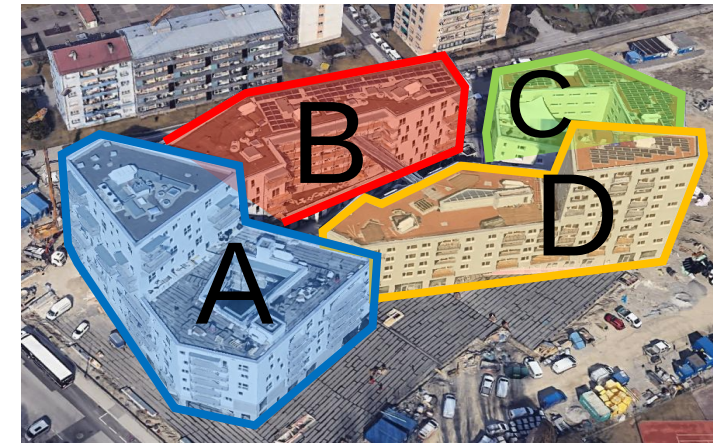
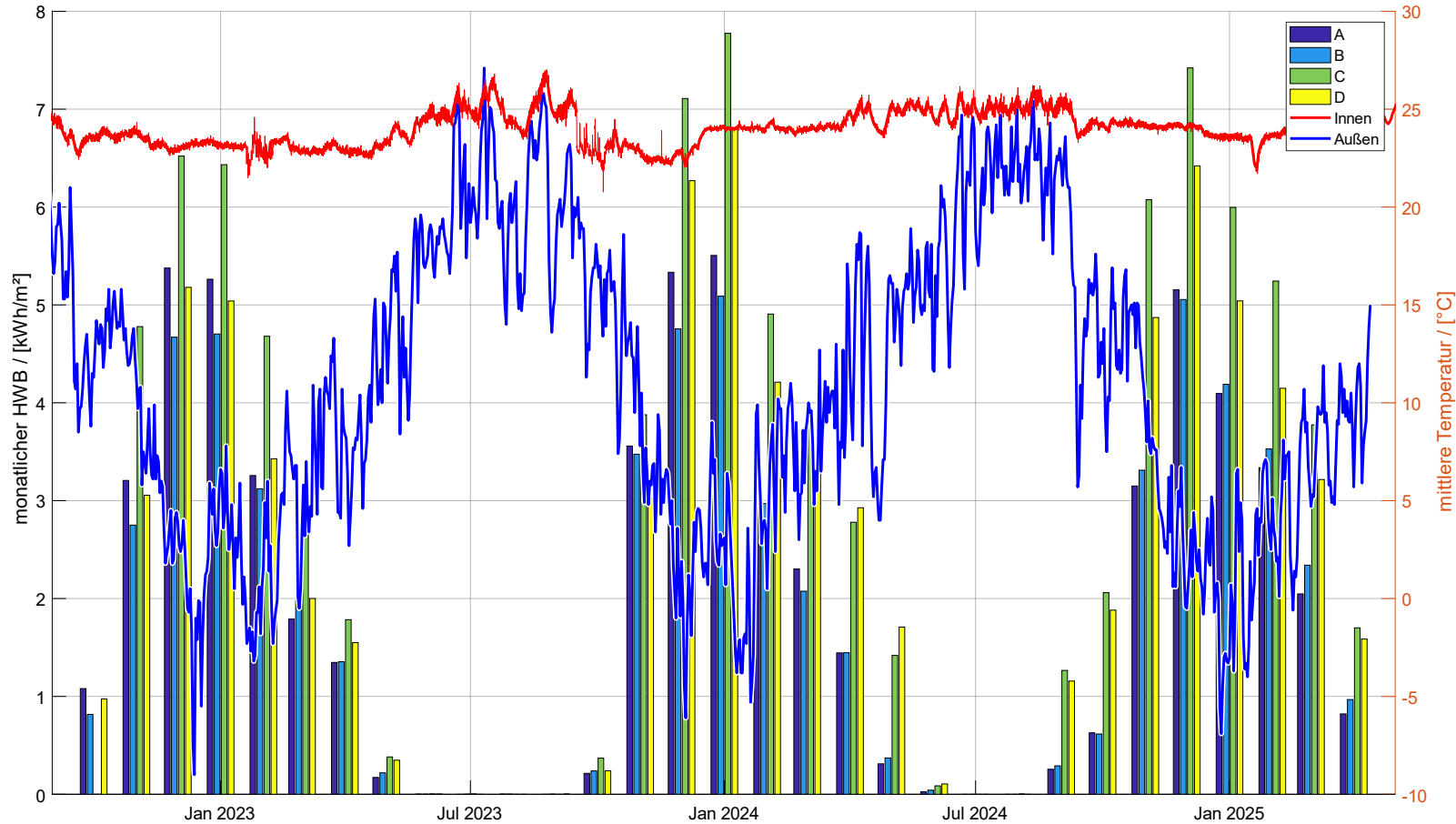
Venturi, Elisa; Ochs, Fabian; Breuss, Samuel; Magni, Mara; Dermentzis, Georgios (2026): Monitoring-Based Analysis of Decentralized Domestic Hot Water Preparation in Large Multi-Family Buildings. Proceedings of the 15th REHVA HVAC World Congress - CLIMA 2025. Conference proceedings, Volume 1, Milan, Italy,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

HP Performance (Monitoring)



Google Earth

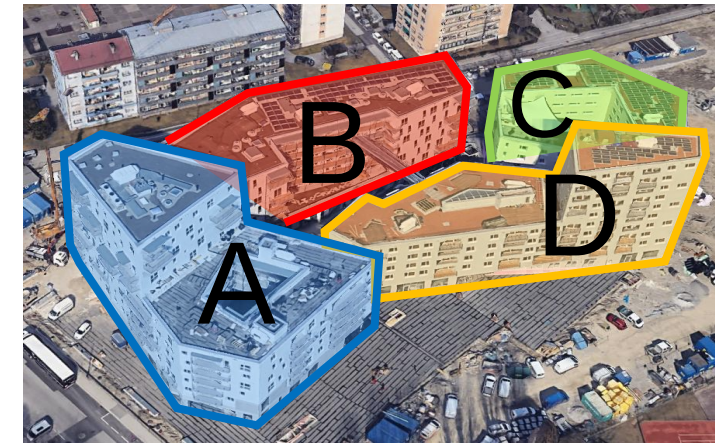
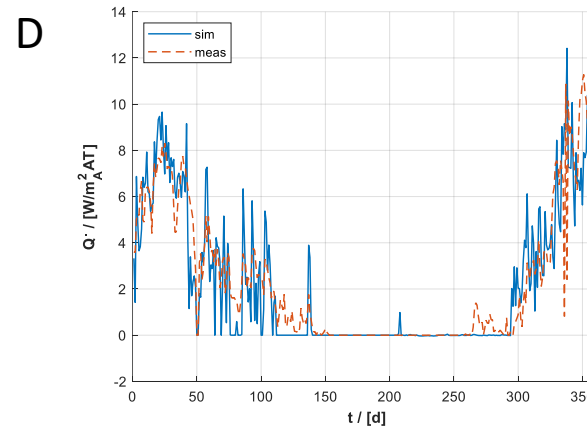
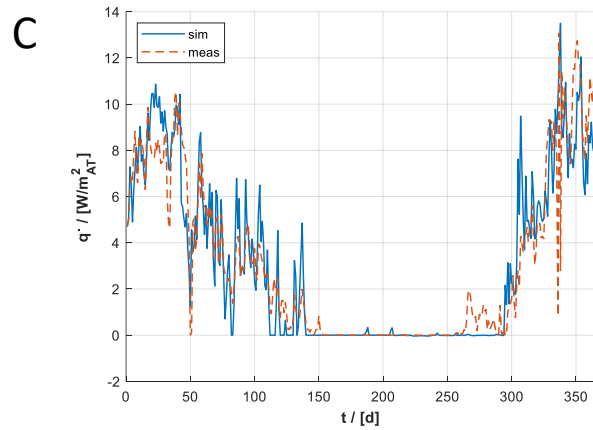
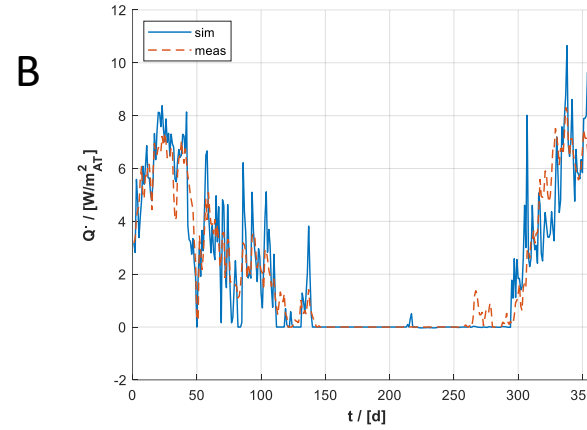
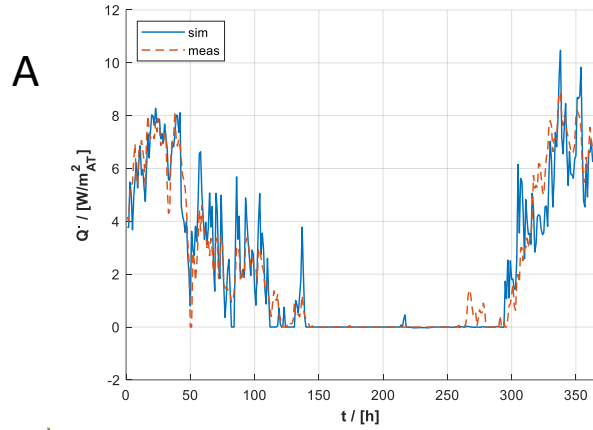
Space Heating Demand



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

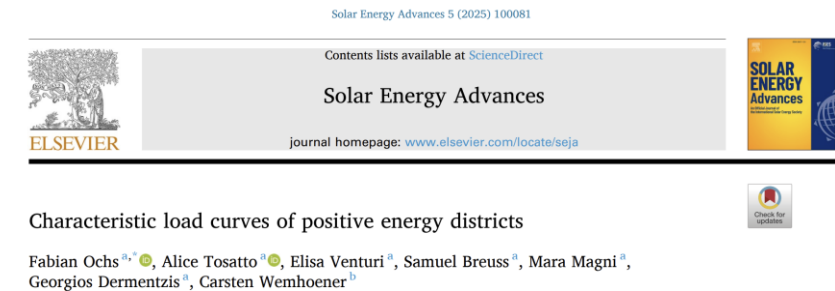
Building Level - Space Heating Demand



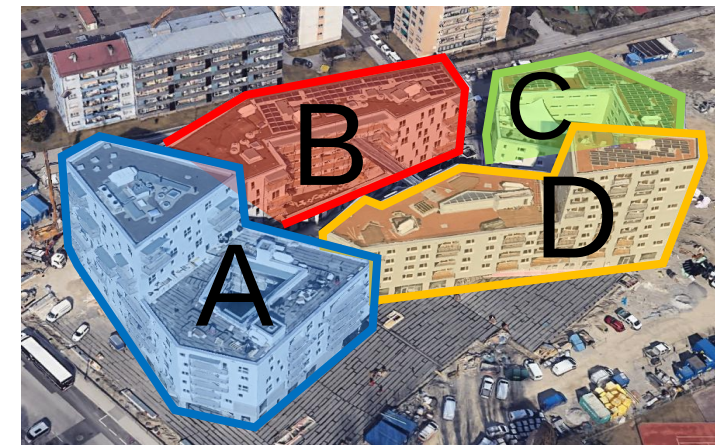
Google Earth

Many unknowns remain ...

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

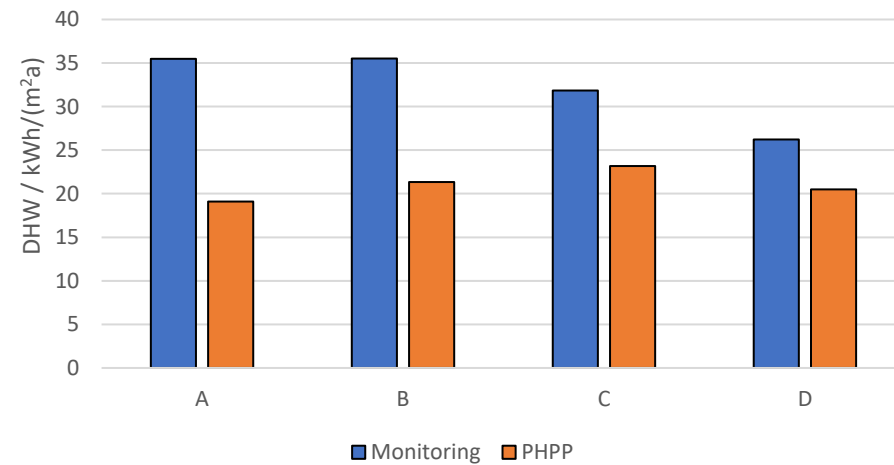


DWH - Monitoring

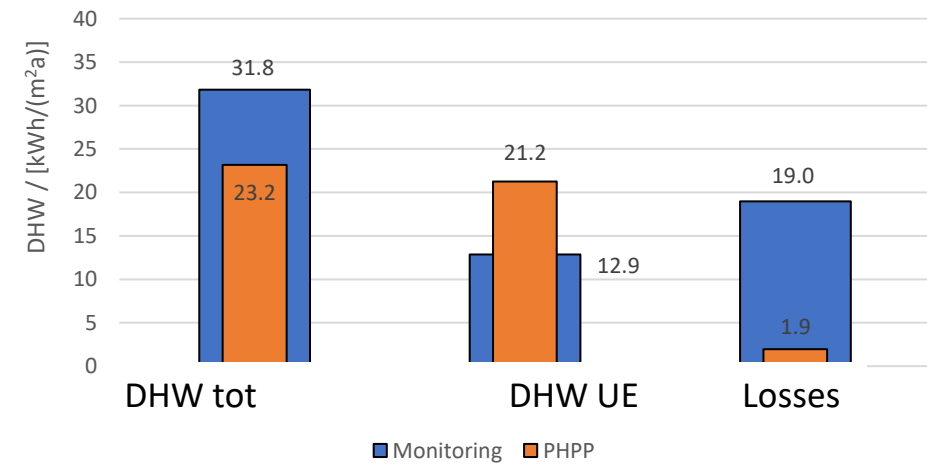


Google Earth

Building A, B, C, D

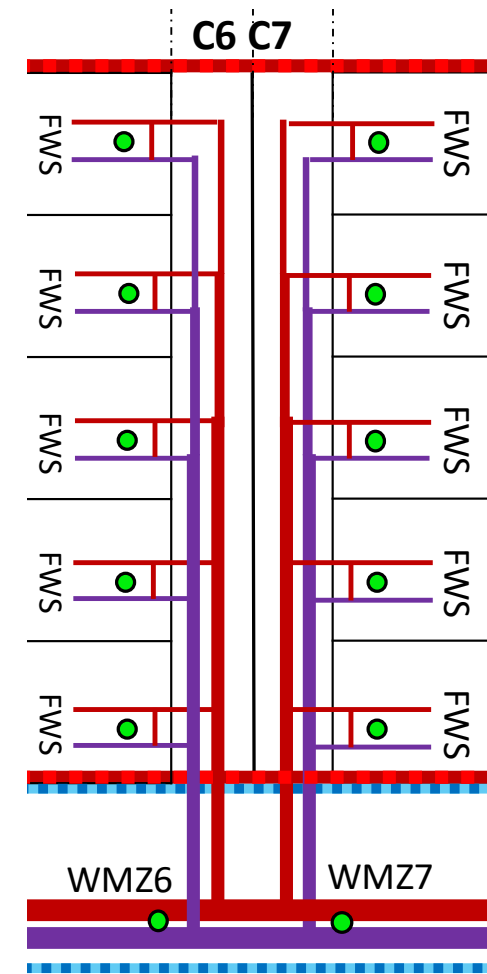
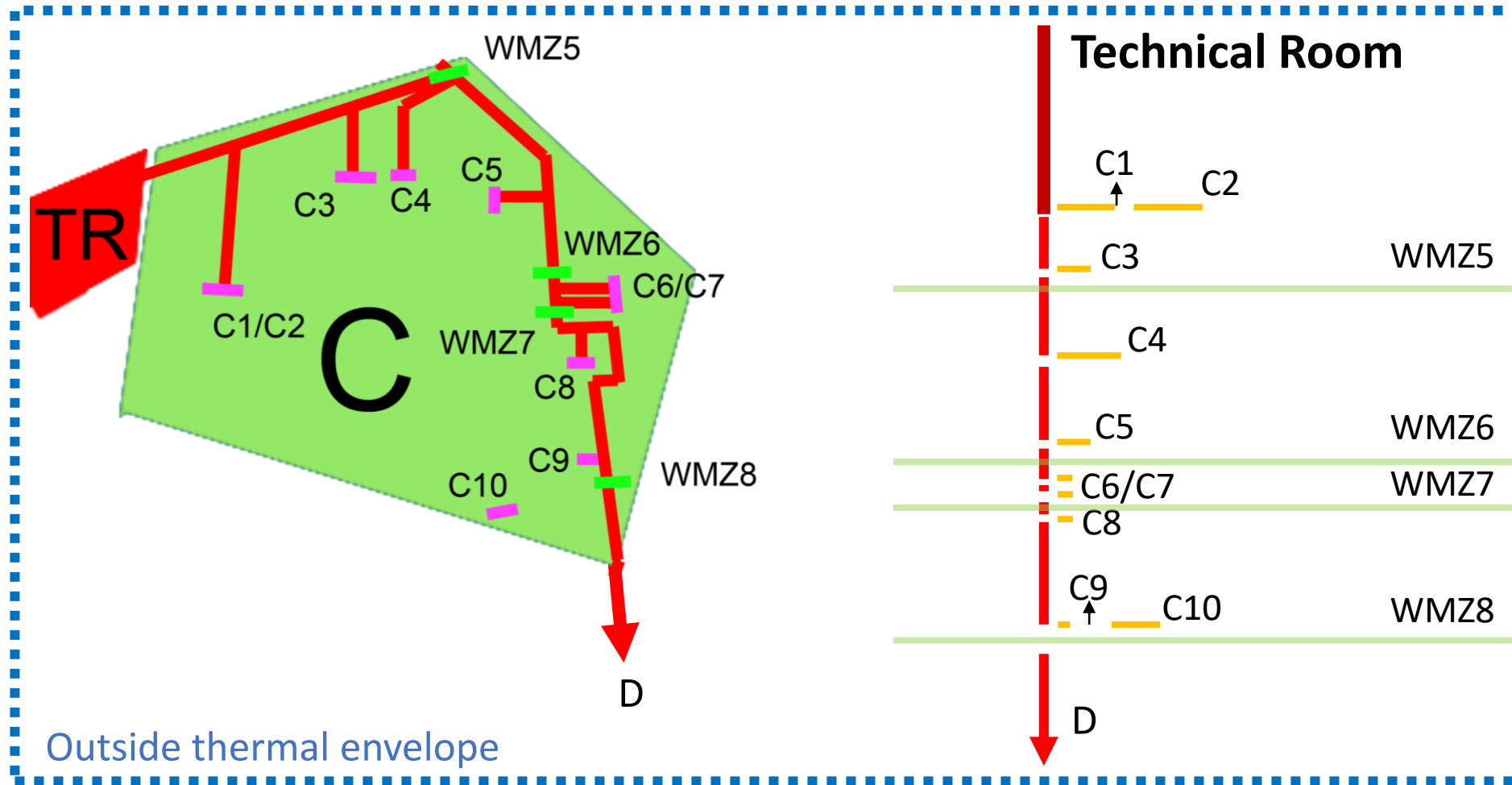


Building C

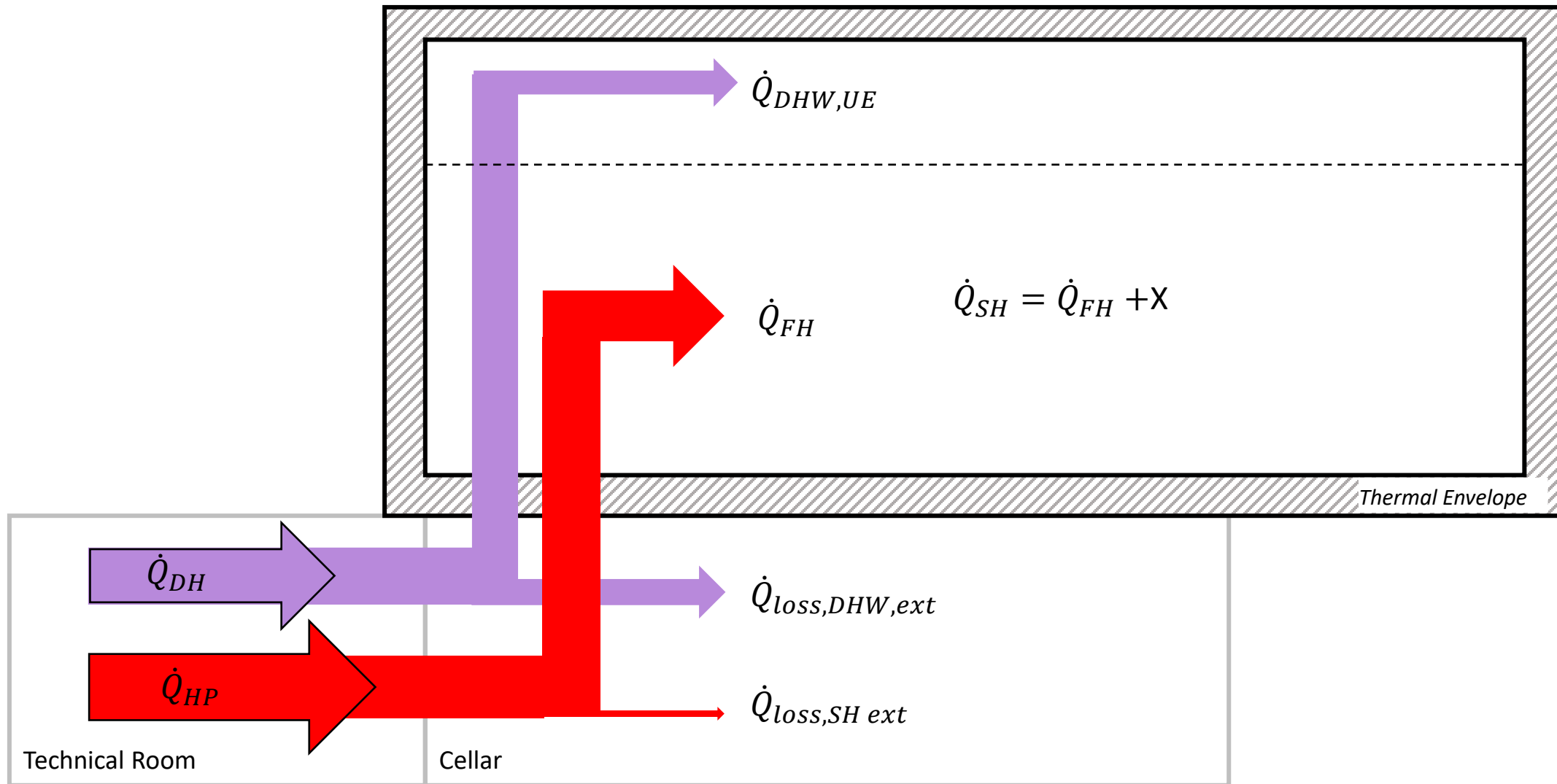


DHW Demand and Distribution Losses

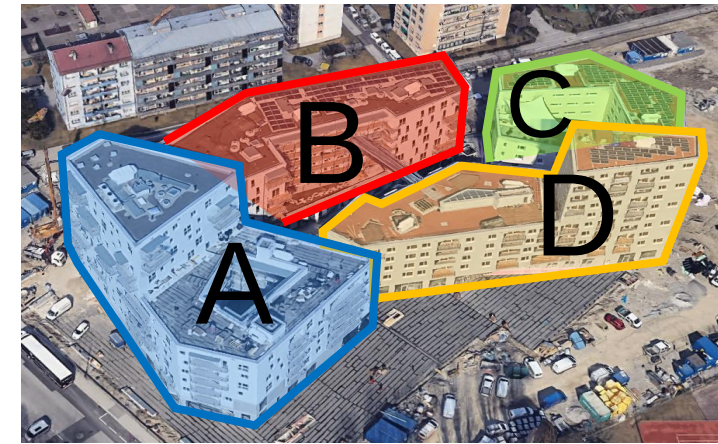
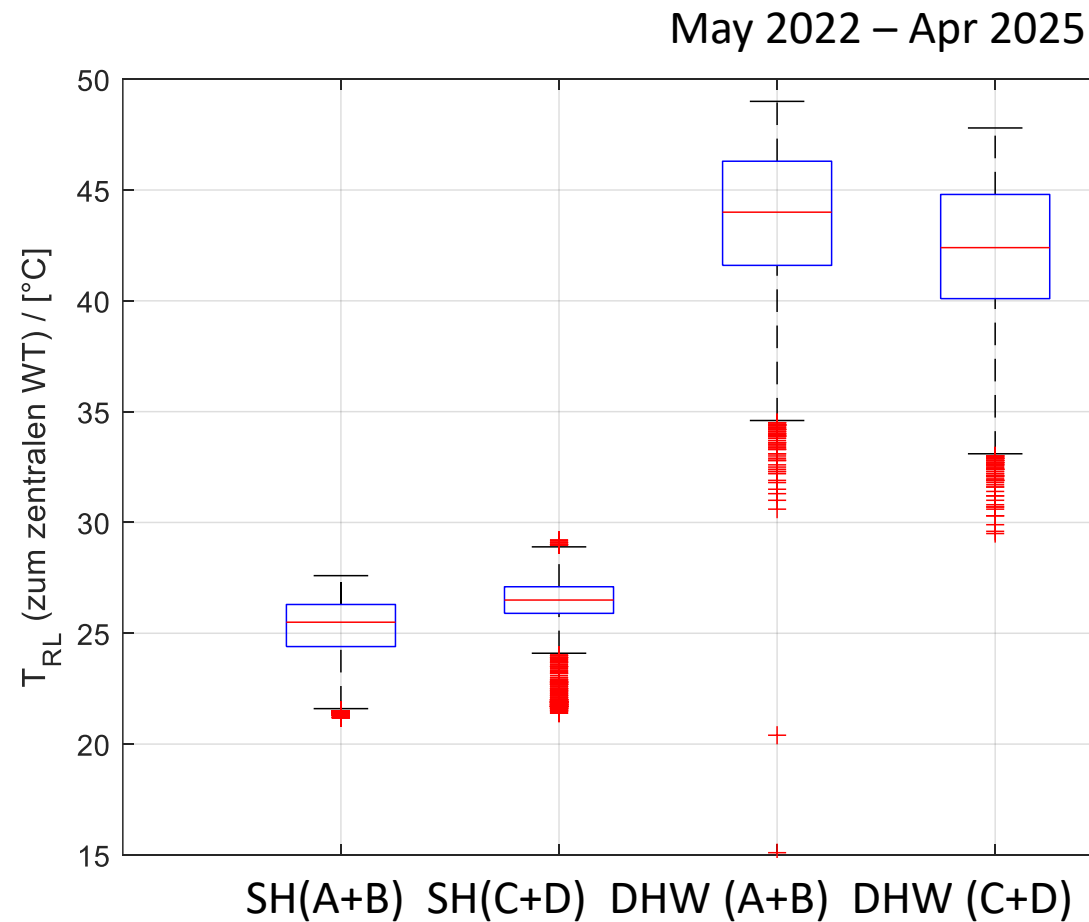
● Heat Meter



SH + DHW – uncontrolled heat



Flow and Return Temperatures

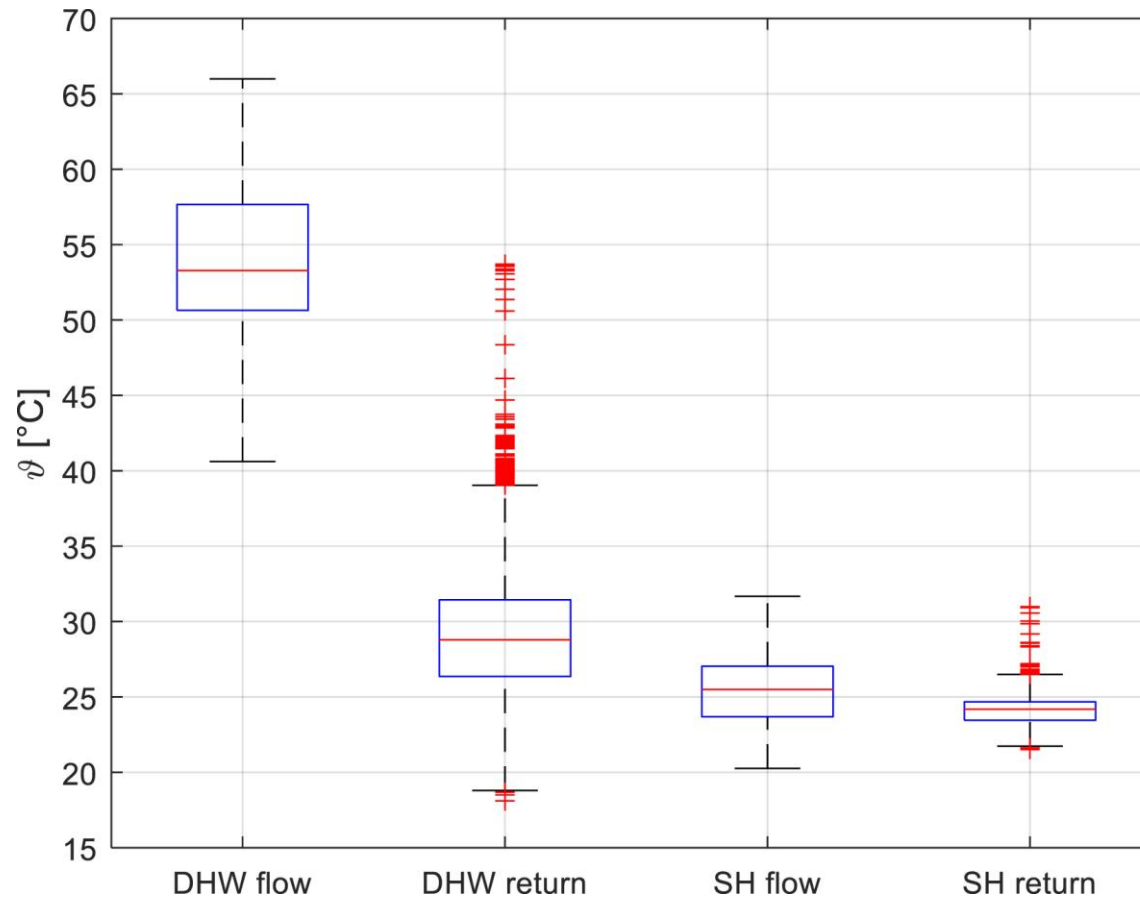


Google Earth

SH: space heating
DHW: domestic hot water

Flow and Return Temperatures

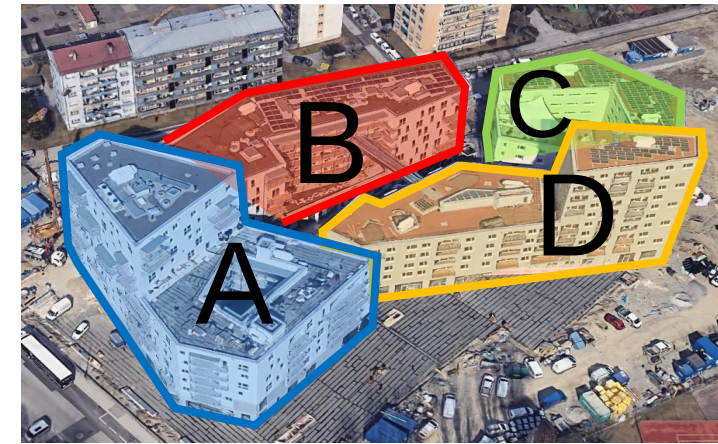
Project – IBK Vögelebichl (NHT)



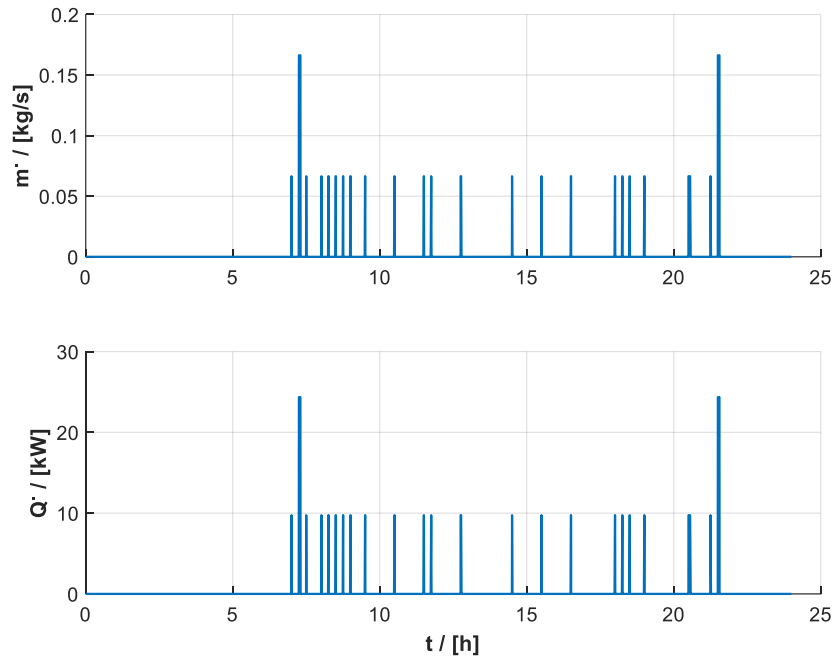
*Dermentzis G., Ochs F., Franzoi N.,
Four years monitoring of heat pump, solar
thermal and PV system in two net-zero
energy multi-family buildings, 2021,
Journal of Building Engineering*

Building Level DHW – Monitoring

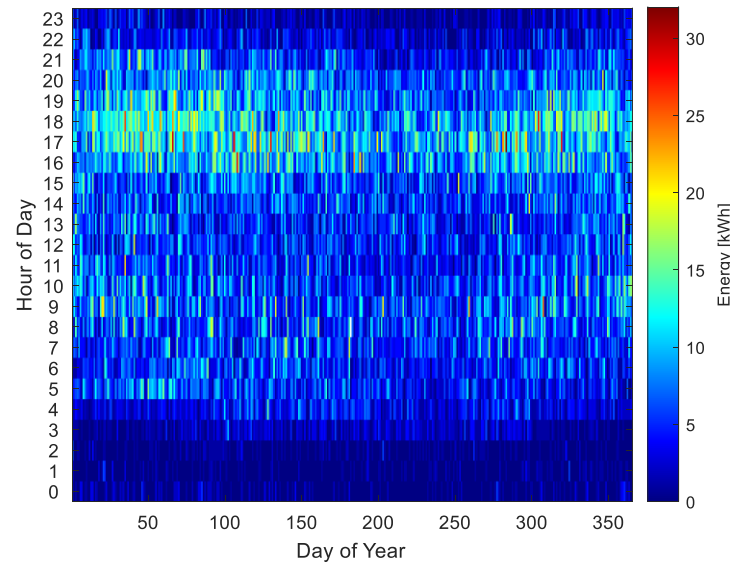
- Design: 25 l / d / P @ 60 °C (energy equivalent)
- Tapping profile acc. to 16147



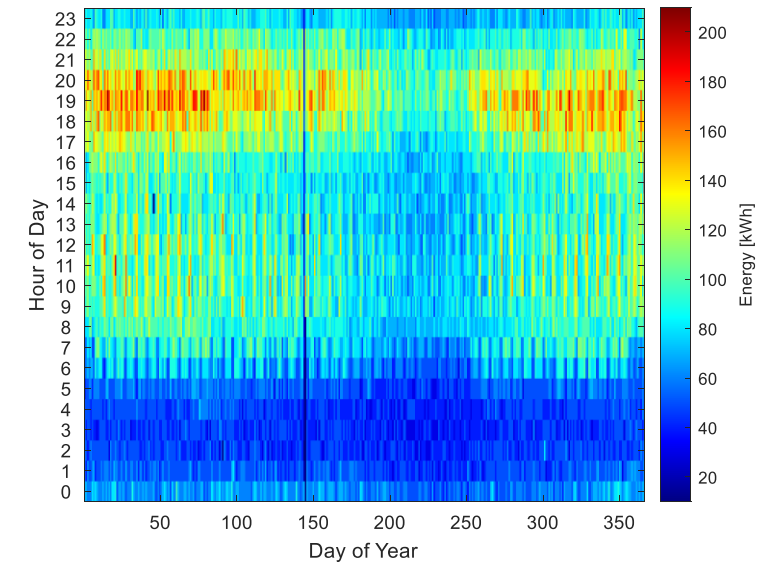
Google Earth



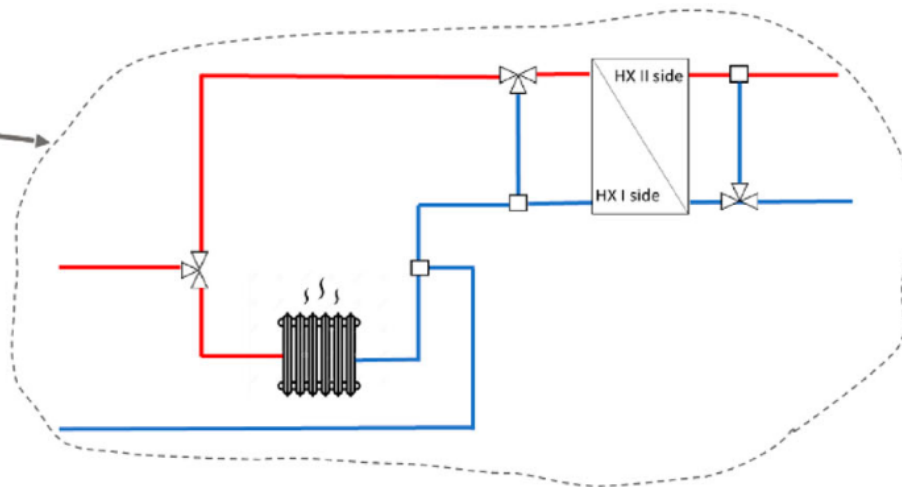
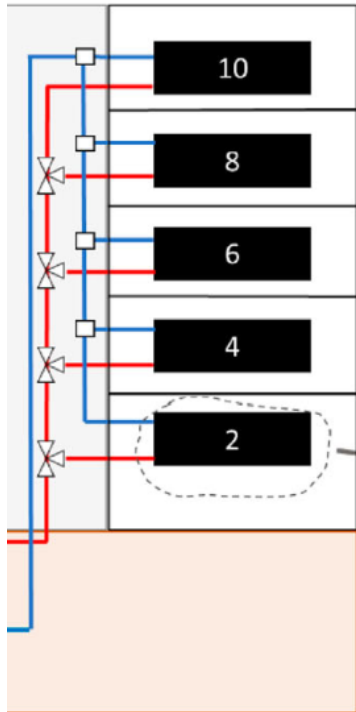
Building C DWH Demand



Heating Central (A + B + C + D)



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

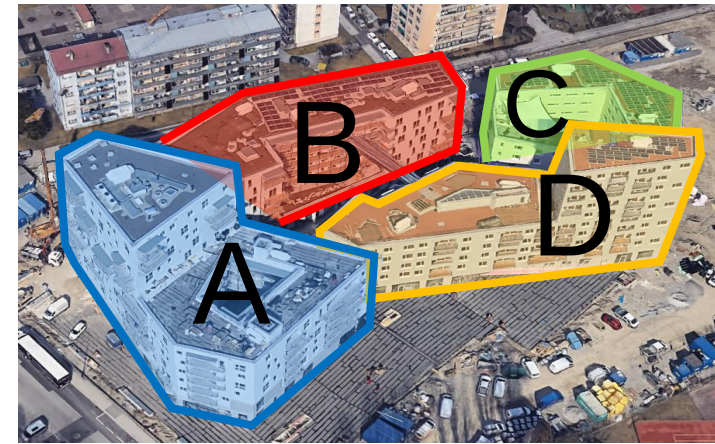
Complex hydronic systems in multi-apartment buildings: modelling approaches and dynamic simulations

Elisa Venturi , Fabian Ochs , Georgios Dermentzis  & Mara Magni 

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

Conclusions and Outlook

- 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 ...



Google Earth

Thank you ...

Acknowledgements

IEA HPT Annex 61 HP in PED (FFG)

Campagne Monitoring (FFG)

EU Life KnowHowHP

