

Lucerne University of
Applied Sciences and Arts

**HOCHSCHULE
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Technik & Architektur

Five-year energy monitoring of a low-temperature heating and cooling network

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Horw

3rd International Conference on
Smart Energy Systems and 4th Generation District Heating

Timeline

1. Introduction on low-temperature district heating and cooling networks
2. The example of the district "Suurstoffi"
3. Why an energy monitoring?
4. Conclusions and lessons learned from the "Suurstoffi" district



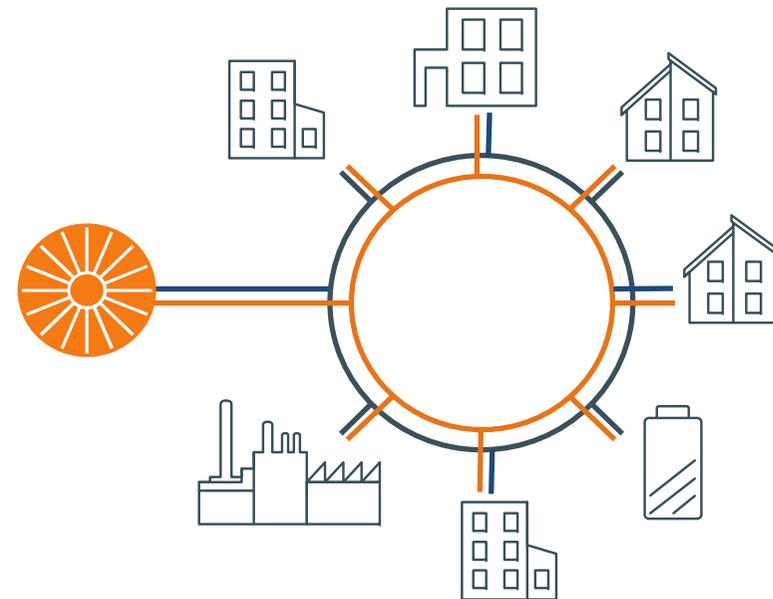
Thermal networks

Standard typology



**High-temperature network
unidirectional**

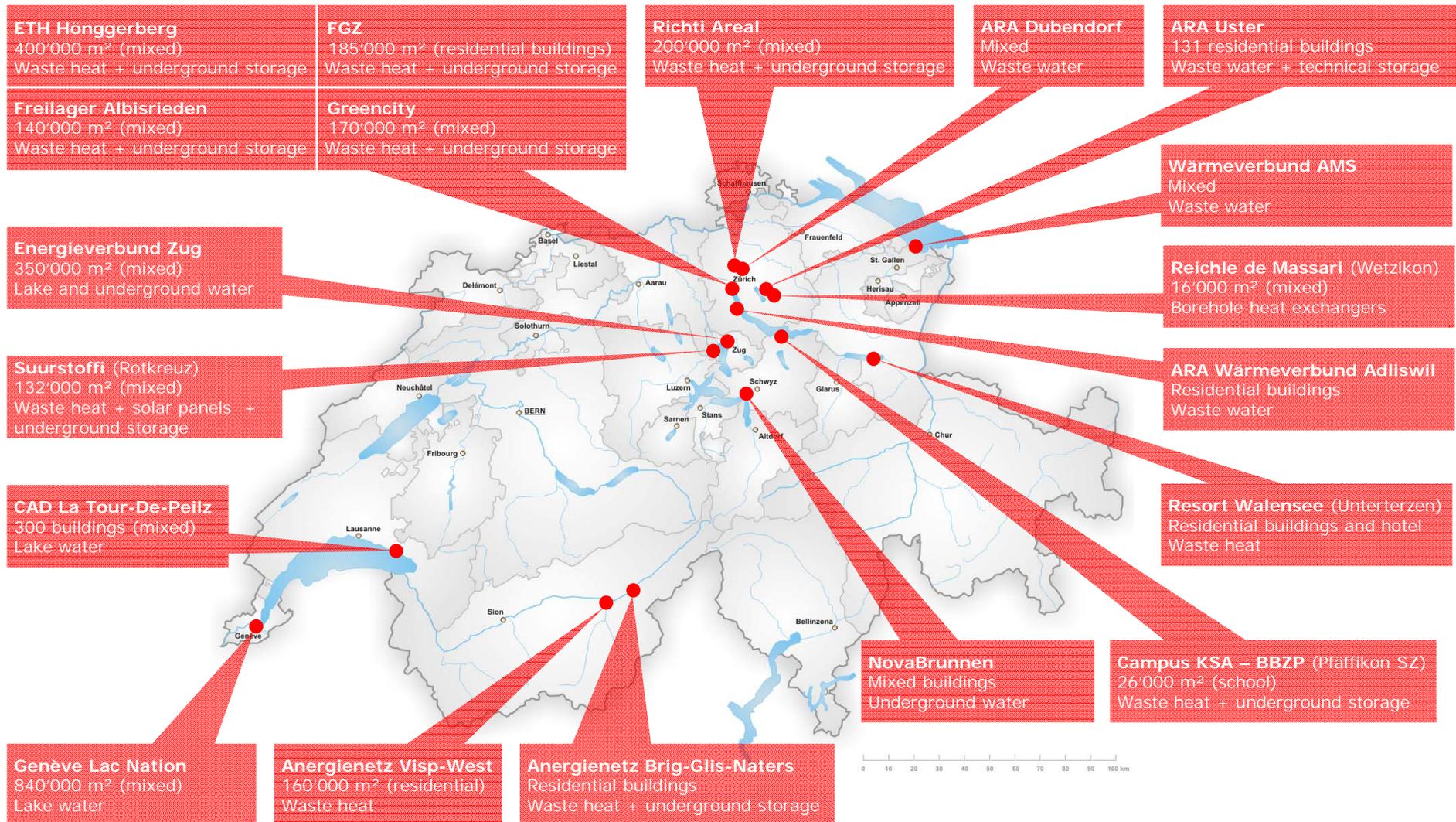
New typology



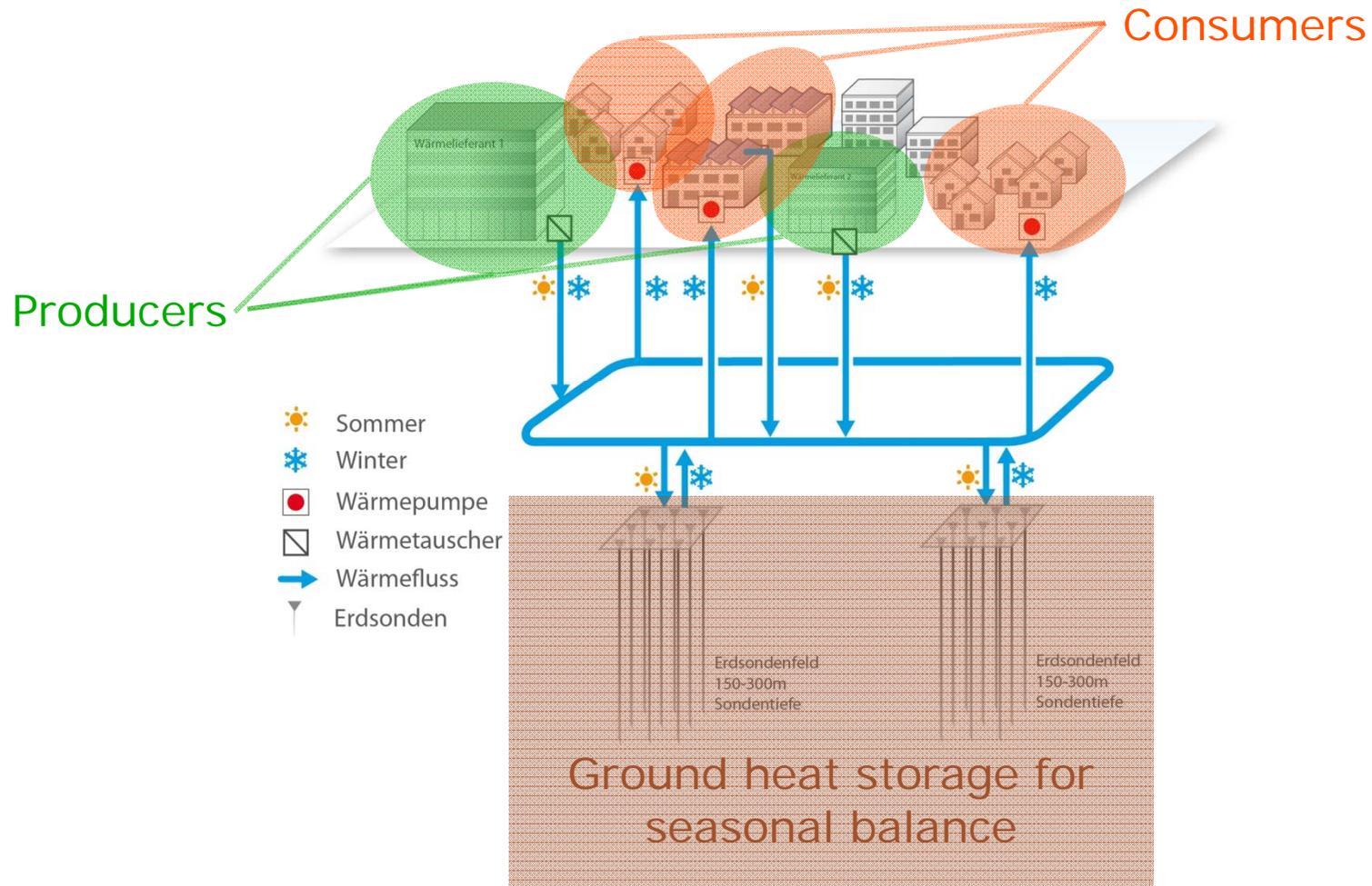
**Low-temperature network (LTN)
bidirectional**



Existing LTN in Switzerland



LTN with seasonal storage





The Suurstoffi district

- low temperature district heating and cooling network (LTN)
- in operation since 2012
- The LTN connects residential buildings, offices and industrial buildings (= consumers and producers) to borehole heat exchangers (215 pieces à 150 m depth), which act as a geothermal storage.
- In its final state, the whole district will include approximately 165'000 m² energy reference area and the geothermal storage will have more than 700 boreholes down to 250 m depth.



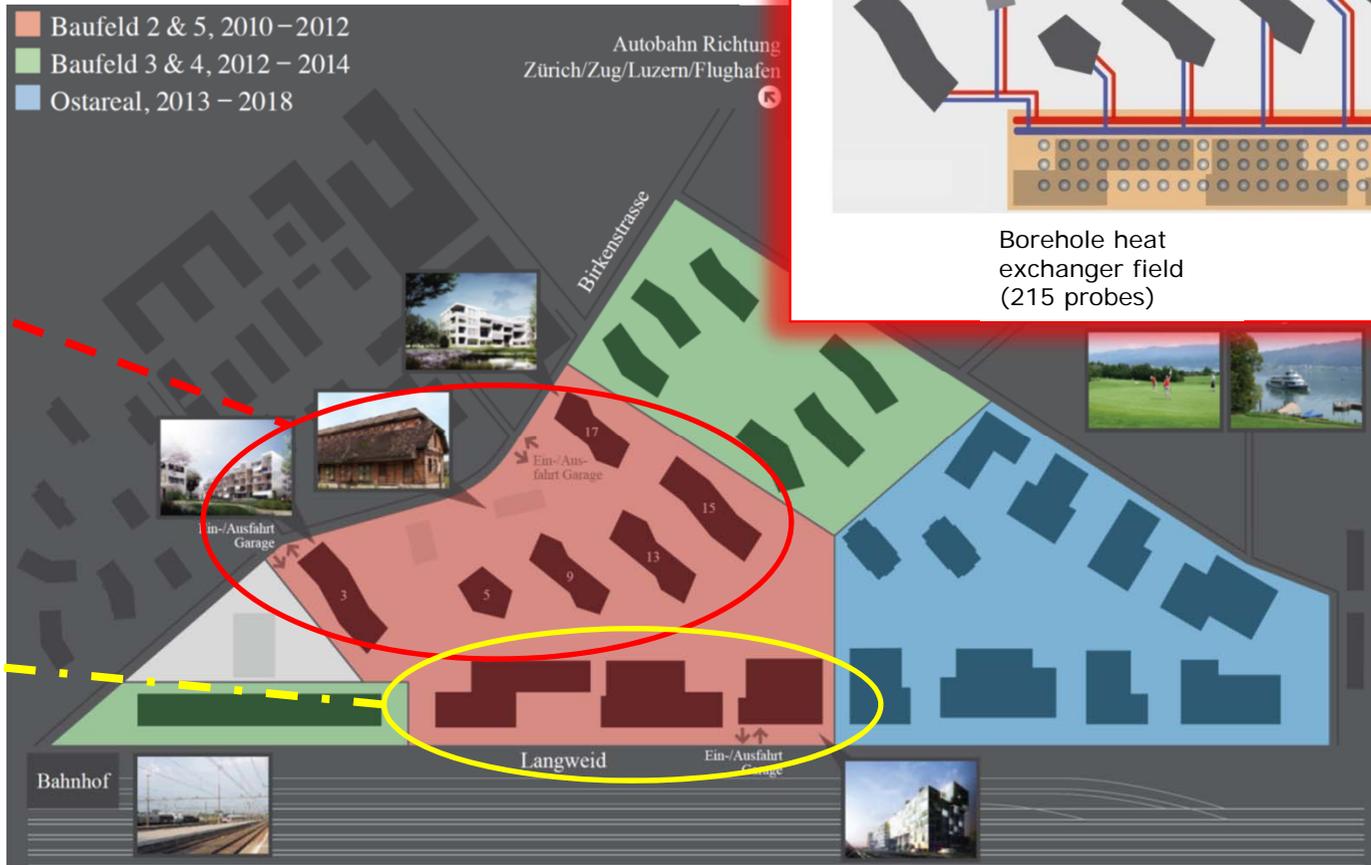


The Suurstoffi district

Building field 2:

19'540 m²

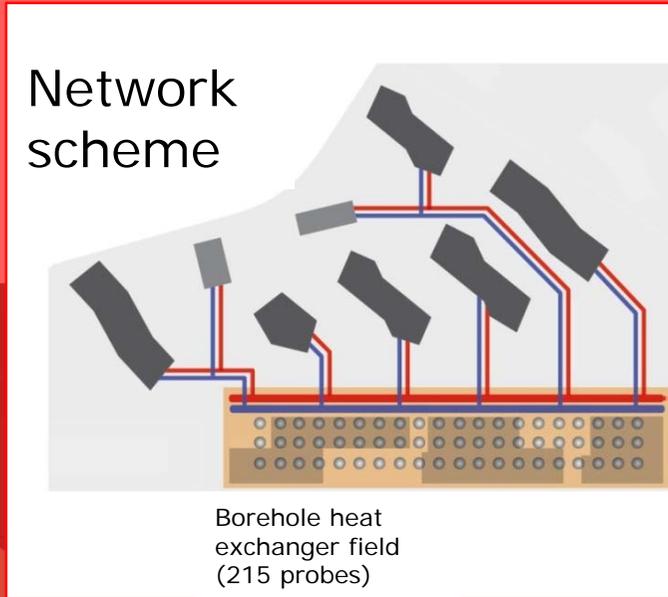
In operation since 2012



Building field 5:

27'250 m²

In operation since 2013



Source: Zug Estates

Final state (2020): 165'000 m²

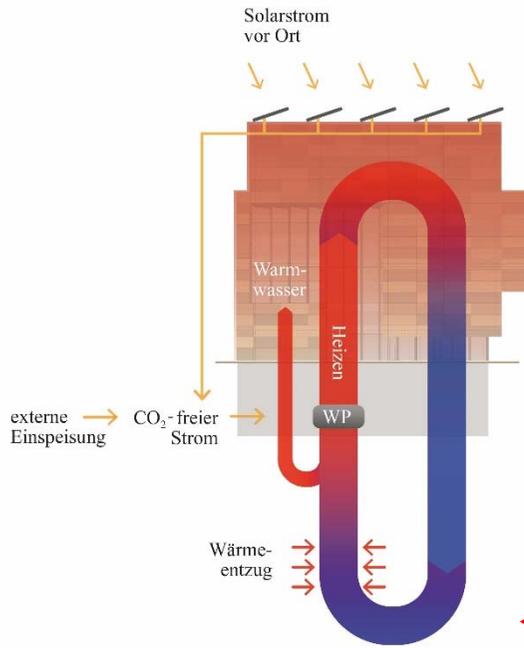
The energy concept

- Heating and domestic hot water are produced by means of decentralised heat pumps, which are connected to the LTN.
- Waste heat deriving from cooling installations in the buildings is used to regenerate the geothermal storage.
- Conventional (PV) and hybrid solar panels (PVT) installed on the roofs of the buildings shall cover the entire electricity demand for the buildings operation (heat pumps, circulating pumps, HVAC, etc.).
- In addition, the PVT panels shall supply additional heat to load the ground storage for its seasonal regeneration.

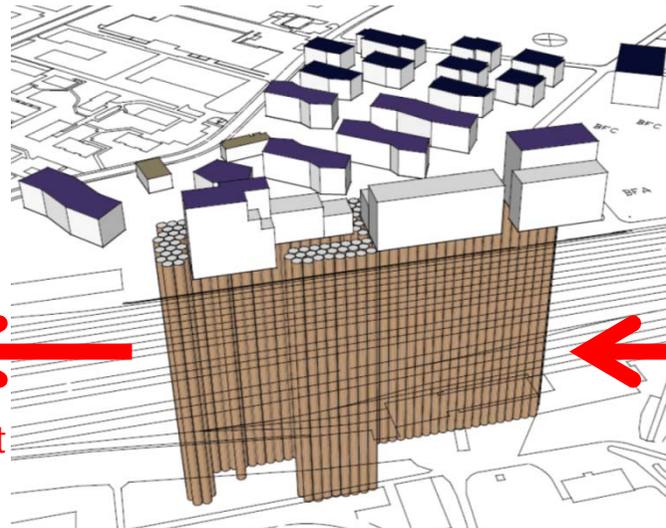


«Anergy» network

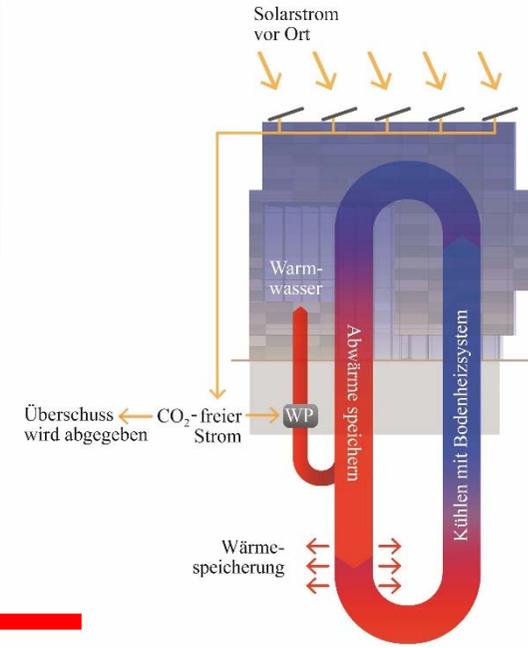
Winter



Uptake of heat through heat pumps

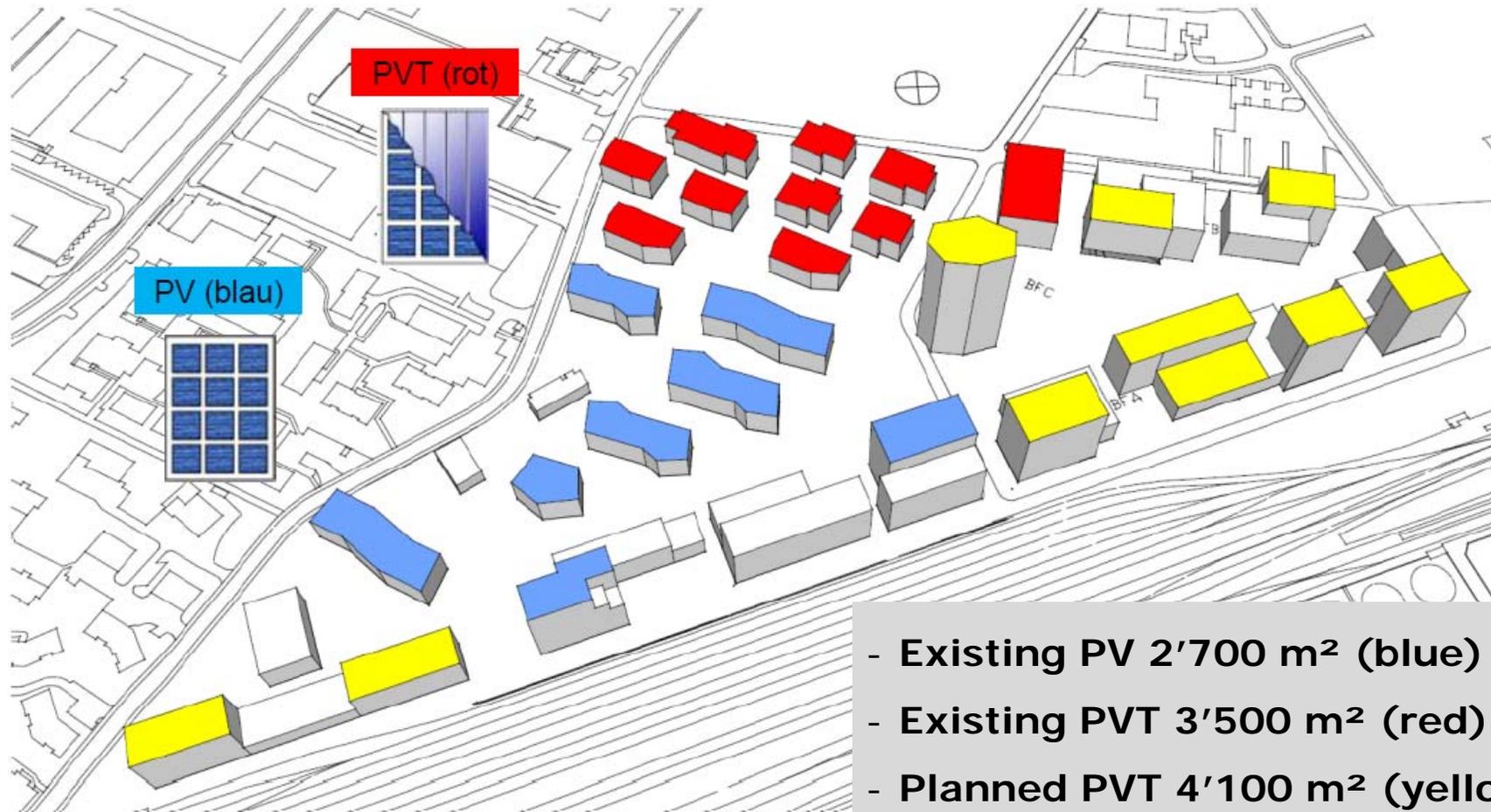


Sommer



Heat supply through freecooling

Solar energy integration in the system





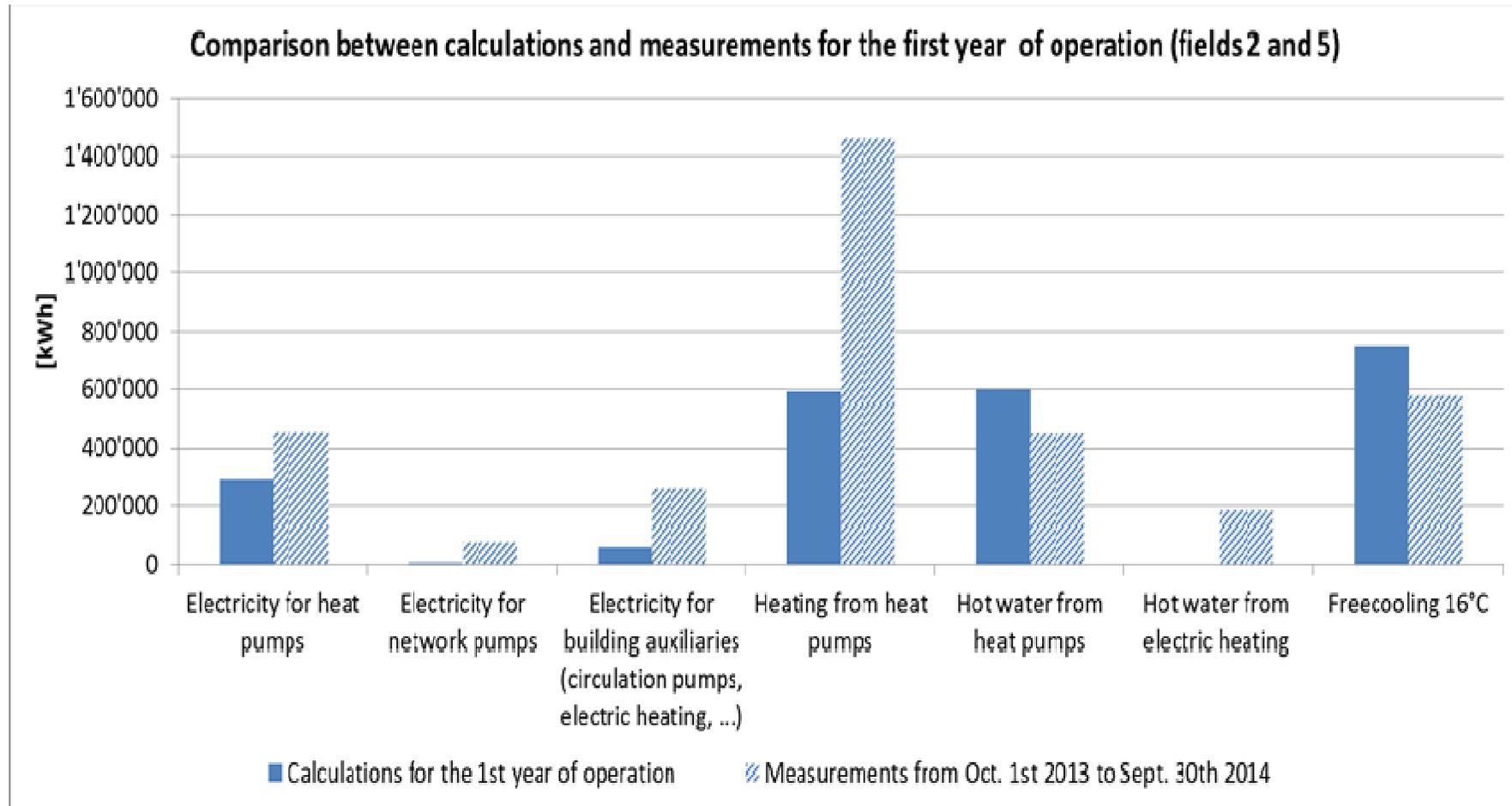
Energy monitoring

- In order to verify the objectives, the LTN "Suurstoffi" is being monitored for at least five years.
- Every heat and power flux as well as temperature change are measured in a 15 minutes interval resulting in more than 300 data points over the existing building fields 2 and 5.
- The Lucerne School of Engineering & Architecture has been analysing the measured data since 2012.
- The results have been regularly compared with the original calculations used for the network design.



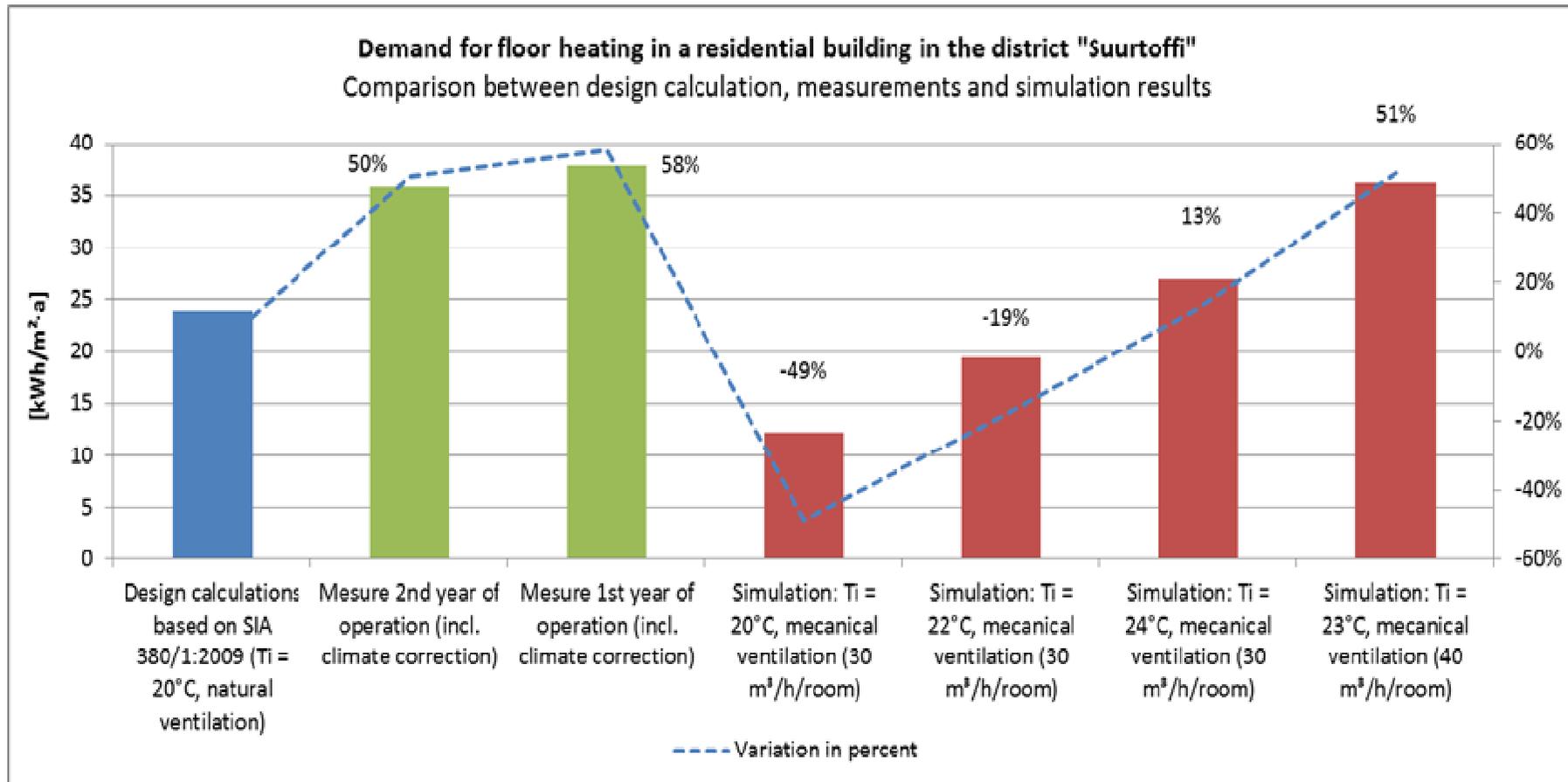


Example of comparison of the calculations with the measurements



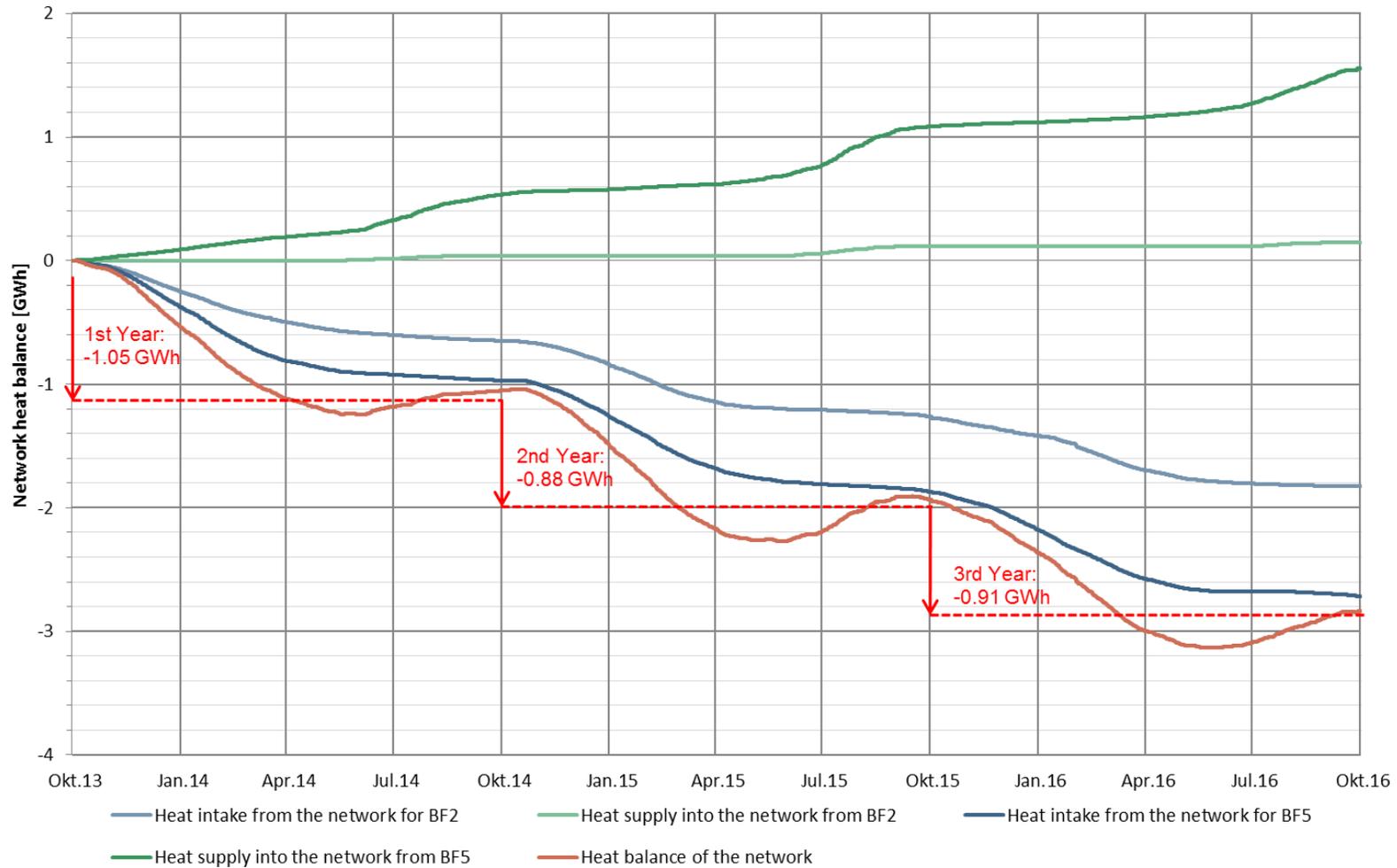


Comparison of the calculations with the measurements and simulations



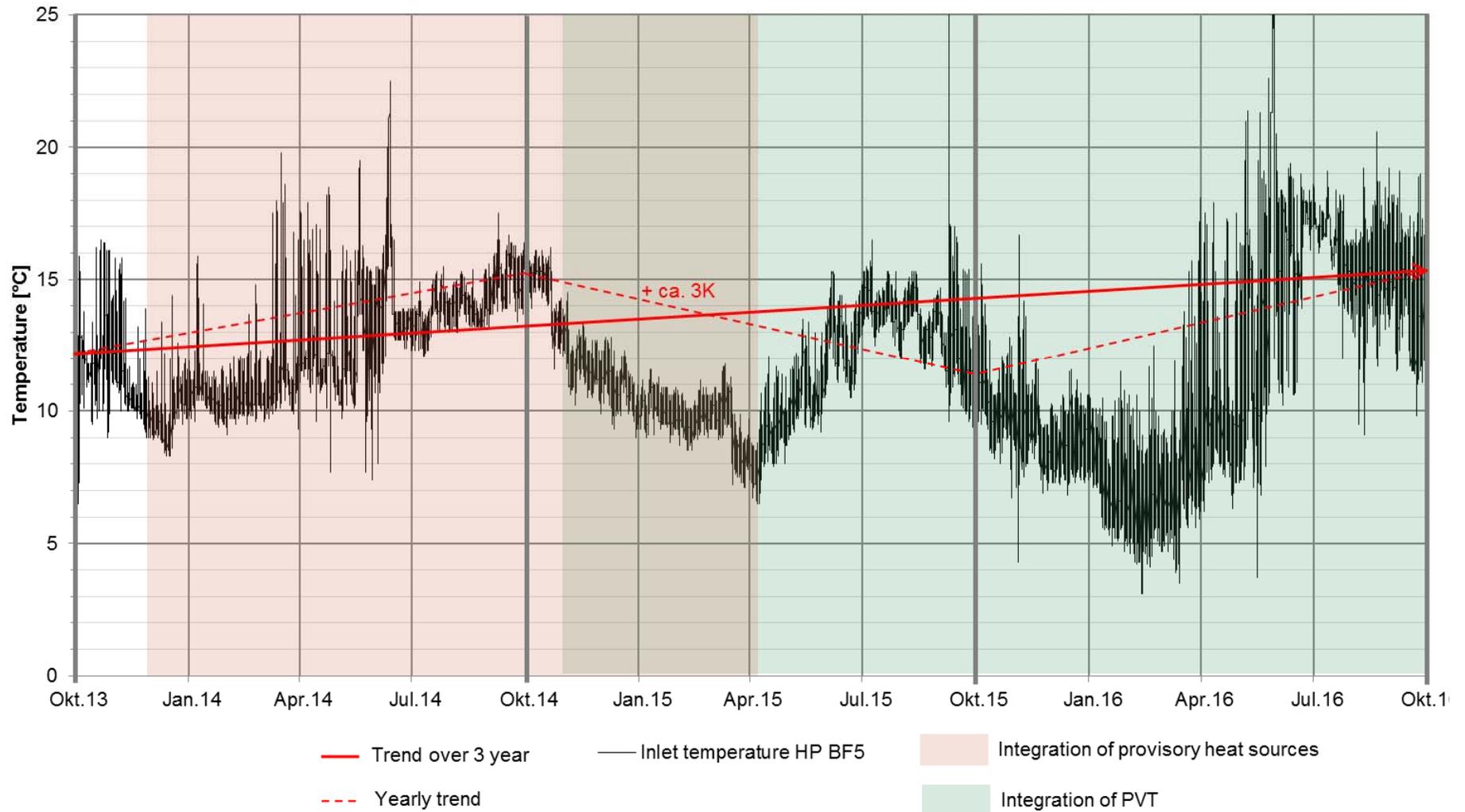


LTN heat balance over 3 operation years (without integration of PVT nor provisory heat sources)





Measured water temperature of the network over 3 years (at evaporator inlet of heat pump BF5)



Benefits from the energy monitoring in Suurstoffi

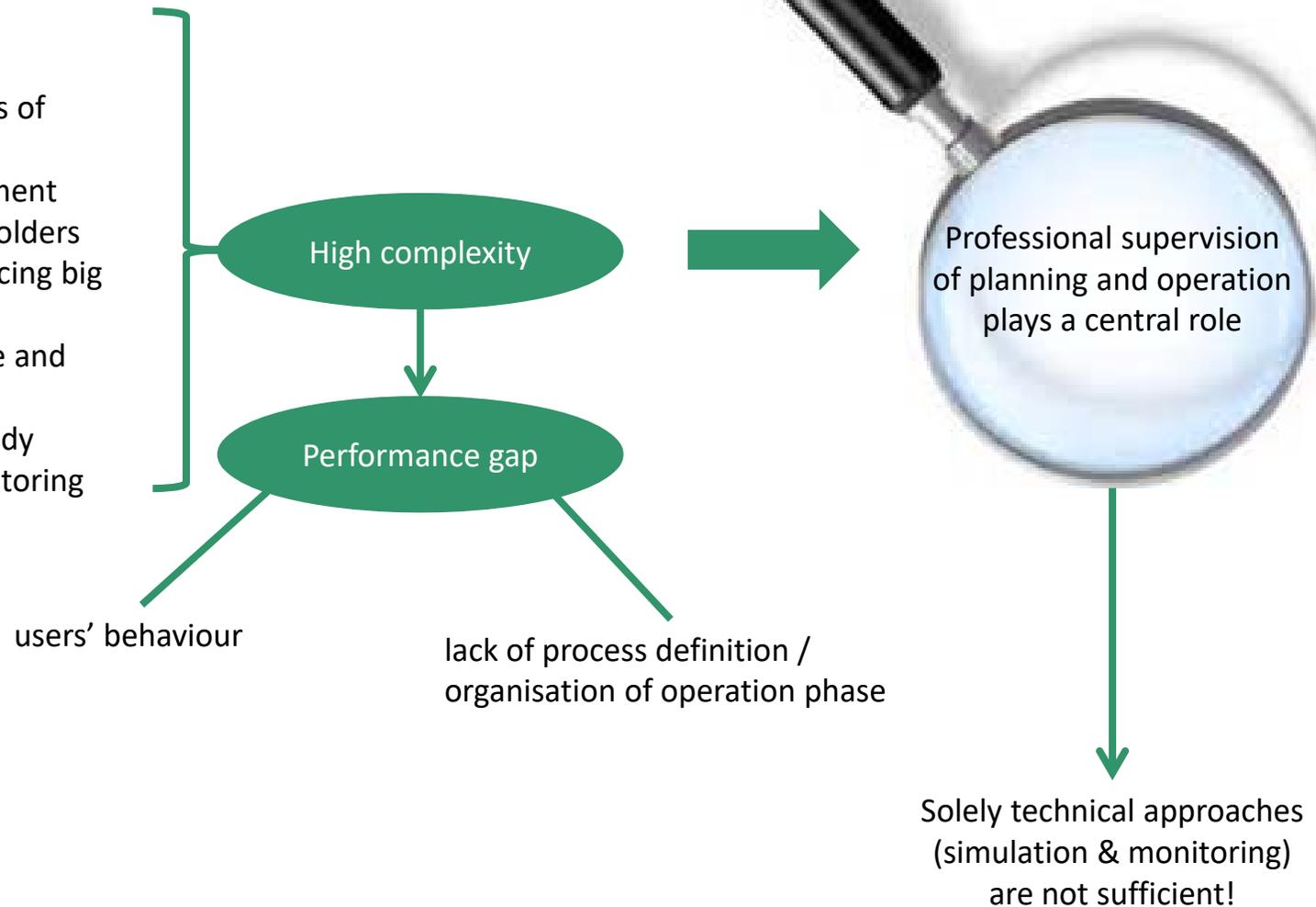
The importance of monitoring has been demonstrated once more in the project "Suurstoffi":

- The measurements were compared with the calculations in order to identify planning errors.
- The gap between the calculated and the effective energy demand was used as a basis for the calculations of the new building areas in order to reduce further errors.
- The monitoring of the project constitutes an important data base and benchmark for future projects in the field of thermal networking.
- A simulation model of thermal networking could be calibrated with real data.



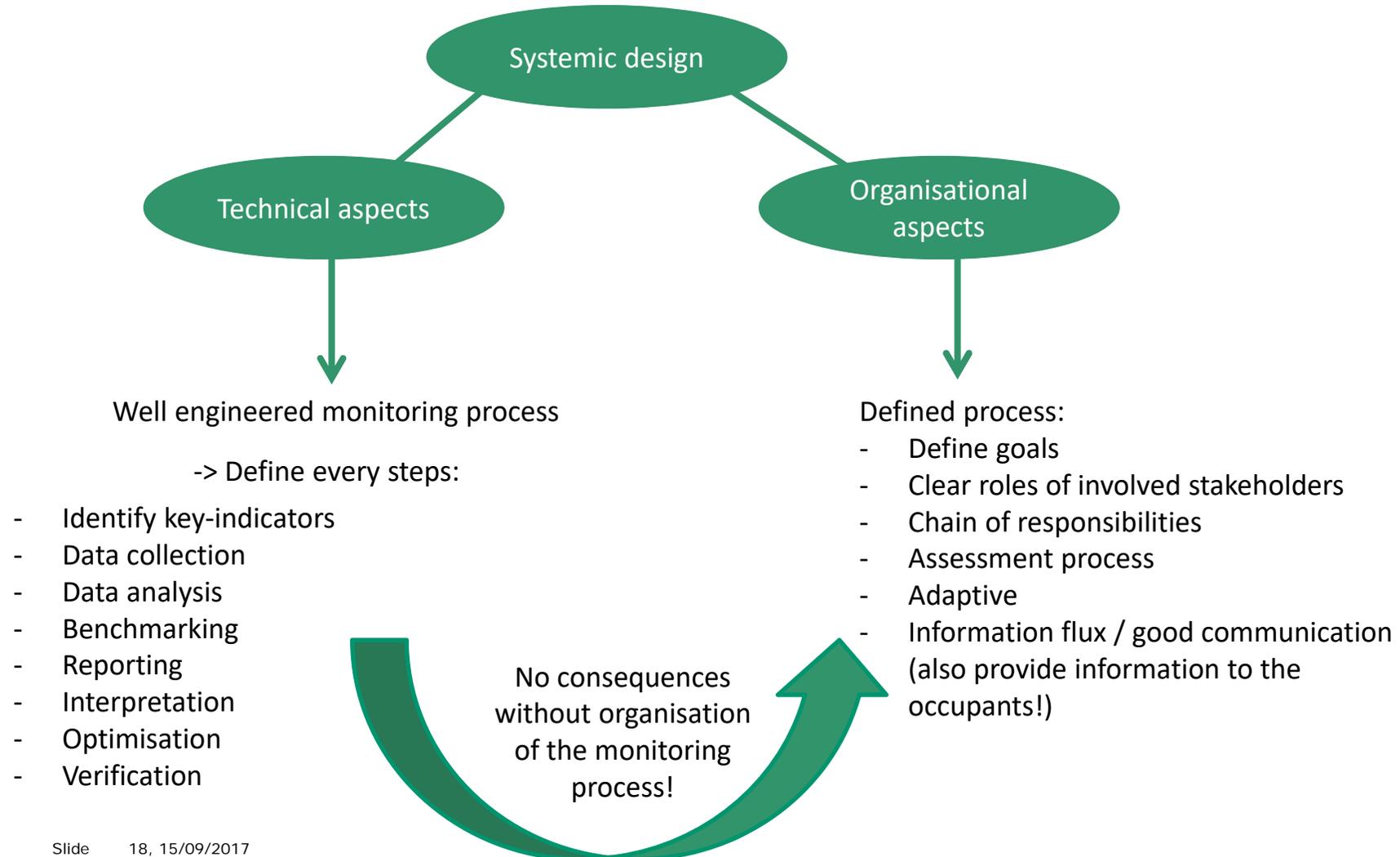
Conclusions

- Project size
- New technologies
- Interdependencies of technologies
- Ongoing development
- Amount of stakeholders
- Monitoring producing big amount of data
- Lack of experience and knowledge
- lack of market-ready solutions for monitoring





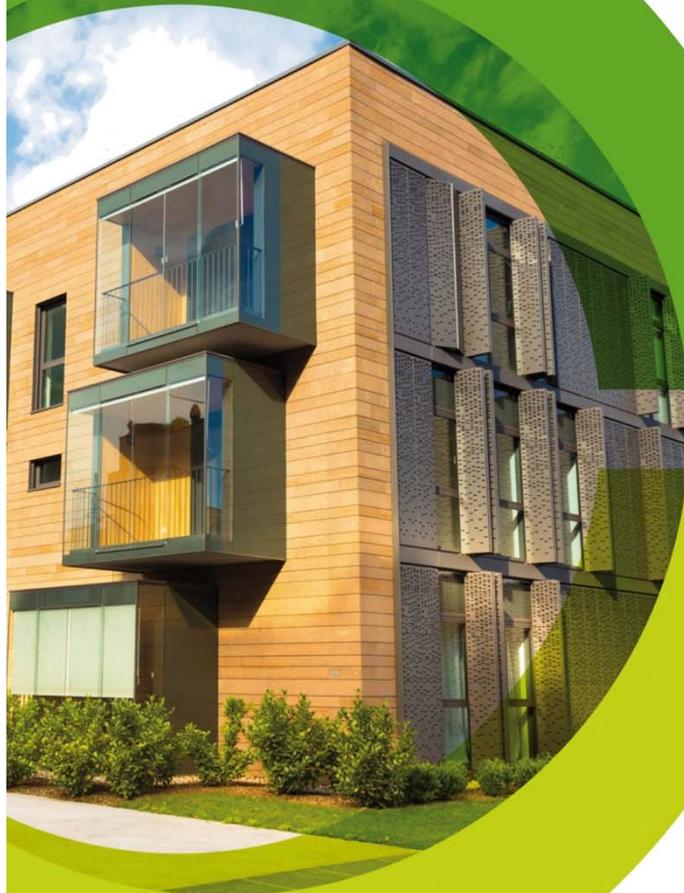
Lessons learned





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Further information at
www.sccer-feebe.ch



In cooperation with the CTI



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