



Lucerne University of  
Applied Sciences and Arts

**HOCHSCHULE  
LUZERN**

Technik & Architektur

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

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Horw

3rd International Conference on  
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## 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



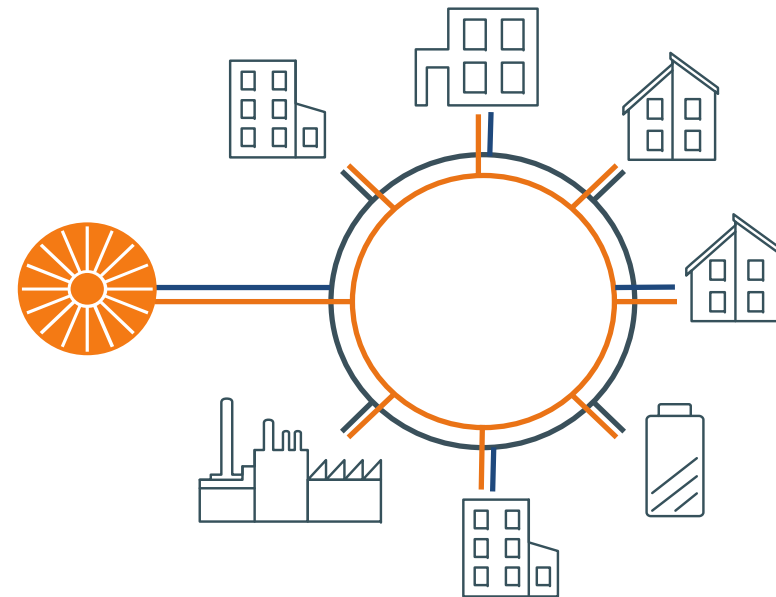
## Thermal networks

### Standard typology



**High-temperature network  
unidirectional**

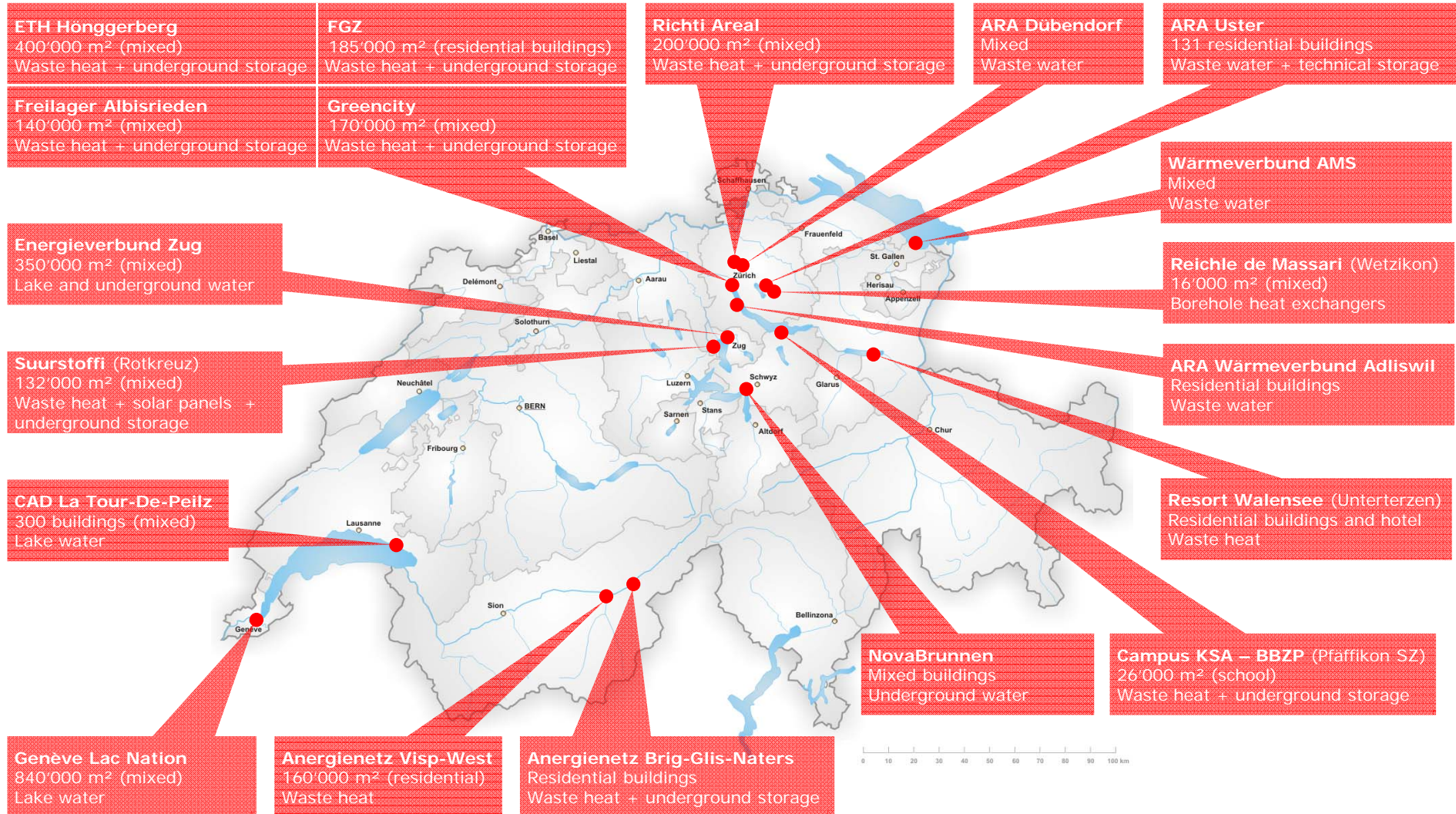
### New typology



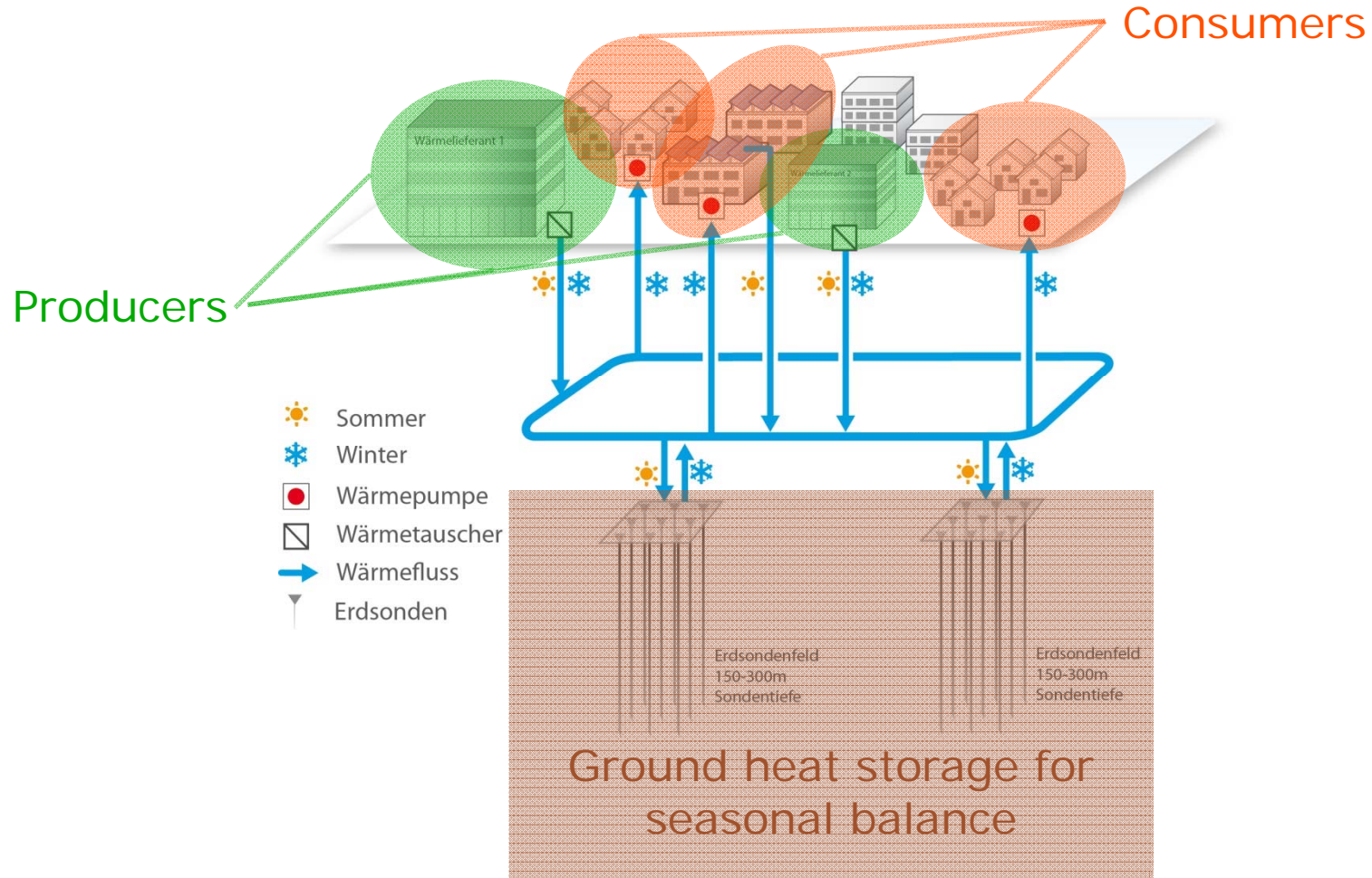
**Low-temperature network (LTN)  
bidirectional**



## 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 m<sup>2</sup> 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 m<sup>2</sup>

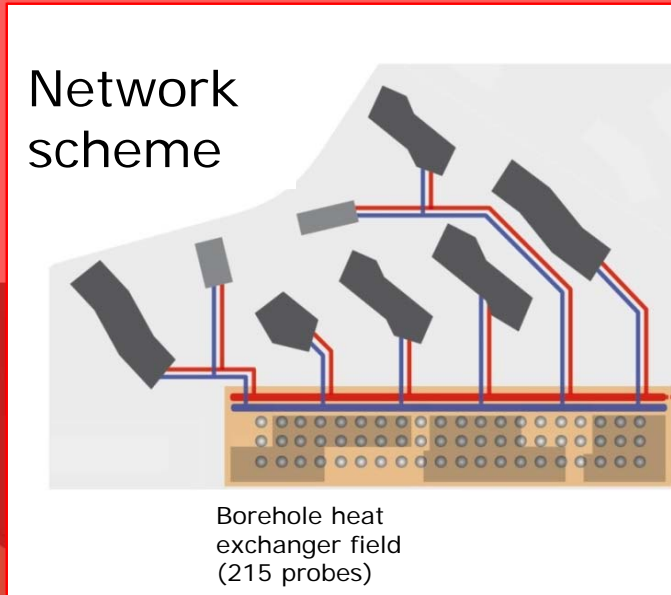
In operation since 2012



## Building field 5:

27'250 m<sup>2</sup>

In operation since 2013



Source: Zug Estates

Final state (2020): 165'000 m<sup>2</sup>

## The energy concept

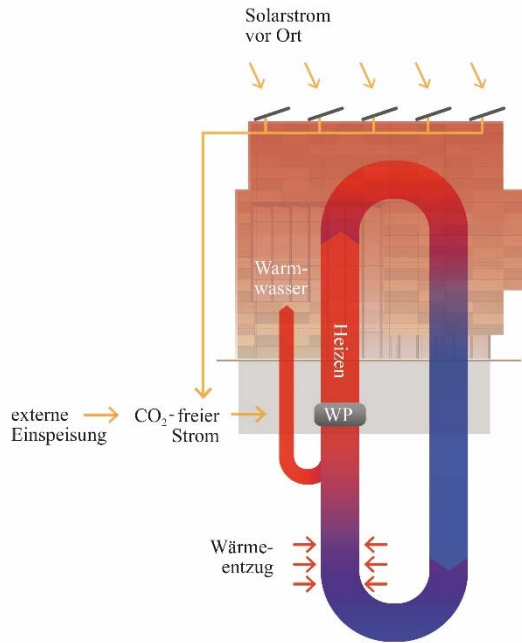
- Heating and domestic hot water are produced by means of decentralised heat pumps, which are connected to the LTN.
- Waste heat deriving from cooling installations in the buildings is used to regenerate the geothermal storage.
- Conventional (PV) and hybrid solar panels (PVT) installed on the roofs 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.



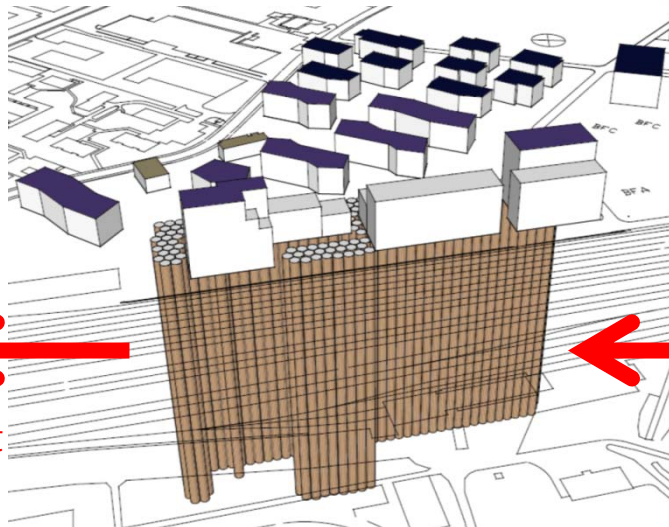


# «Anergy» network

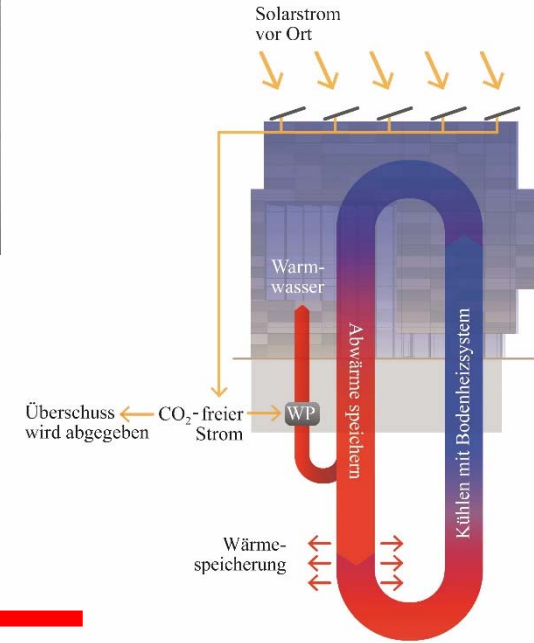
Winter



Uptake of heat through heat pumps

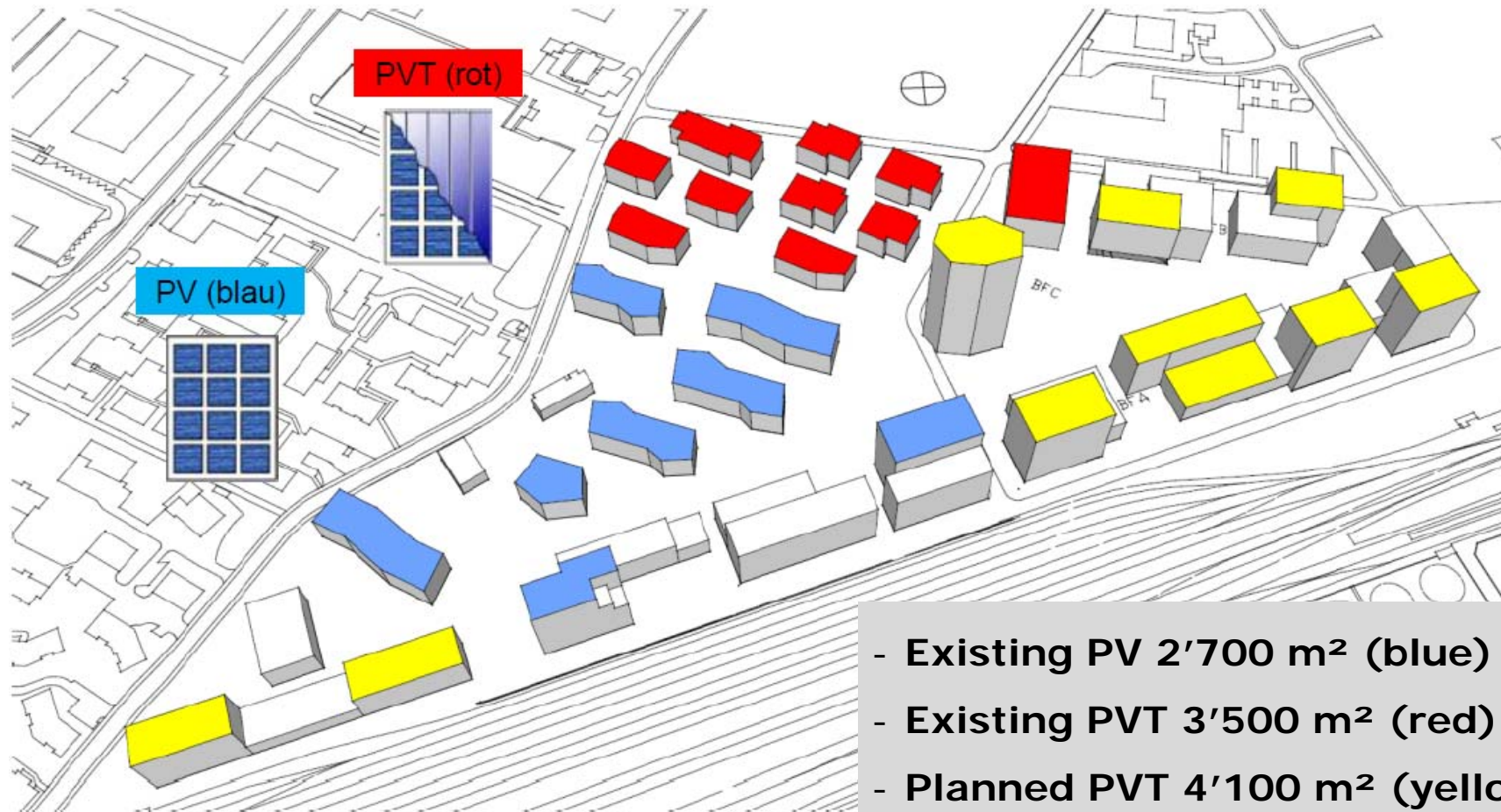


Sommer



Heat supply through freecooling

## Solar energy integration in the system





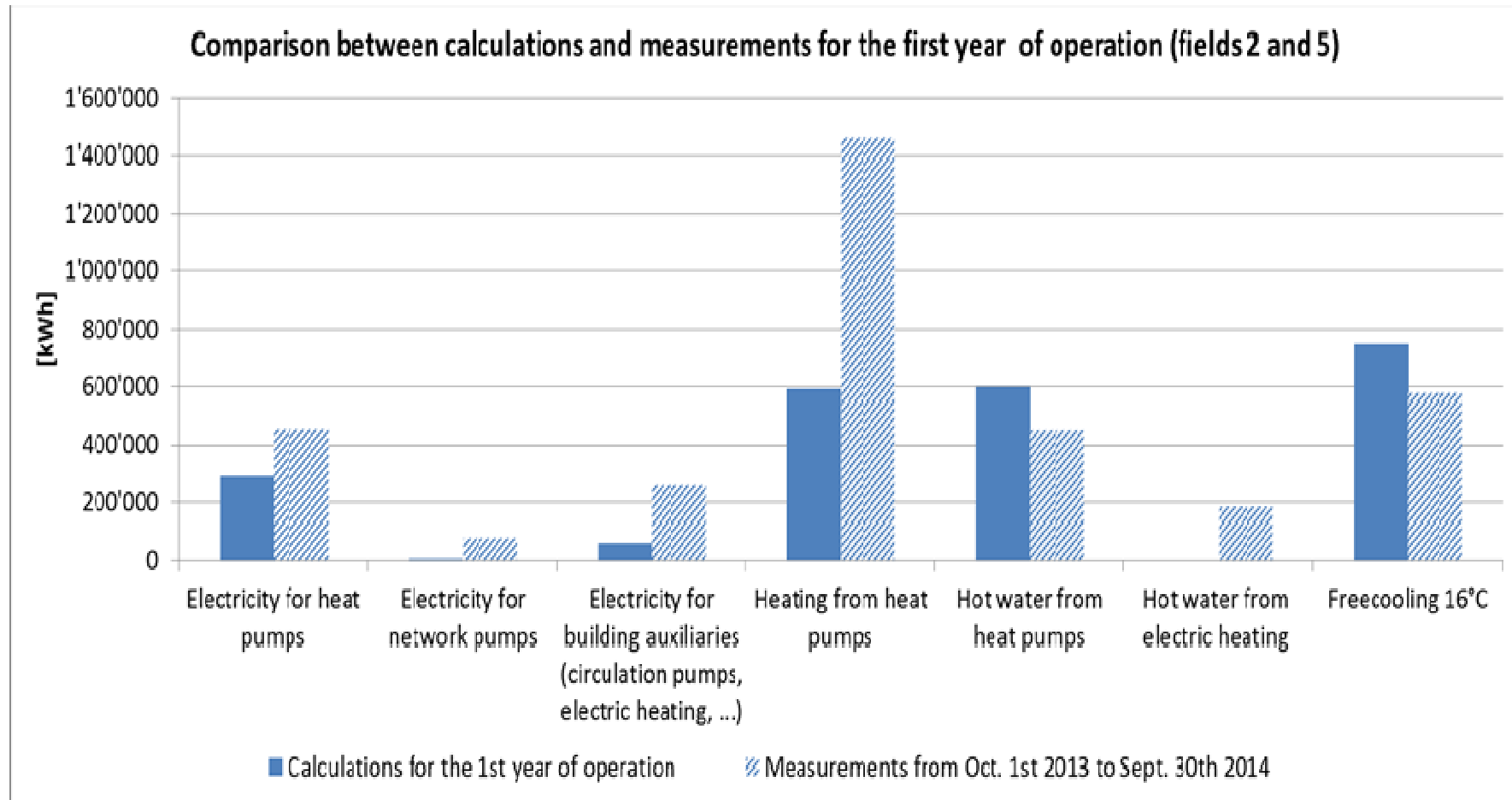
## Energy monitoring

- 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.



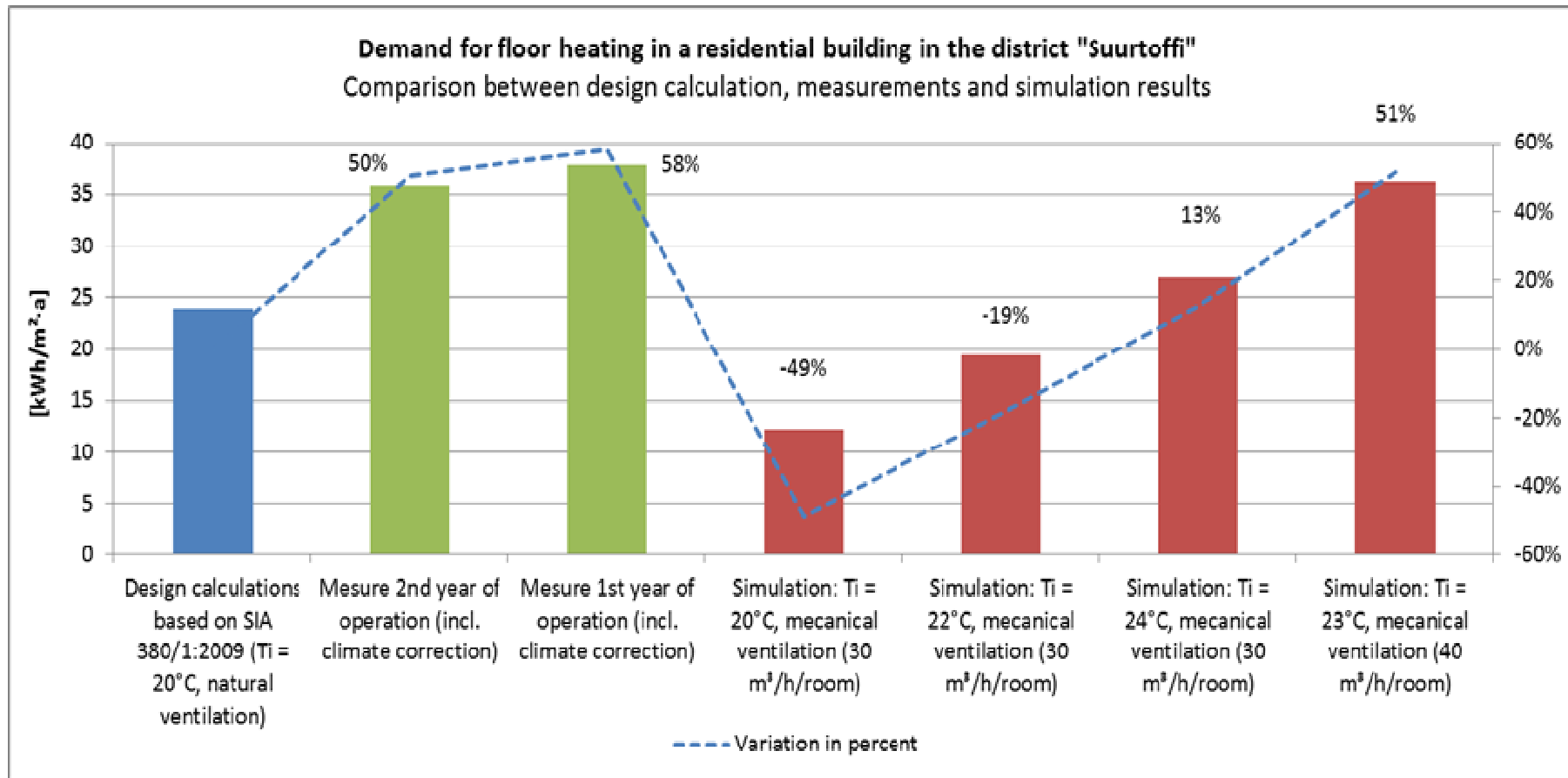


## Example of comparison of the calculations with the measurements



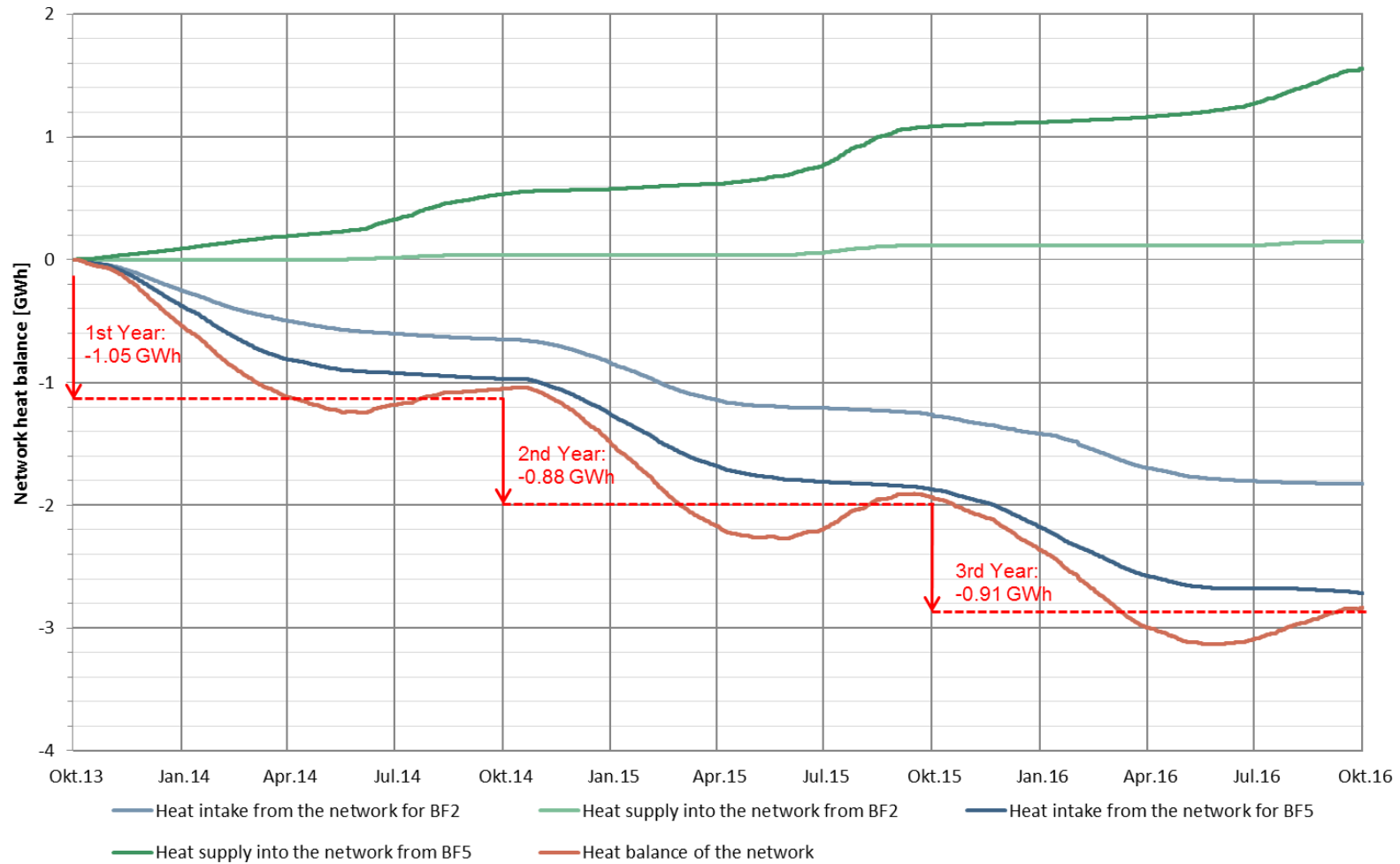


## Comparison of the calculations with the measurements and simulations



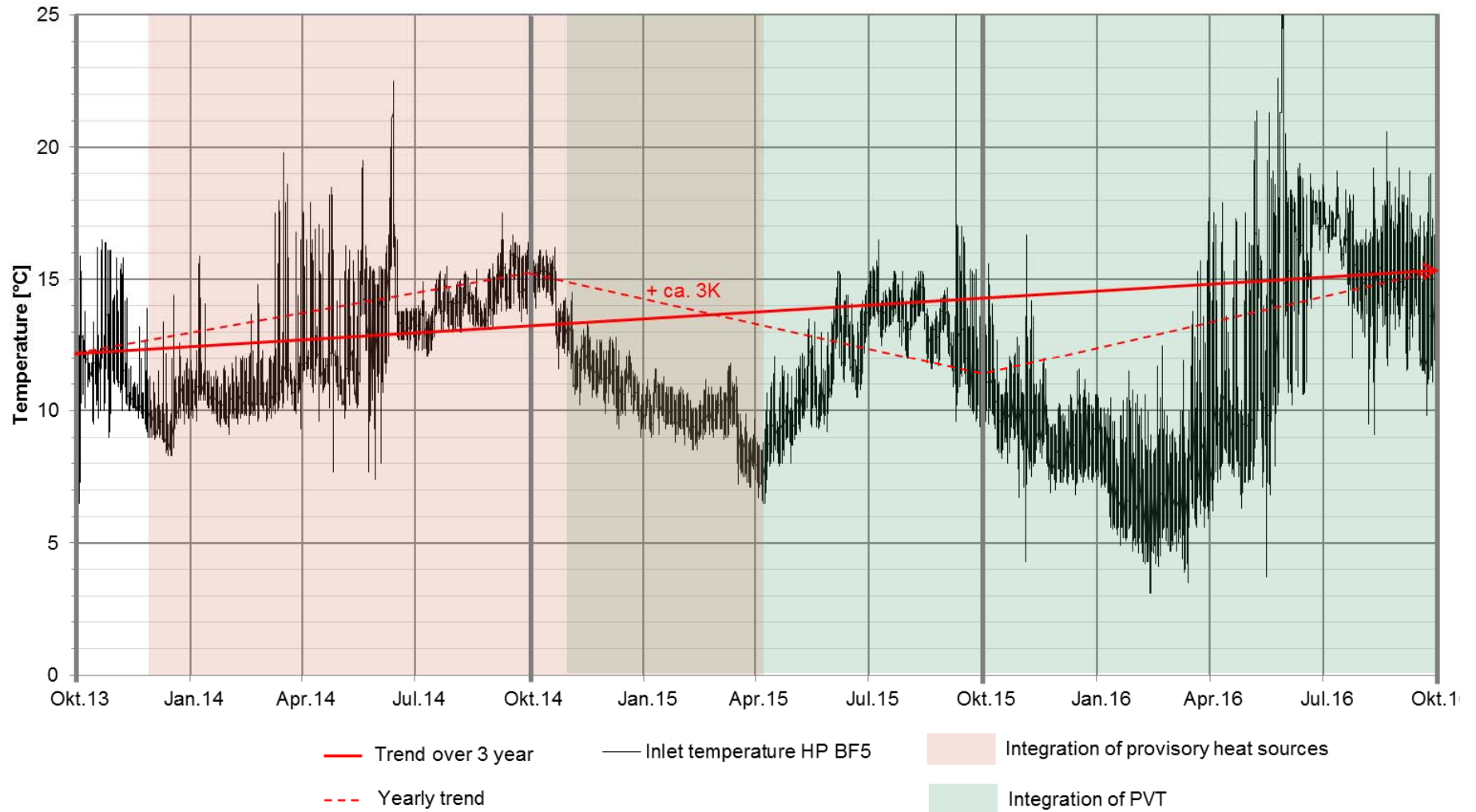


## LTN heat balance over 3 operation years (without integration of PVT nor provisory heat sources)





### 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":

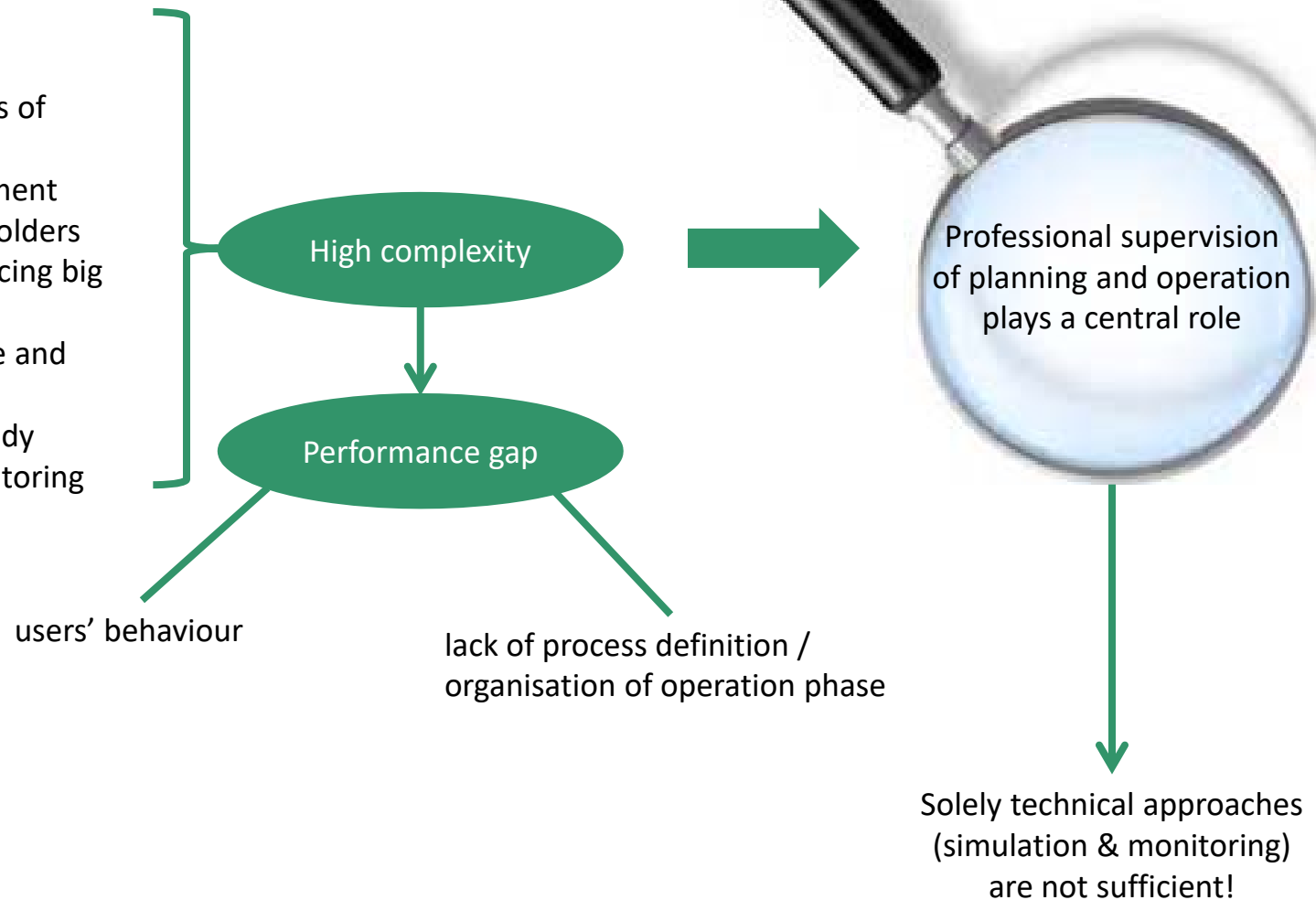
- The measurements were compared with the calculations in order to identify planning errors.
- The gap between the calculated and the effective energy demand was used as a basis for the calculations of the new building areas in order to reduce further errors.
- The monitoring of the project constitutes 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.





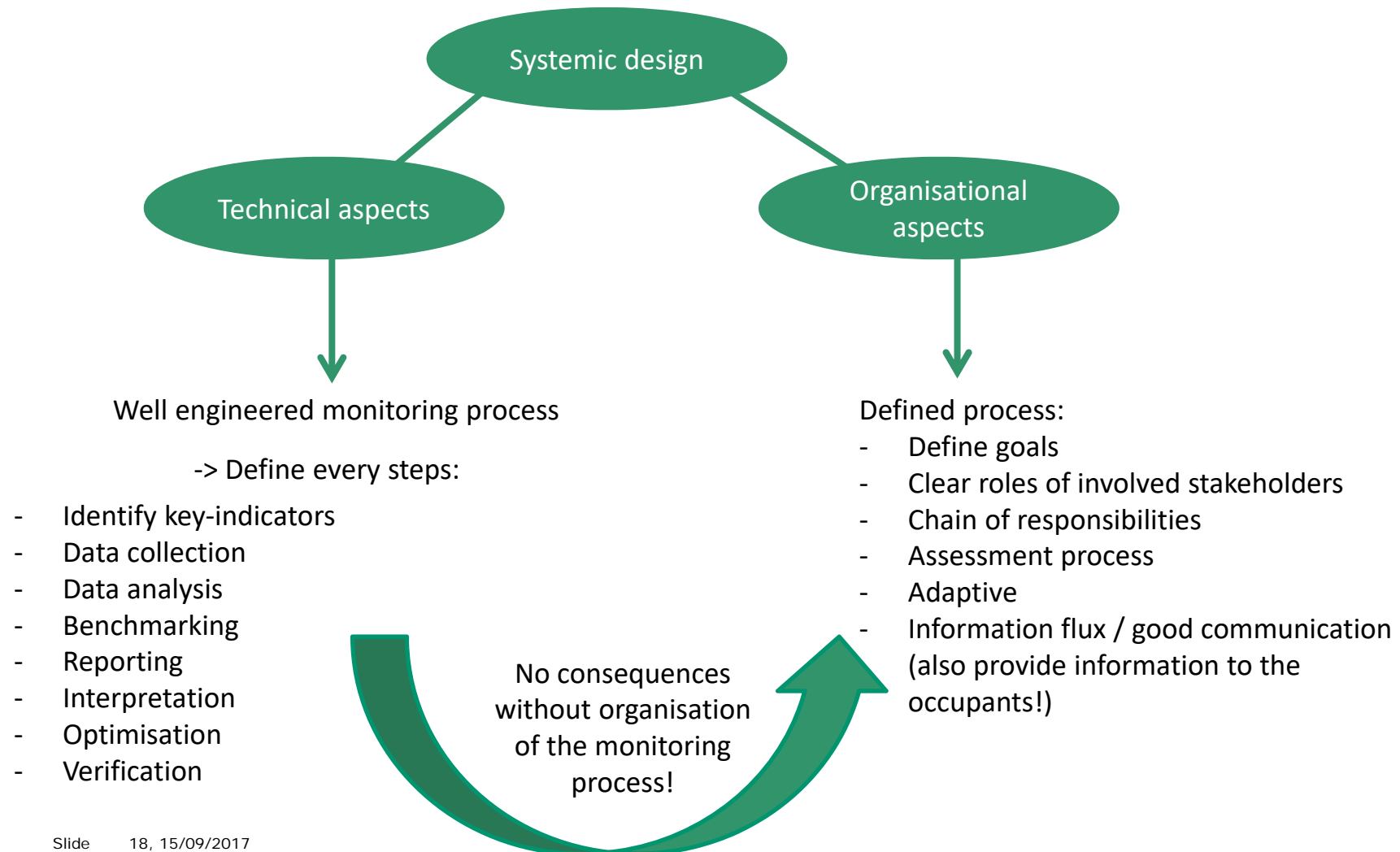
## Conclusions

- 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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**sccer** | future energy efficient  
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Further information at  
[www.sccer-feebe.ch](http://www.sccer-feebe.ch)



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