Operational analysis and detailed monitoring results of measurements taken from large-scale solar thermal plants integrated into district heating

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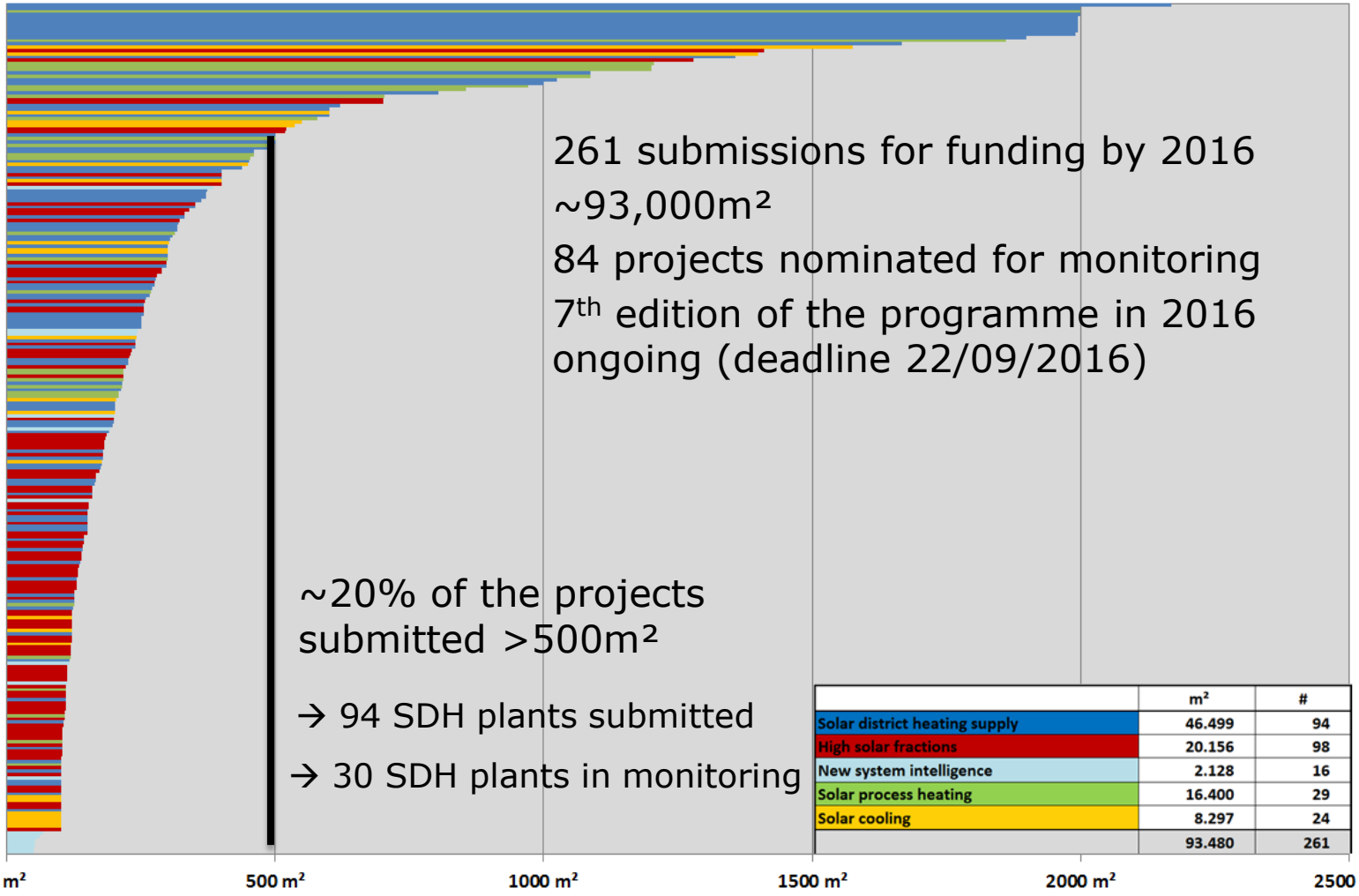
Austrian funding programme

- Funding programme for commercial ST applications
- between 100 and 2.000m², covering 4 categories:
  - Solar process heat
  - **Solar district heating**
  - Solar combi systems with >20% solar fraction
  - Special developments
- Funding amounts for up to 45% of the extra costs caused by a ST system compared to a reference oil based system
- Applicants have to take advantage from a scientific project support by AEE INTEC (project lead), AIT
  - → Mandatory scientific consultancy beforehand for all applicants
  - → 12 months monitoring of selected projects with high market relevance (replicability) and/or high level of innovation

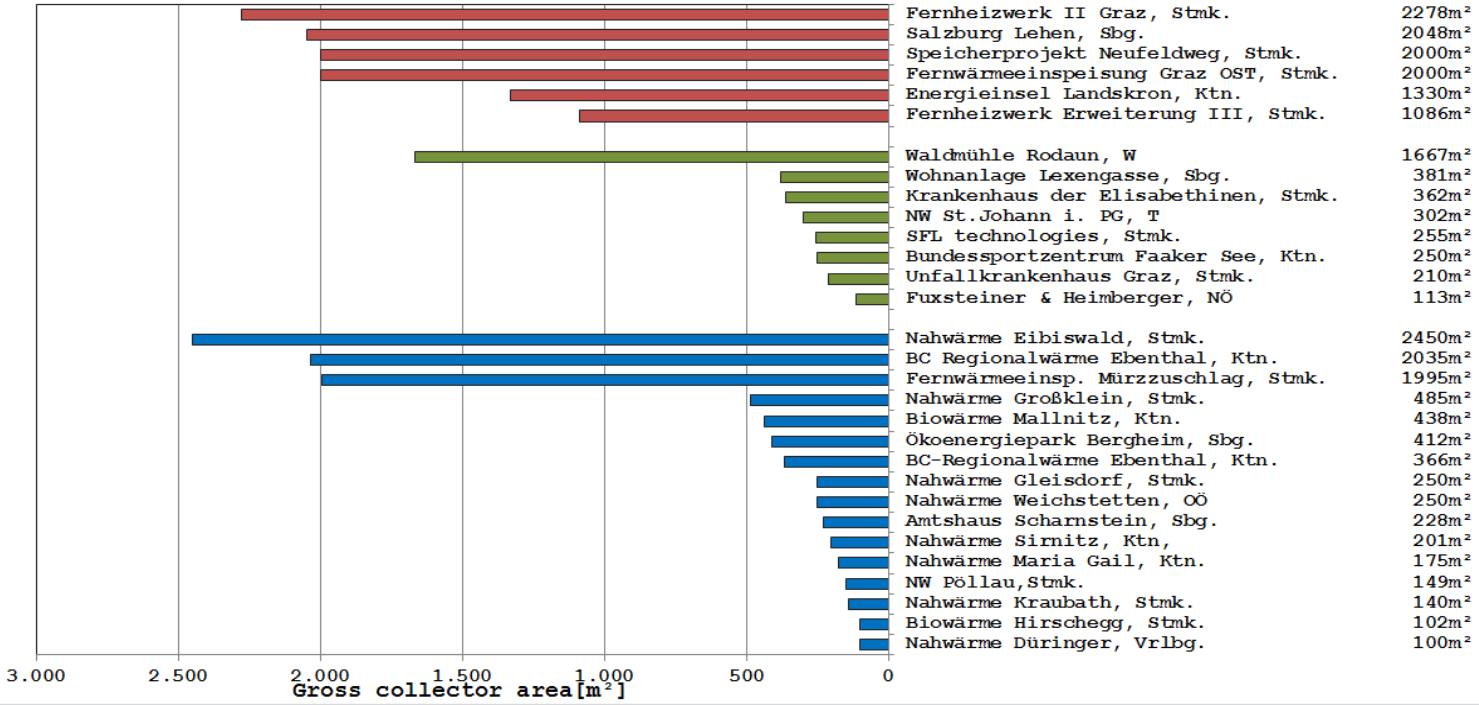
Austrian funding programme 2010 – 2016



	m²	#
Solar district heating supply	46.499	94
High solar fractions	20.156	98
New system intelligence	2.128	16
Solar process heating	16.400	29
Solar cooling	8.297	24
	93.480	261

SDH plants in monitoring

- **30 SDH plants in monitoring**
  - 14 SDH plants monitoring phase finished
  - 16 SDH plants in montoring or in implementation phase
- **Three categories:**
  - Urban heating network integration (7 projects)
  - Solar assisted biomass heating network (16 projects)
  - Solar thermal microgrid integrations (7 projects)



„Biowärme Mallnitz“
Solar assisted biomass heating network

Solar assisted biomass heating network with a network demand of 8,5 GWth and a network length of 7.000m.

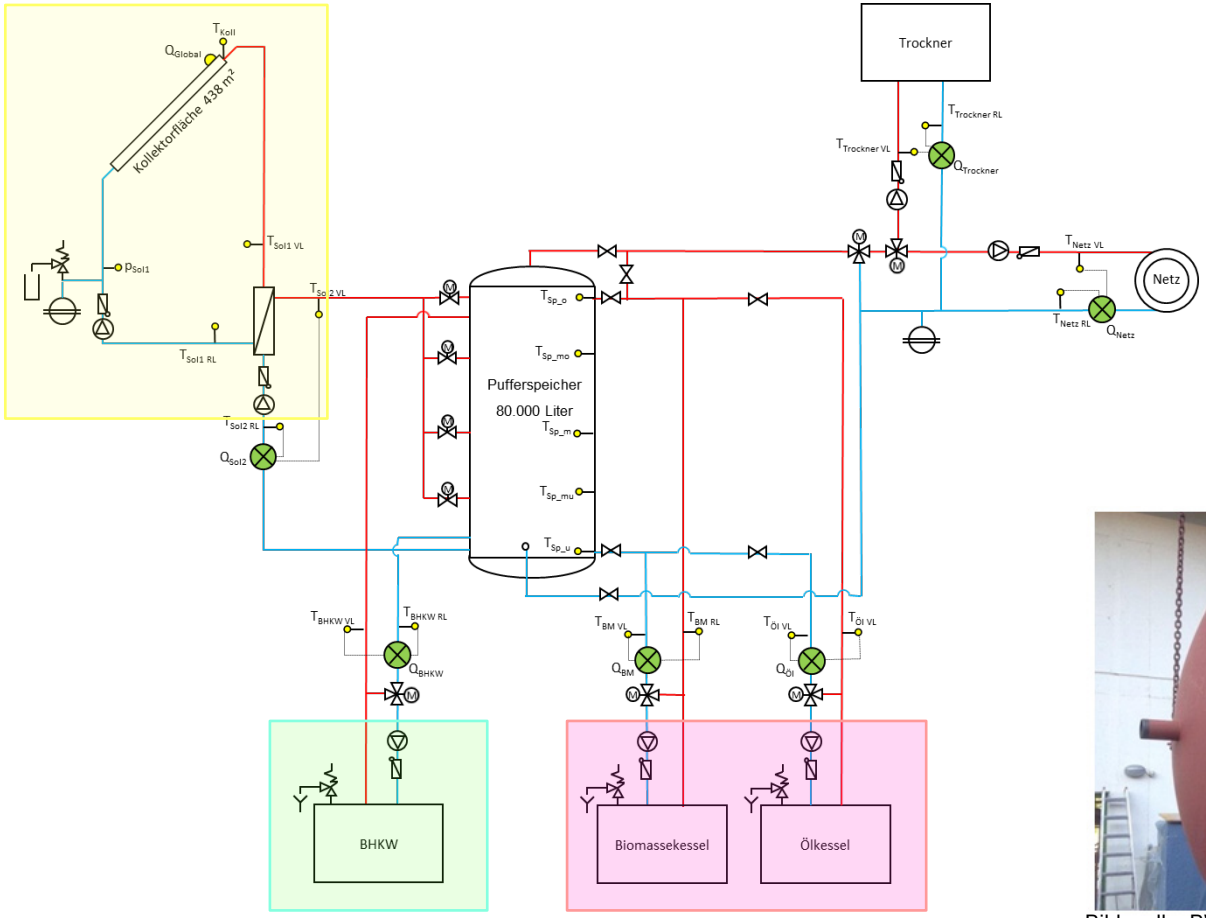
Key figures:

- 438m² flat plate collector field
- 80 m³ energy storage (105 & 68.5 m³)
- 1,5% SD, 358 kWh/m²$_{Apertur}$a
- DH supply temperatures: 95/52 in winter resp. 85/42 in summer
- Auxiliary heating: biomass boiler (2MW) + 1 oil boiler reserve + 1 Biomass – CHP (550 kW$_{thermisch}$)

Status: Monitoring finished August 2015

Source: AEE INTEC

„Biowärme Mallnitz“



Bildquelle: BW Mallnitz

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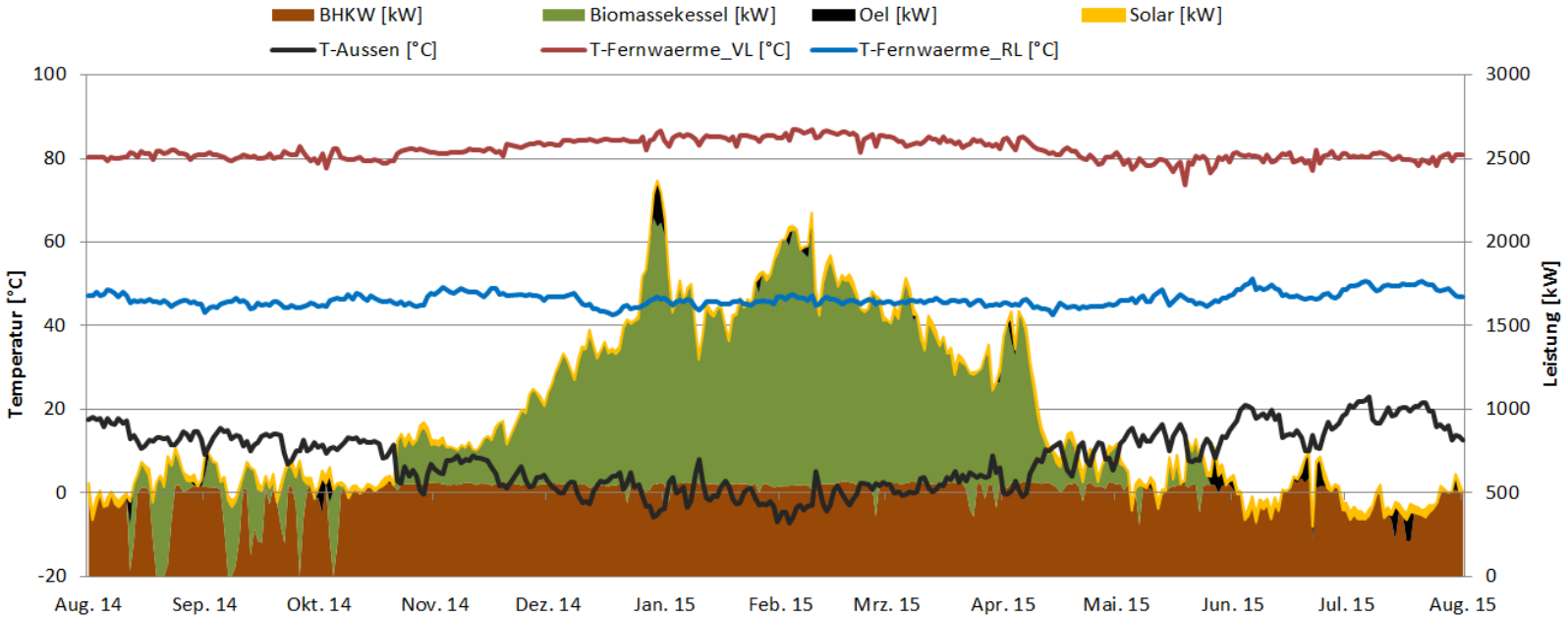
„Biowärme Mallnitz“
Key figures and energy balance

- **Heat demand**: ~8500 MWh/a
- **Solar yield**: 358 kWh/m²a
- **Solar fraction:** 1,5%

- Little operation of the biomass boiler and oil boiler during summer
- Reduction of operating hours of both boilers
- Good boiler selection



„Stadtteil Salzburg-Lehen“
Urban heating network integration

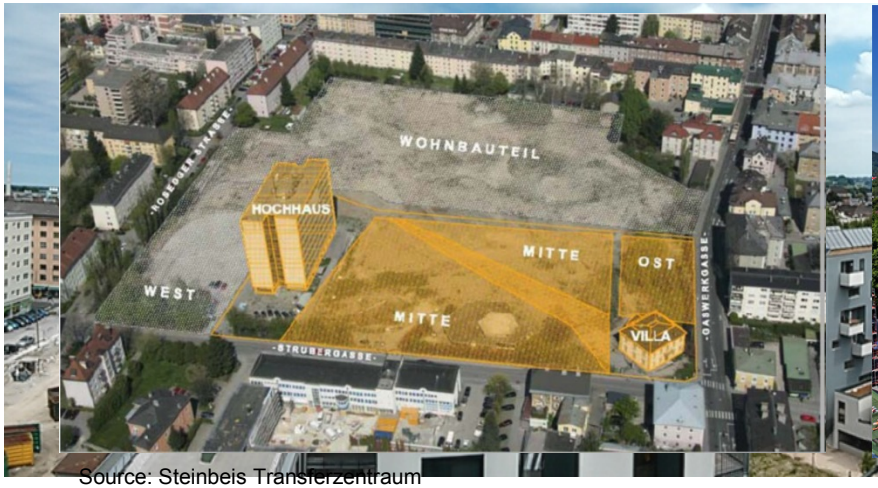
Solar thermal system connected to a low-temperature heating network supplying around 38,000m² of heated floor area. 300 apartments, student hostel, laboratories, office buildings, a hotel and 150 renovated homes

Key figures:

- 2.048 m² flat plate collector field (mounted on 13 separate roofs)
- 200 m³ energy storage
- 25% SD
- 533 kWh/m²$_{Apertur}$a
- 160 kW storage integrated HP and district heating network

Status:

- Monitoring finished July 2015

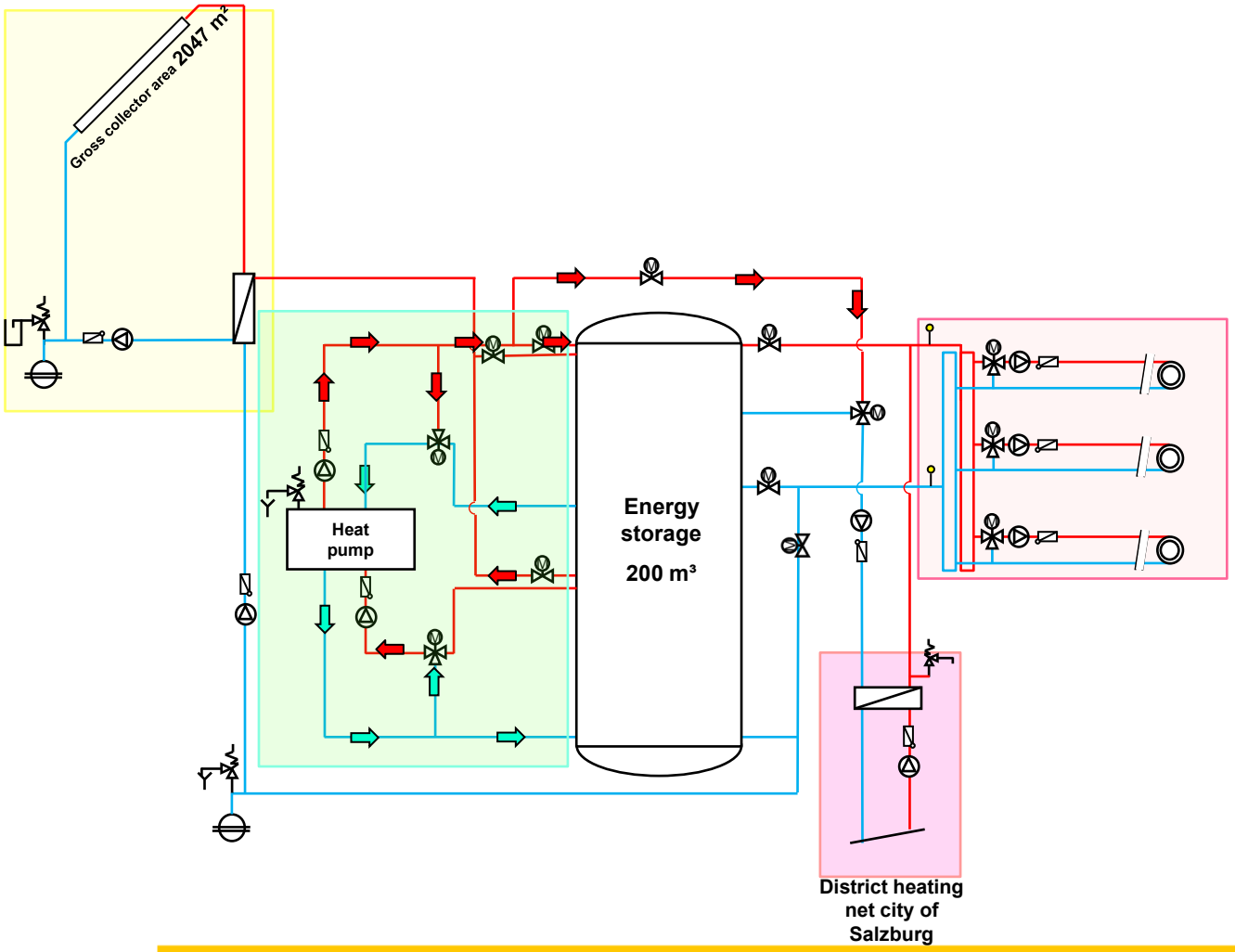


Source: Steinbeis Transferzentraum

Source: http://www.steiner-bau.at

Source: AEE INTEC

„Stadtteil Salzburg-Lehen“



❖ Heat pump

- Storage integrated
- Two operating modes: **heating mode** und **summer mode**

❖ HP control strategy:

- **„summer mode“** in operation if T_a > 13 °C
- otherwise **heating mode**

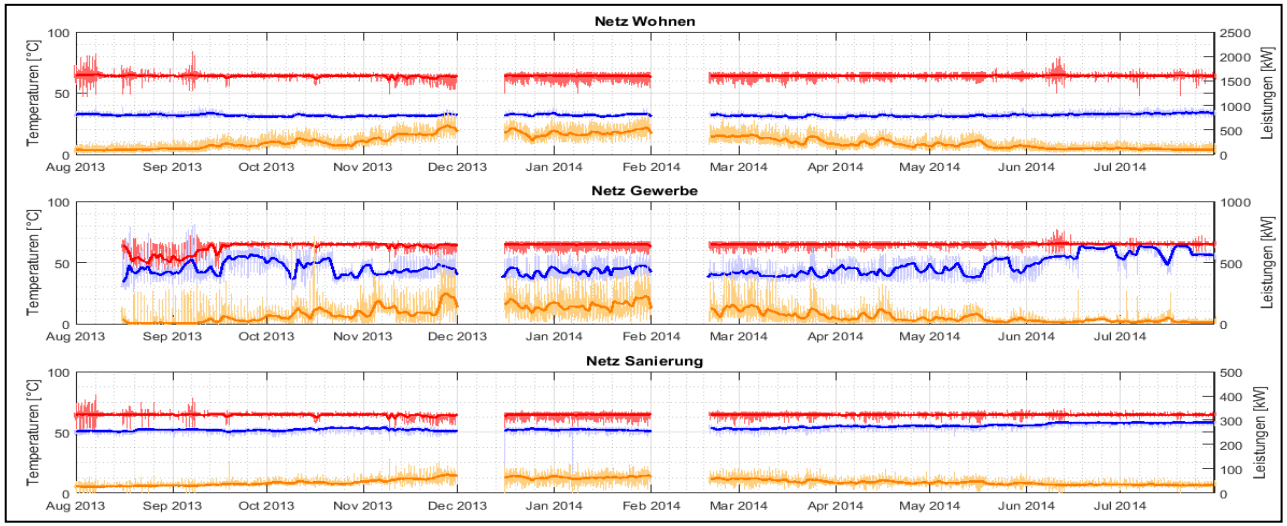
❖ Control strategy district heating:

- Additional heating if storage temperature is under < 65 °C

❖ Monitoring

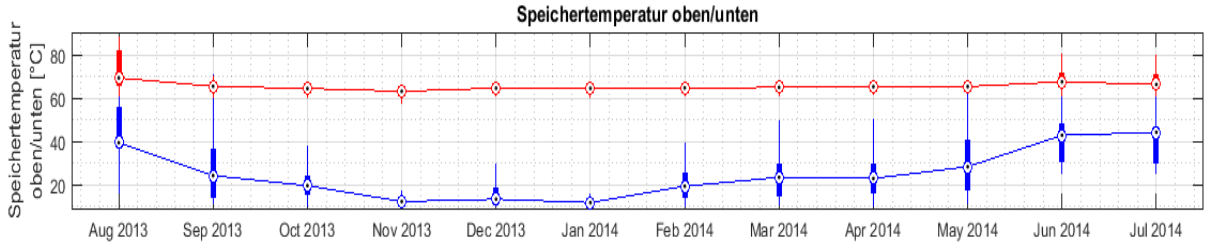
- ~ 300 measuring points
- 10 storage temperatures

„Stadtteil Salzburg-Lehen“
Urban heating network integration



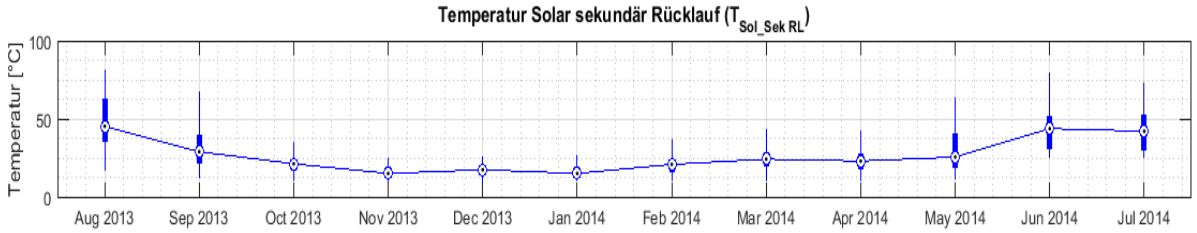
❖ Temperature distribution

- Net total:
  Return temperature ~40 °C
- New build appartments:
  Return-temperature ~35 °C



❖ Energy storage temperature:

- Except in summer (June, July, August) under net return temperature

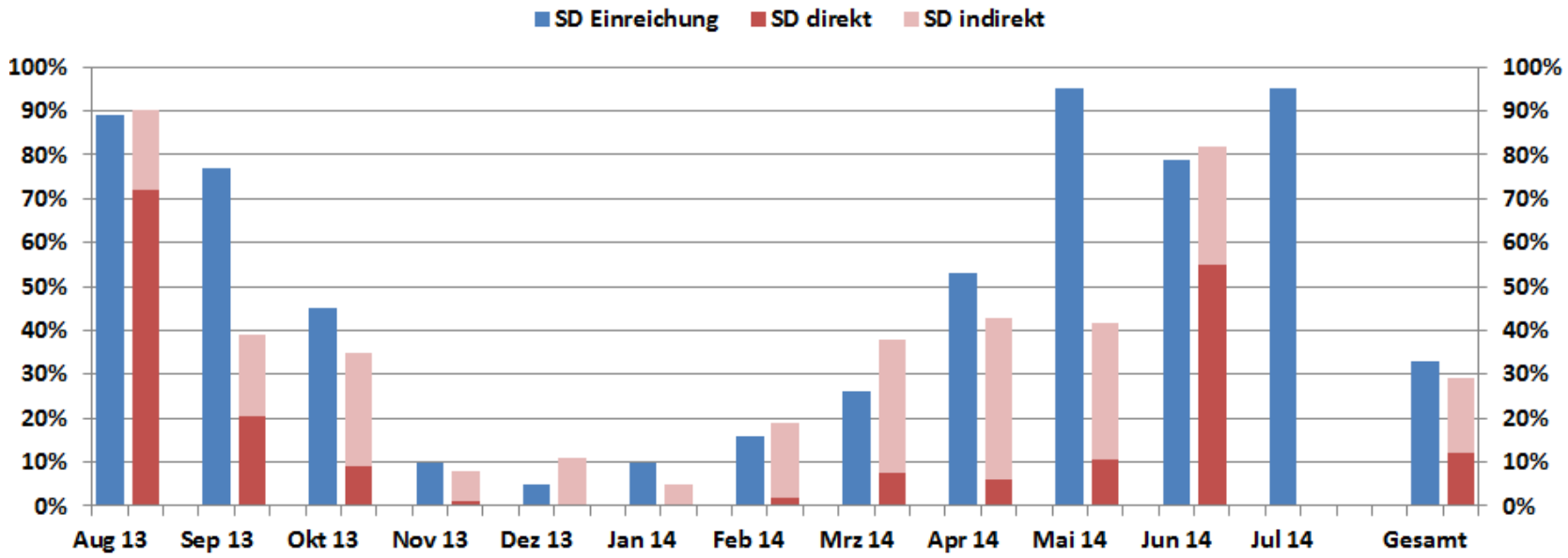


❖ Solar thermal system

- Leads to low return
- temperatures for the solar system

„Stadtteil Salzburg-Lehen“
Key figures and energy balance

- **Heat demand**: ~3500 MWh/a
- **Heat pump**: ~740 MWh/a (165 MWh current energy)
- **Solar yield**: 533 kWh/m^2_{ap}a
- **Solar fraction:** 29% (12% direct, 17% indirect over HP)
- **Seasonal Performance Factor:** 4,5



„SFL technologies “
Solar thermal microgrid integrations

Heating and hot water preperation over a microgrid integration of the company SFL technologies and regenerating of deep geothermal heat exchanger

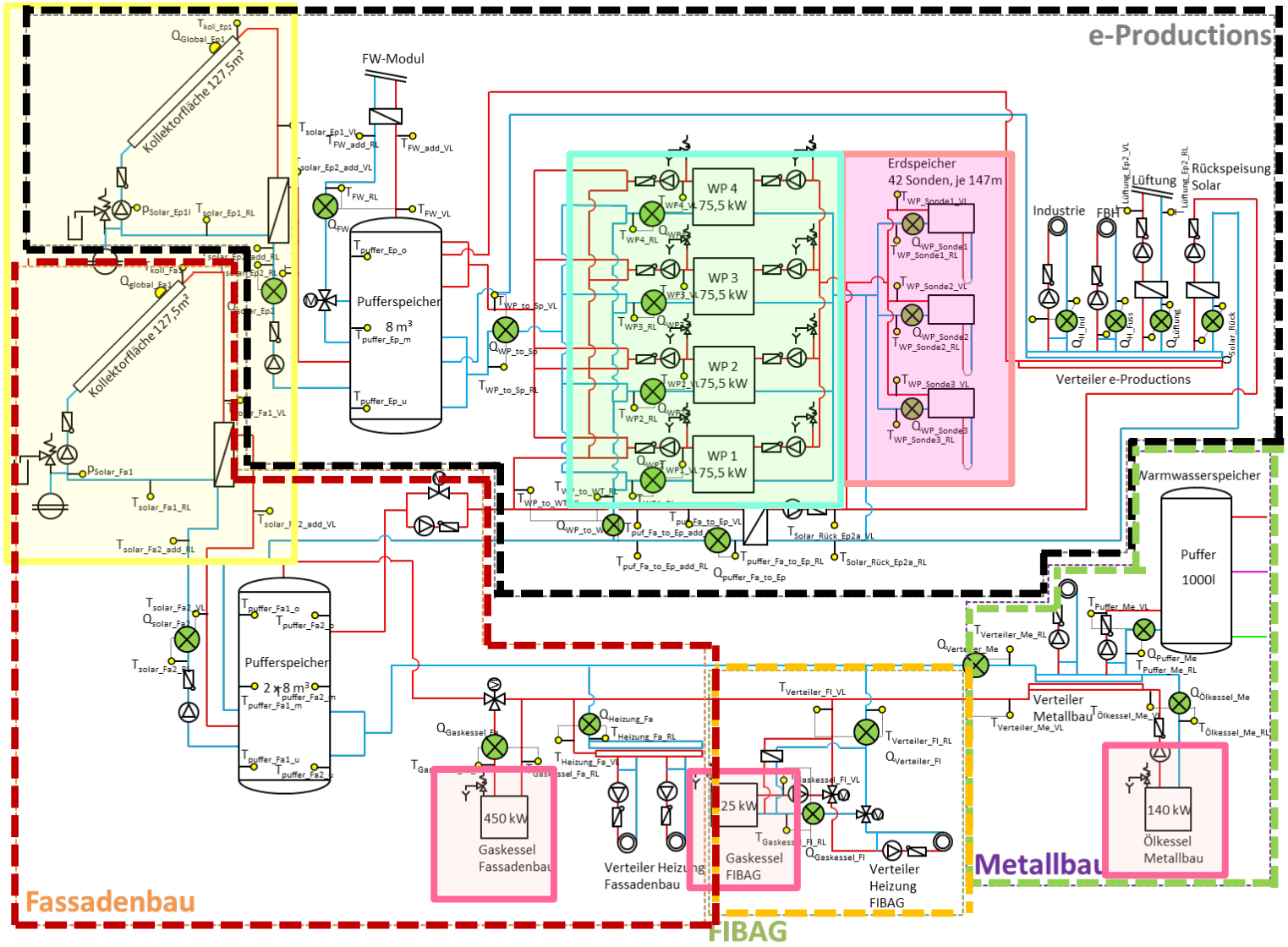
Key figures:

- 255 m² flat plate collector field (mounted on two separate roofs)
- 24 m³ energy storage
- geothermal field of 42 probes with a depth of 147 m each
- 4,5% SD, 366 kWh/m²a (prediction)
- 1 gas boiler with 450 kW and 4 heat pumps with a total capacity of 360 kW
- **Status:** Monitoring started in September 2015

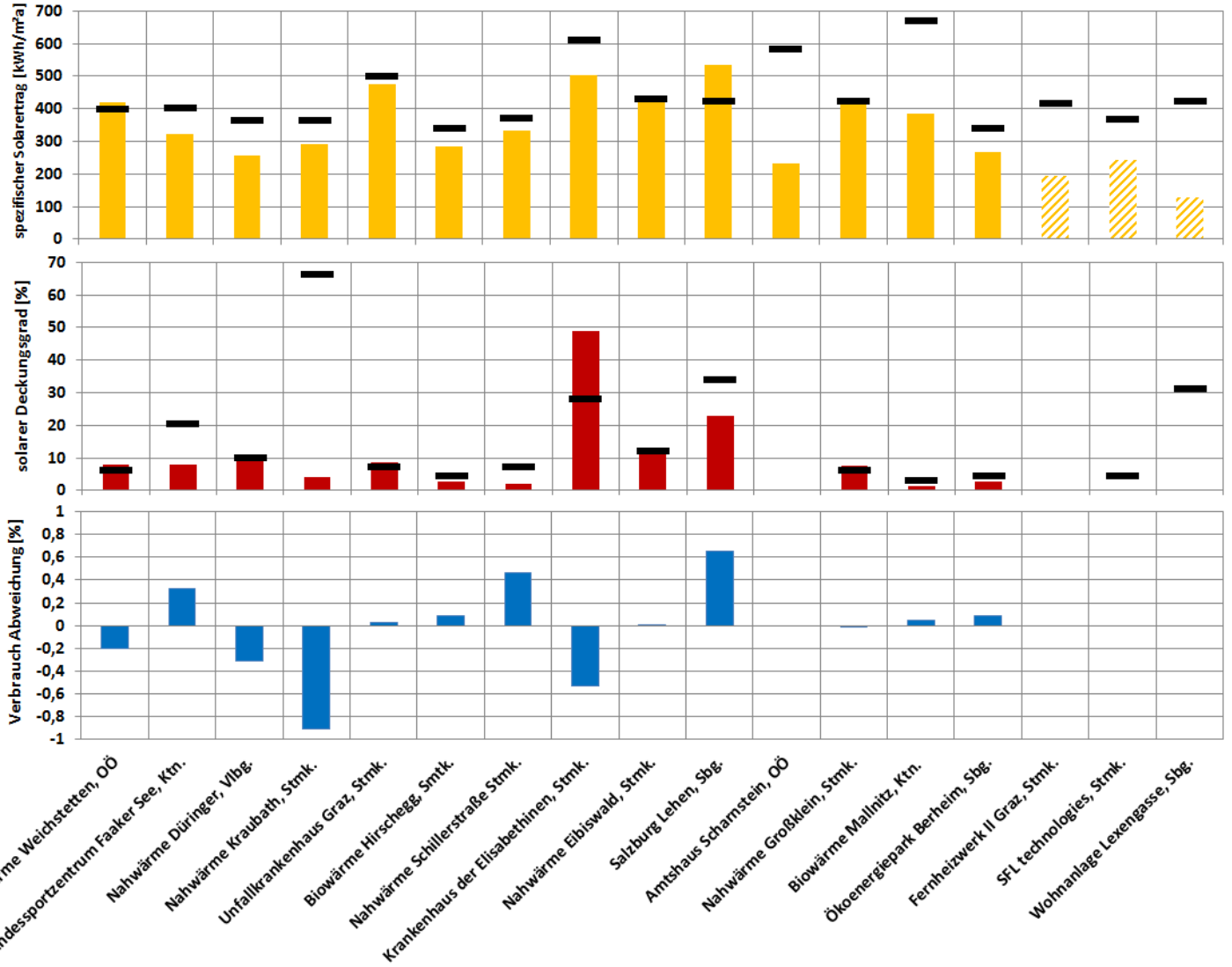
Source: Firma H. Traussnigg GmbH

Source: Firma H. Traussnigg GmbH

Hydraulic scheme „SFL technologies “

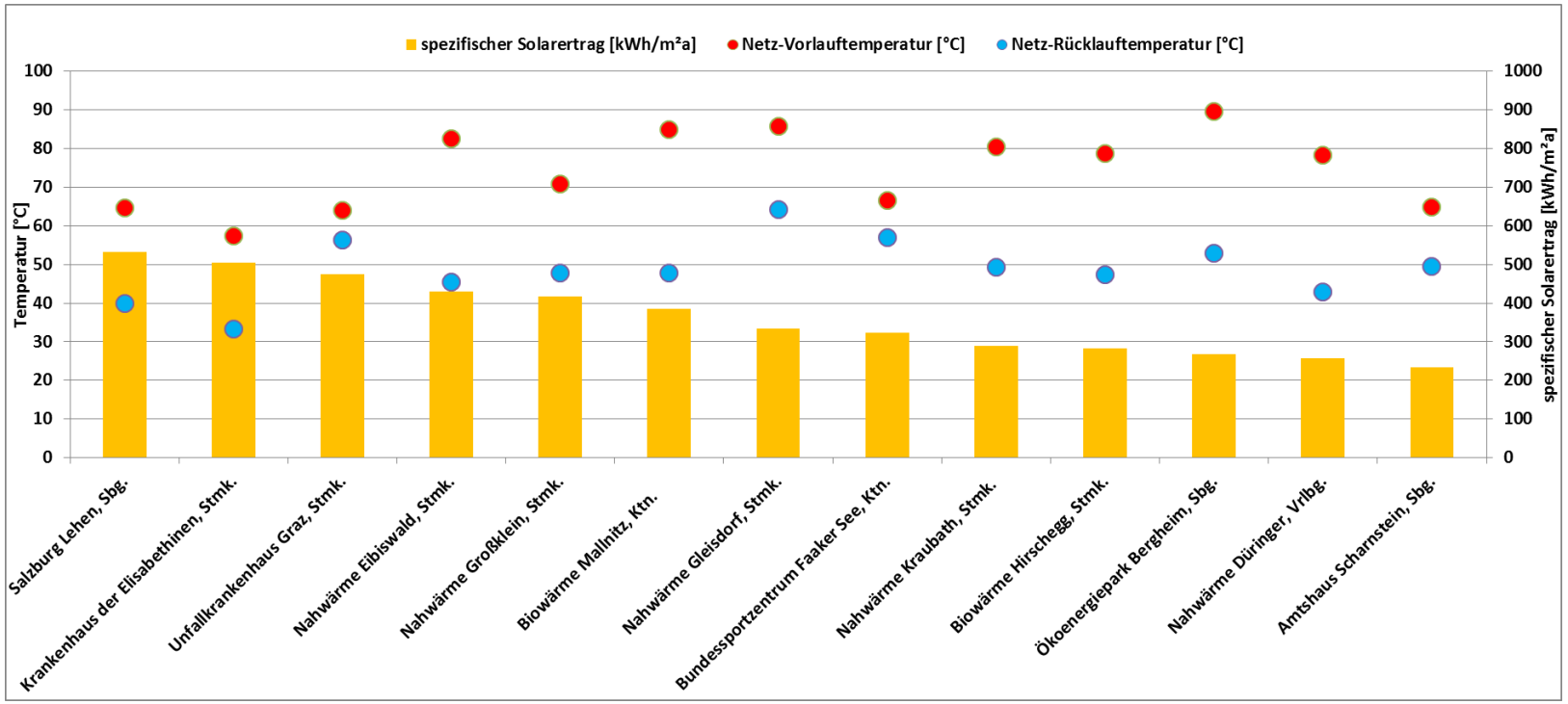


Comparison of measurement results and projections from planning



Comparison of net temperatures

❖Return temperature level of the monitored SDH has significant influence on the solar yield of the solar thermal systems



Summary and outlook

- The Austrian funding programme is well accepted and brought a considerable market momentum for commercial large scale ST applications
- Funding programme was launched and successfully accomplished for the 7th time this year.

- Trend towards complex, intelligent heating networks recognizable (cogeneration, heat pumps, decentralized feed, underground storage tanks, etc.)
- Storage integrated heat pump increases the solar output and allows smaller dimensions of the storage volume.
- The objective of replacing fossil peak load boilers or the avoidance of “partial load”-operation of biomass boilers could be achieved in some projects

- The range of net temperatures of the analyzed SDH was between 60/30°C and 85/65°C. An clear impact on the efficiency of the solar system was shown.

- Potentials for cost reductions need to be further exploited (e.g. standardization) and new/adapted business models need to be established (e.g. consumer co-operatives, ESCO’s, Crowd-Investing…)


Thank you for your attention!