IEA SHC Task Meeting
Task 53
11th till 13th of April 2016, ATECYR, Madrid, Spain

Solar PV Cooling

set in operation and system measurements
on going work

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HSR
HOCHSCHULE FÜR TECHNIK
RAPPERSWIL
FHO Fachhochschule Ostschweiz

SPF INSTITUT FÜR SOLARTECHNIK

Agenda

- **Content**

  - System
  - Set in operation - first measurement results
    (active cooling, free-cooling)
  - System States and Control - measurement results
    (domestic hot water preparation)
  - Conclusion and Outlook

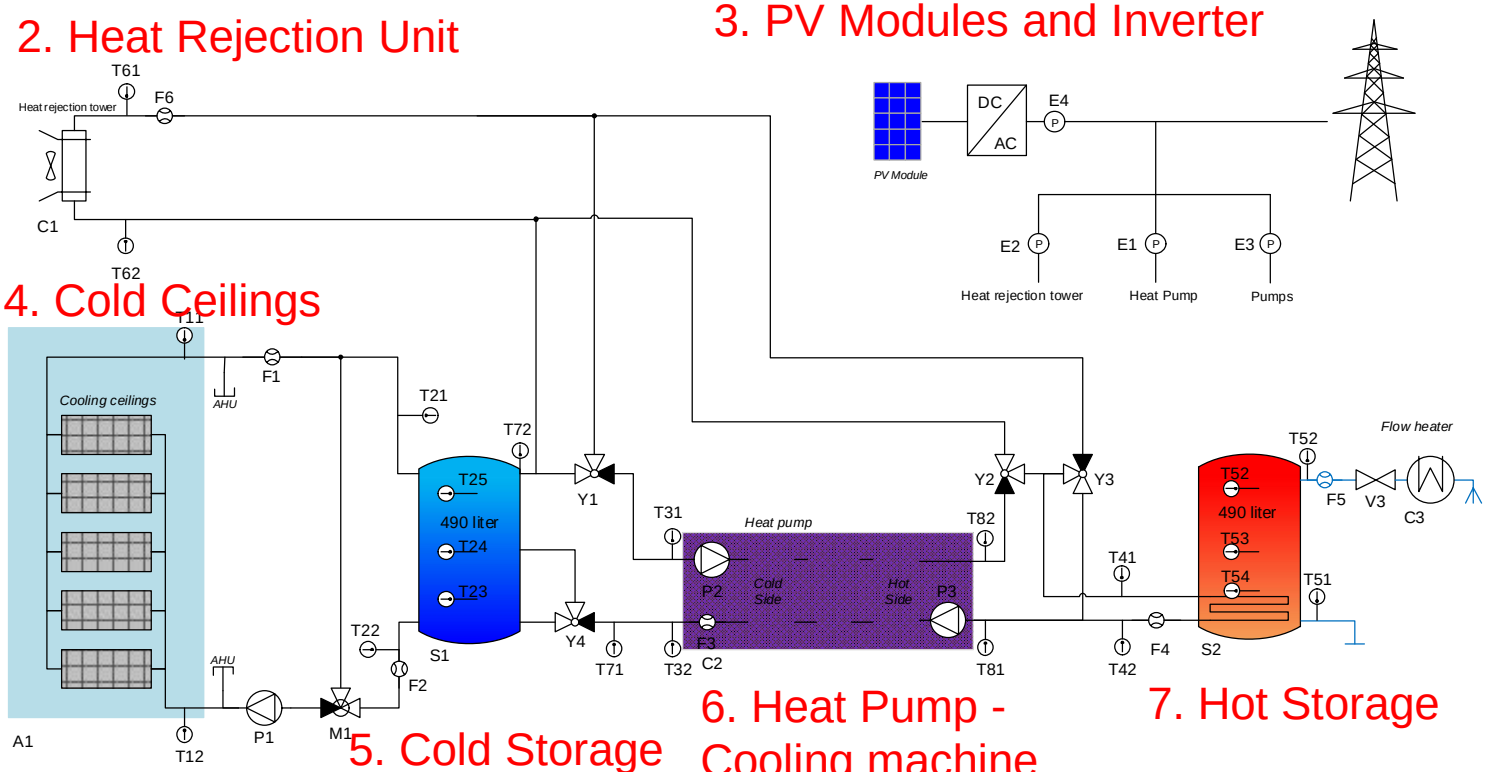
System

- **Hydraulic schematic**
  apparatus, tubes (sensors & DAQ)

1. Measurement Equipment and Data Acquisition

2. Heat Rejection Unit

3. PV Modules and Inverter



System

Main Components

PV modules (Meyer Burger) – south oriented

Cooling machine (HP; ait / Nibe) & storage tanks.

System

- **Main Components**

Cold ceilings (Zehnder) installed in the Laboratory (52.5m^2).

Outdoor unit

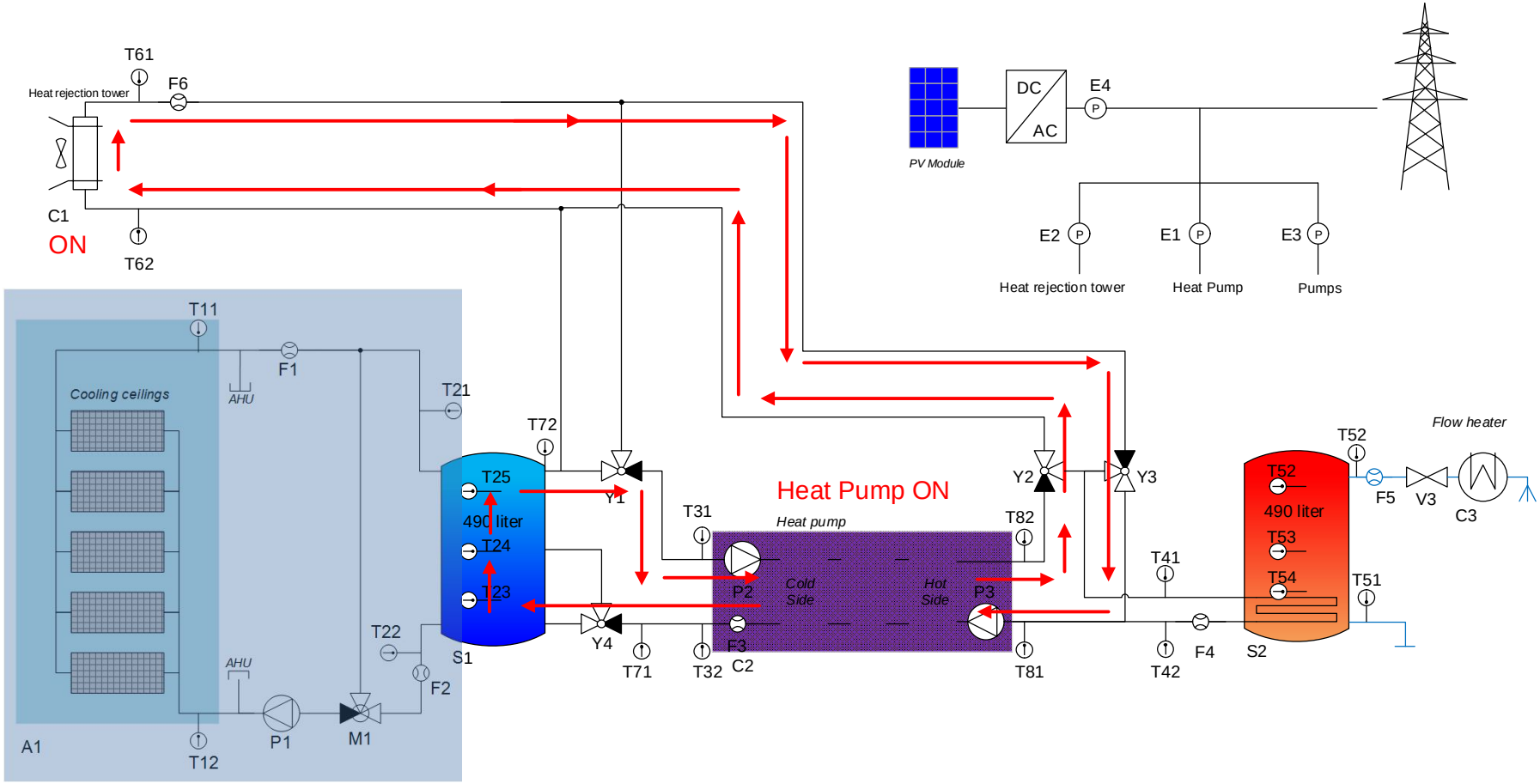
System

Main Components

Component	Manufacturer / Distributor	Type	Description
PV Modules	MEYER BURGER AG	Sky 285	9 modules (285 W_p nominal power) orientation: α = 8° West, inclination: β = 15°
Inverter	SMA	TL2500	2.5 kW nominal power
Heat Pump	Nibe	F 1155-6	brine / water heat pump (7 kW cooling power)
Cold Storage	alpha innotec	TPSK 500	445 l storage
Hot Storage	alpha innotec	SWWS 506	477 l immersed heat exchanger
Outdoor Unit	WT AG	-	brine - air heat exchanger (outdoor unit)
Cold Ceilings	Zehnder Group Schweiz AG	Zip2	25 elements (dimension: 3 m x 0.704 m)
Heat Transfer Fluid	Abderhalden Harapol AG	Minoltherm	Antifreeze heat transfer fluid based on water with 20 wt.% ethanol
Meteo Station	SMA	SMA Meteo Station	irradiance, outdoor ambient temperature, PV module temperature

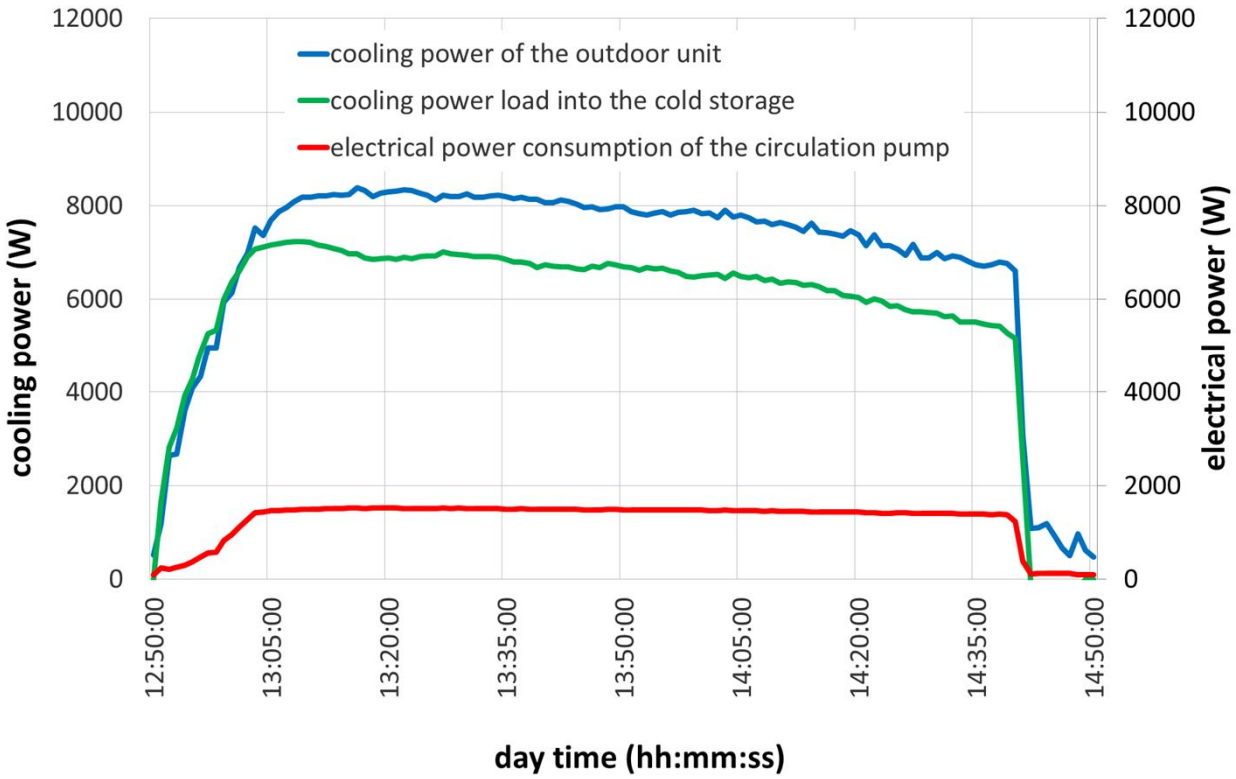
System states «active cooling»

- **Charging the cold storage and heat rejection to the ambient**



«active cooling» measurement results

- **Active cooling and heat rejection to the ambient**



«active cooling» measurement results

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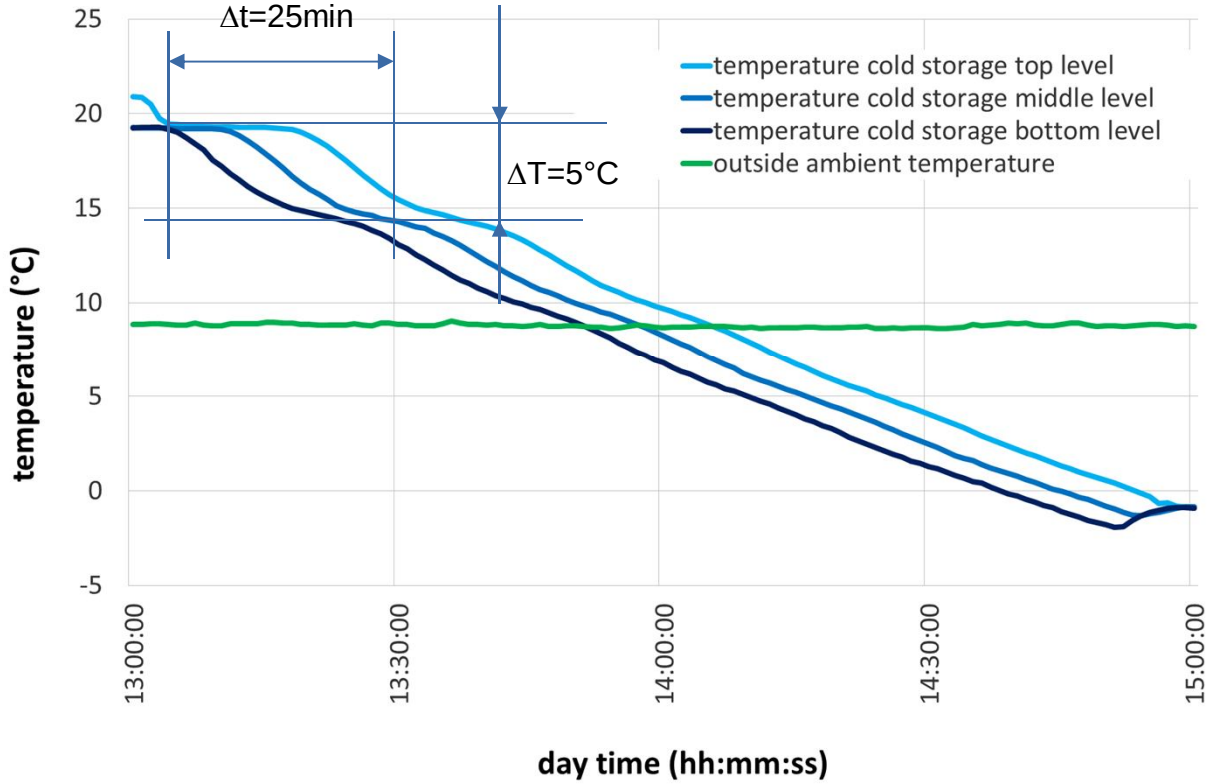
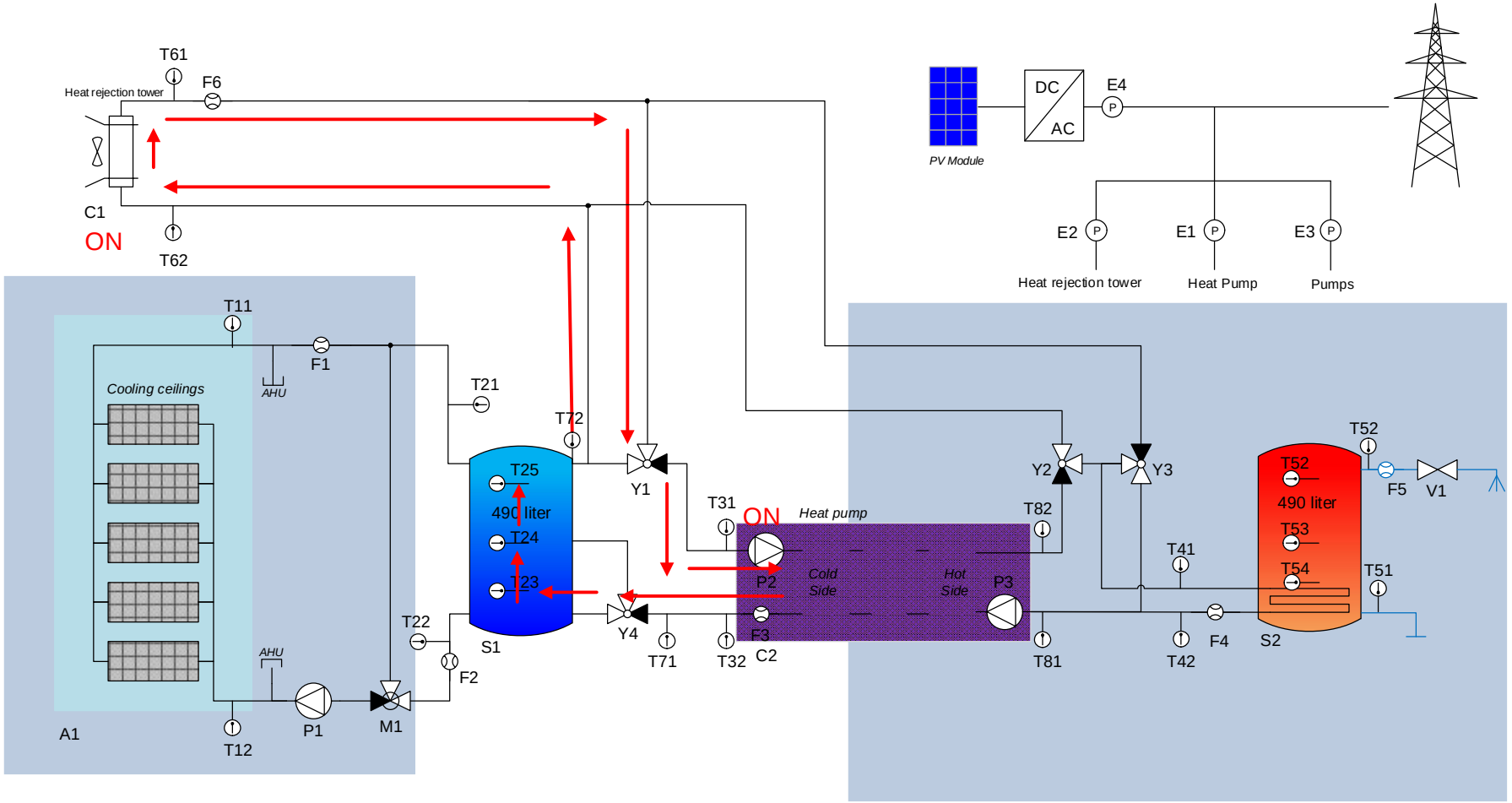


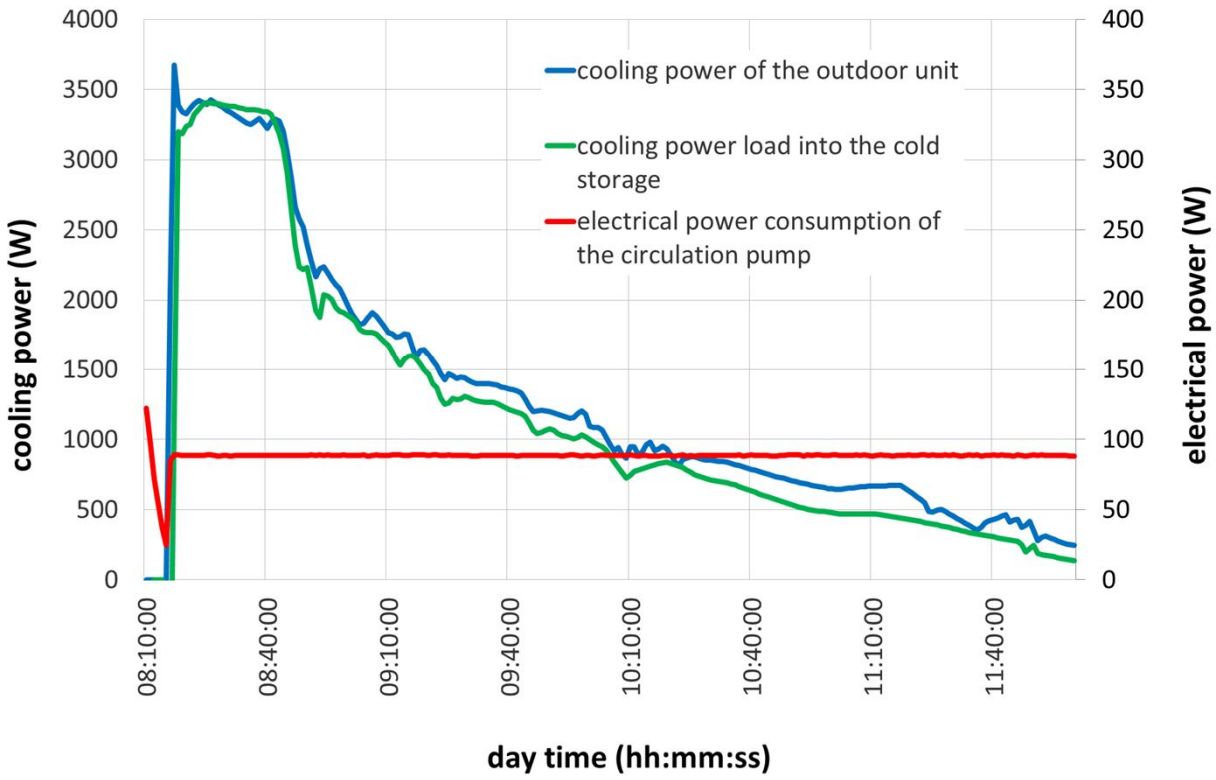
System state «free-cooling»

- **Charging the cold storage tank, outside ambient air as heat sink**



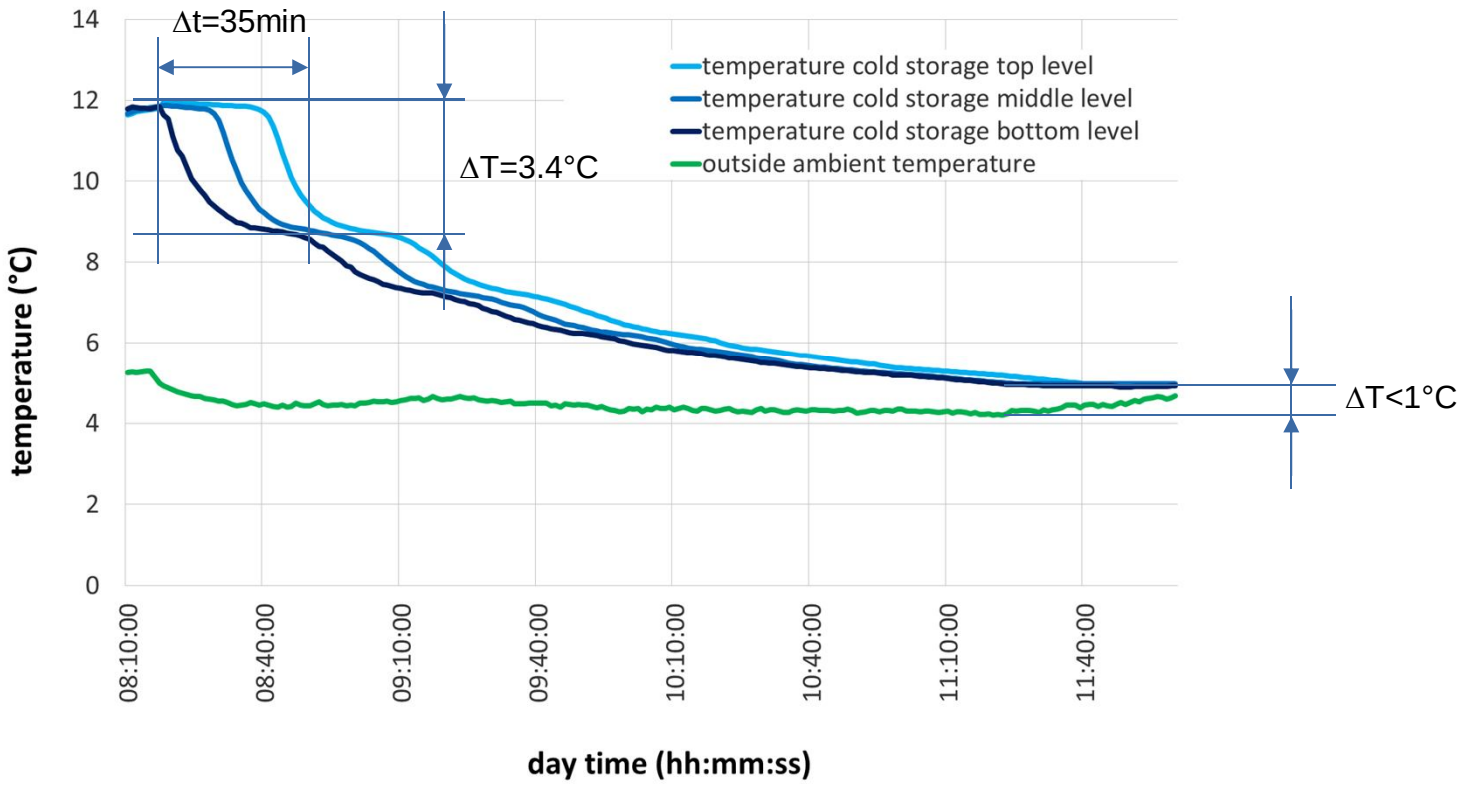
«free-cooling» measurement results

- **Cold preparation with free-cooling**



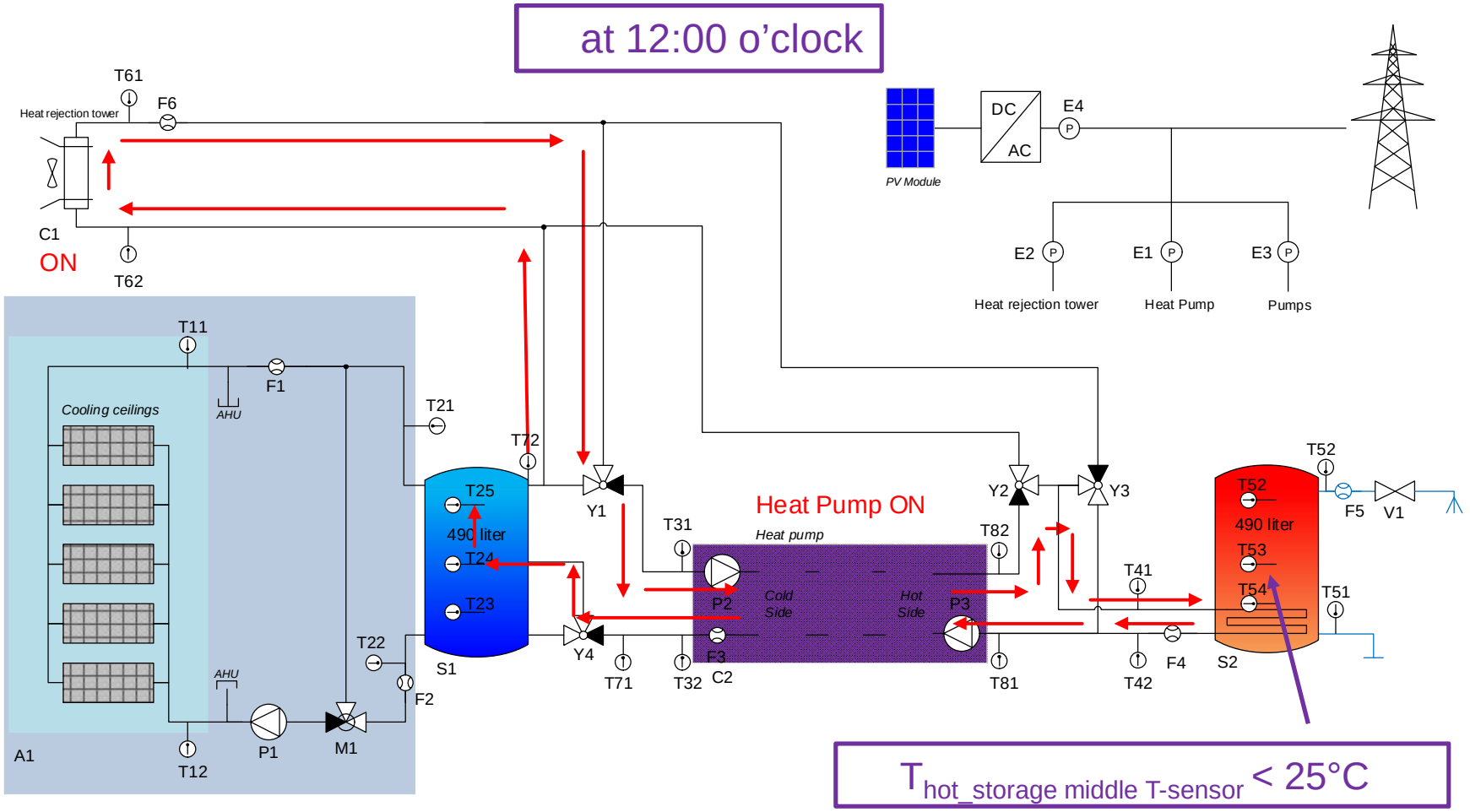
«free-cooling» measurement results

- **Cold preparation with free-cooling**



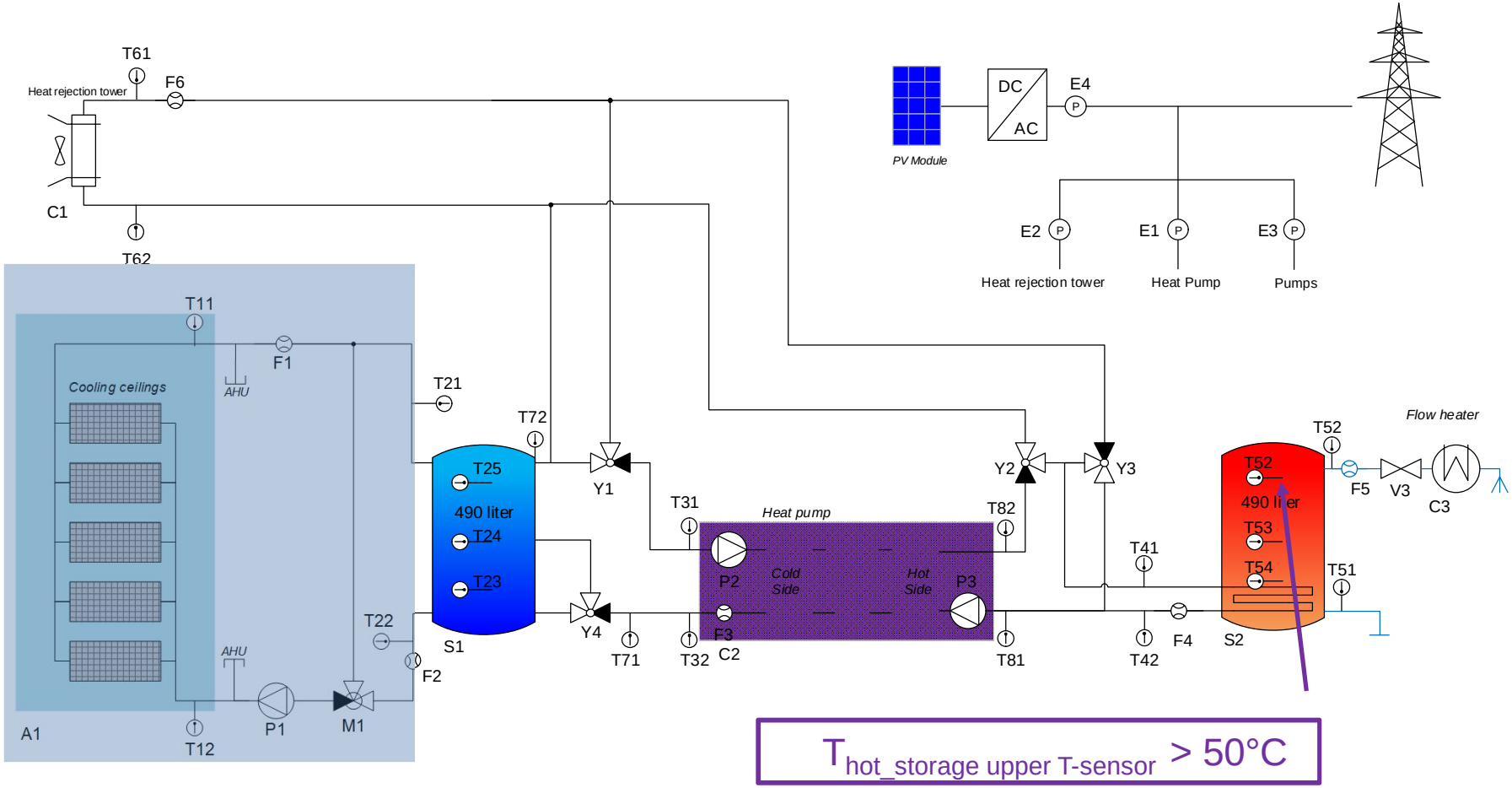
System states «domestic hot water preparation»

- **Charging the hot water storage tank, outside ambient air as heat source**



System states «domestic hot water preparation»

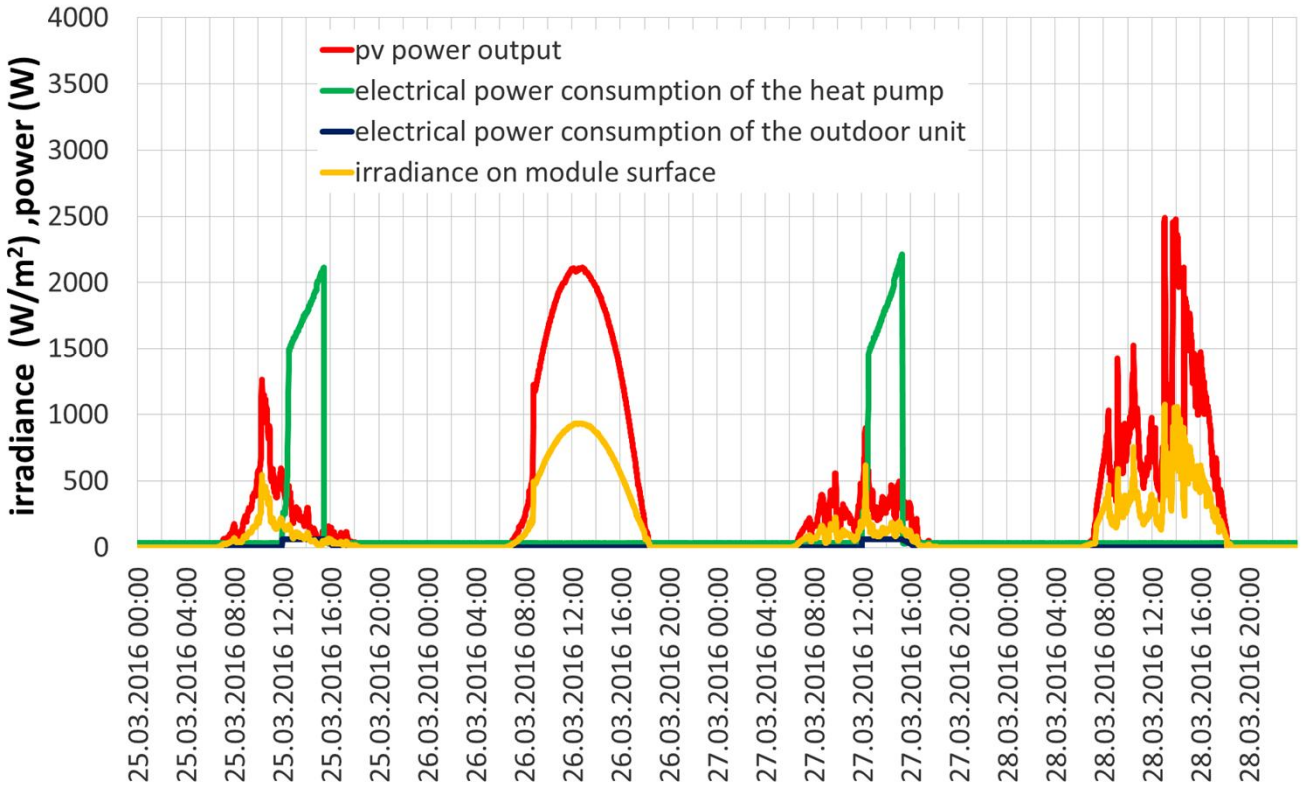
- **Stop Domestic Hot Water preparation.**



$T_{hot\_storage\ upper\ T\text{-}sensor} > 50°C$

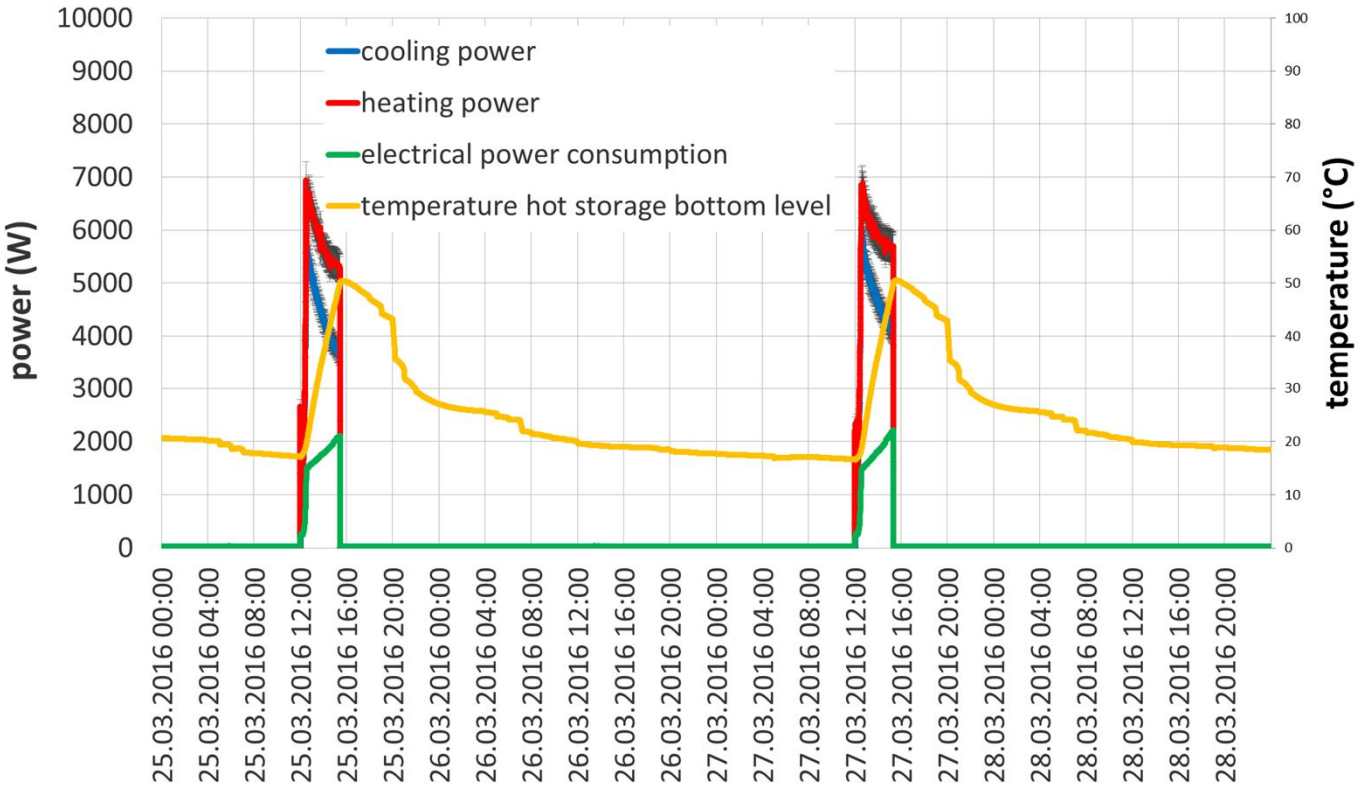
«domestic hot water preparation» measurement results

- **Produced PV Power and the electrical energy consumption of the system**



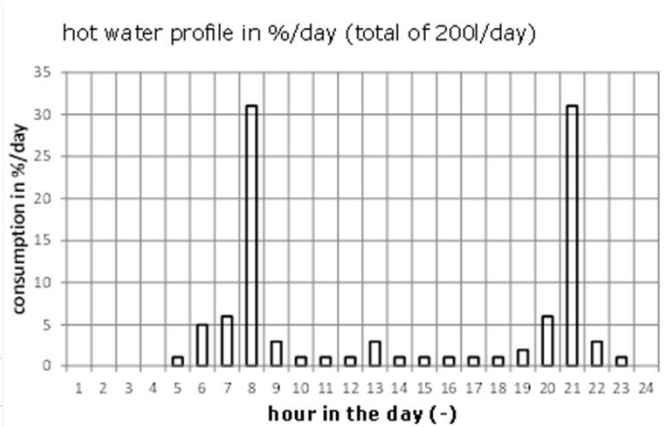
«domestic hot water preparation» measurement results

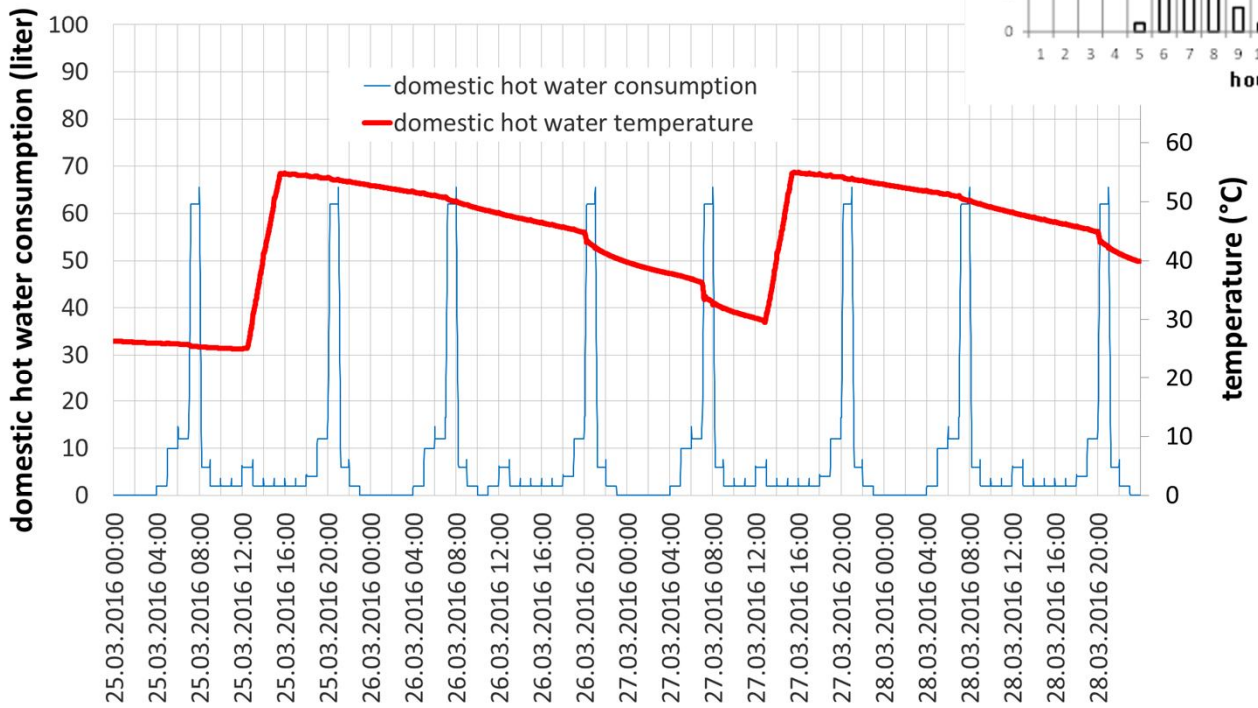
- **Heat pump power during the heating season (winter time)**



«domestic hot water preparation» measurement results

- **Domestic hot water consumption**





Conclusion and Outlook

- **Summary and Outlook**

  1. **Further test and measurements**
  2. **Development of additional control strategies**
  3. **Simulation and validation of the system in Polysun**
  4. **Find the relevant parameters for scaling up the system to higher power**

- **Partners**

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

NIBE

vela solaris

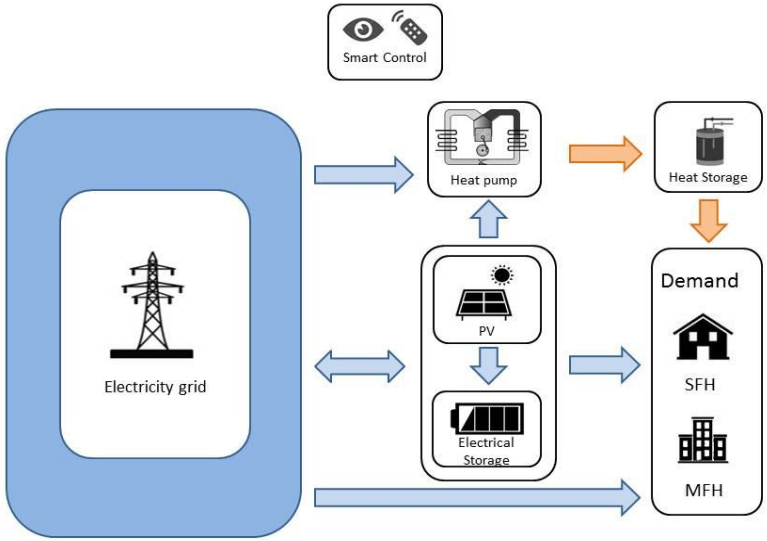
MEYER BURGER

zehnder

HARAPOL
SWISS MADE
FINEST SWISS OIL PRODUCTS

CombiVolt I

- **Impulse**
  - increasing PV production
  - first «smart heat pumps» on market, advertised to both optimize self-consumption of PV electricity and to deliver grid services to electricity utilities
  - but: how is their performance?



- **Project aims**
  - analysis of the influence of intelligent control for heat pumps on PV-self-consumption and on grid-stability
  - comparison of electrical and thermal storage
  - consideration of different electricity tariff models (current and future scenarios)

CombiVolt II

- **Procedure**
  - whole system testing in the lab of 4 different systems
  - simulation (e.g. extrapolation of measured system data, variation of climate data, load or tariff models, comparison realized vs. possible potential, electrical vs. thermal storage)

- **Project partners**
  - Energie Zukunft Schweiz (think-tank of 7 electricity utilities) + 3 more public electricity utilities
  - 4 heat pump and system manufacturers

- **Contact**

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