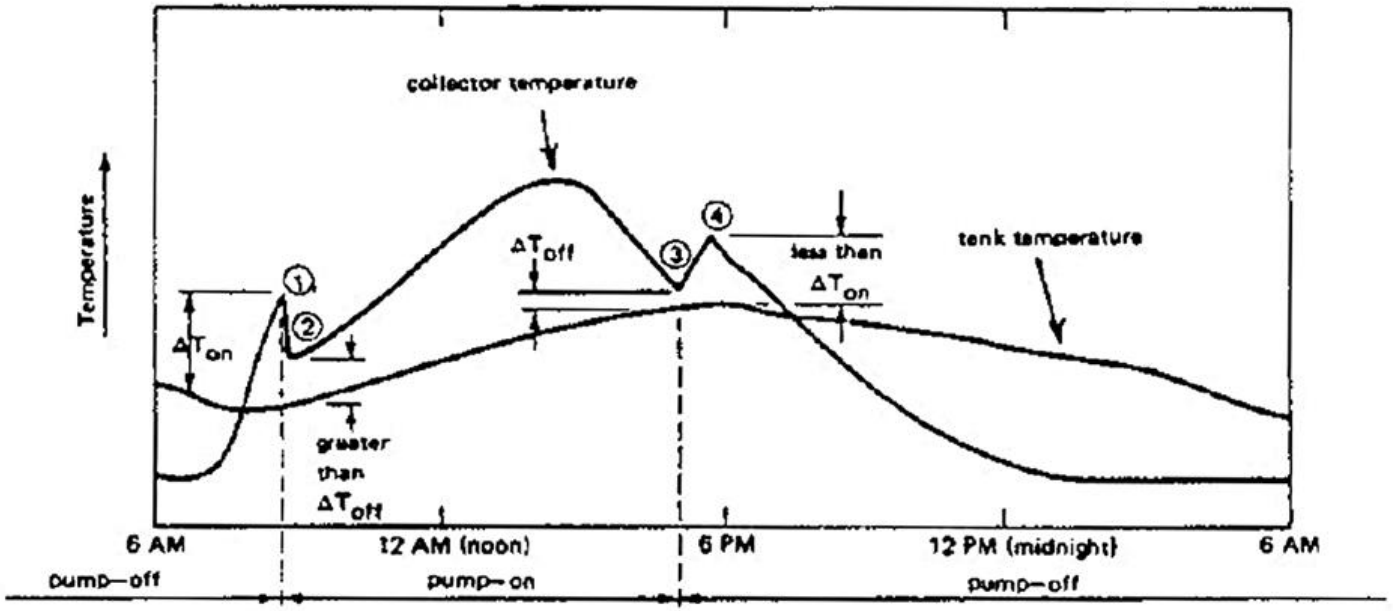
SHIP Egypt

Controller & Monitoring

Wolfgang Glatzl & Josef Buchinger

AEE INTEC & ConPlusUltra

ΔT Controller

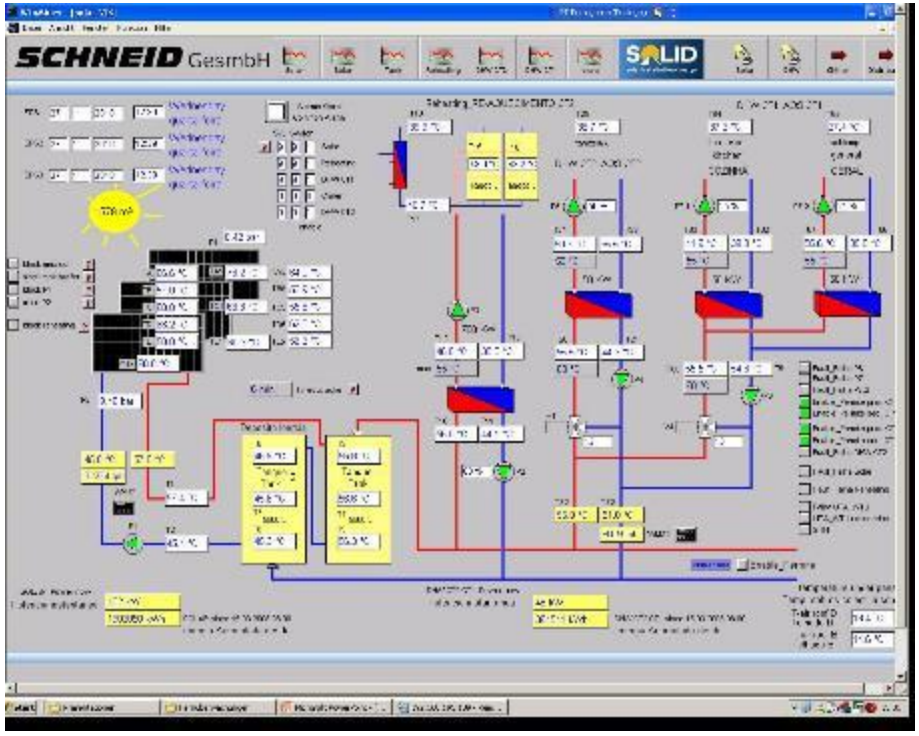


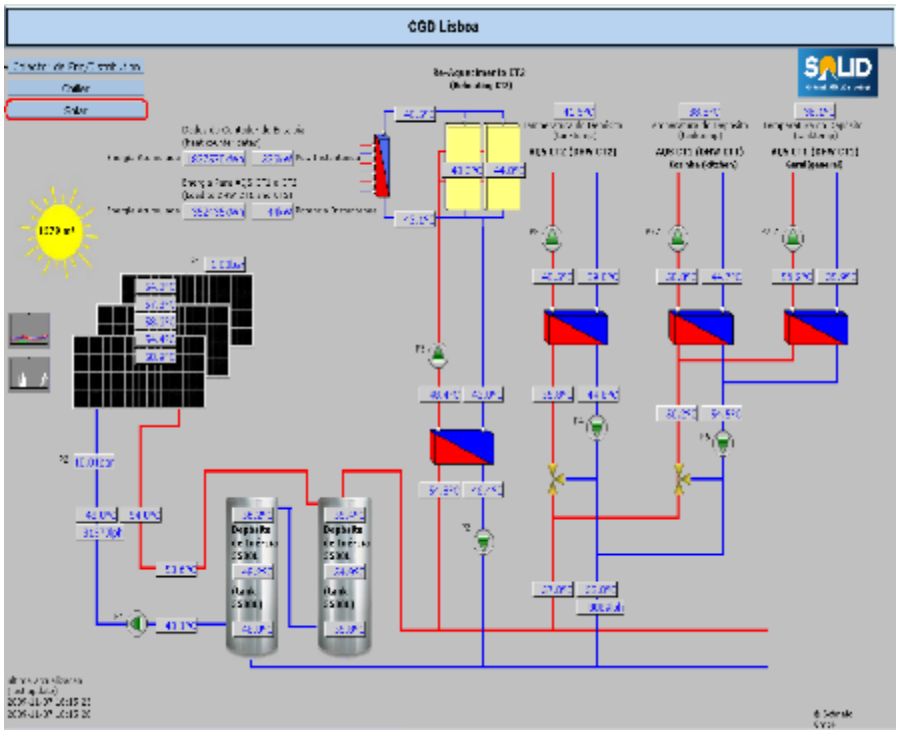
What to control for?

Maximum temperature OR maximum yield

- Heat distribution to different processes
- Heat stratification in storage tank
- Avoid overheating of the
  - collector field
  - storage tank
- Avoid over pressure
- Alarm on pressure losses (leakage)
- Protection against freezing ($T_{ambient}$ < 4°C)

Different users different views





For:
- active working
- Quick reaction
- Controlled access for service

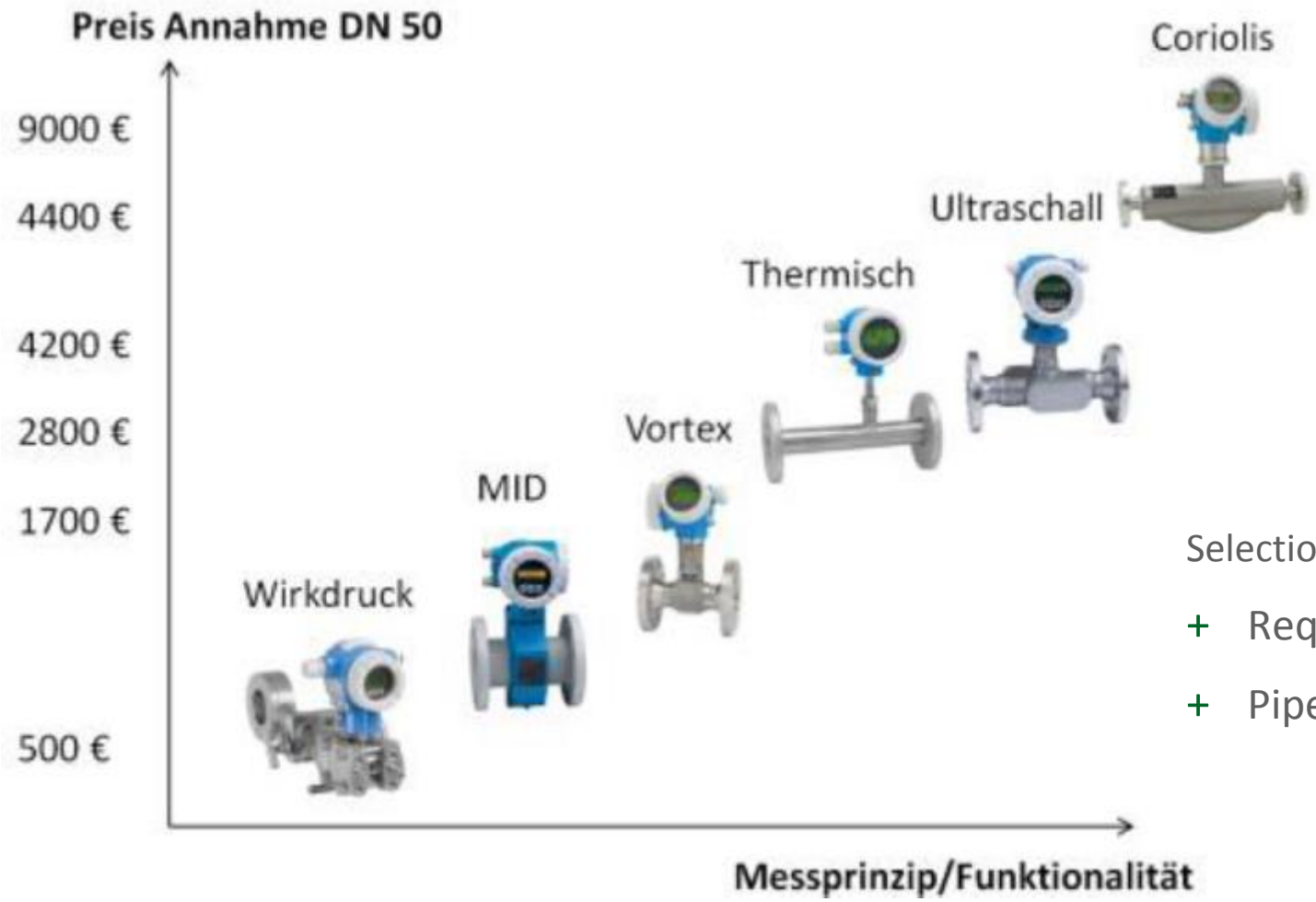
For:
- Passive watching
- slow reaction (1Min refreshing time)
- free access via Internet possible

What do we need to measure?

- Temperature
- Flow for (water, gas, oil,..)
- Heat, cold, steam
  - ⇨ 2 temperature, 1 flow
- Pressure
- Irradiation
- Electric consumption

- Other inputs:
- Status of other processes

Flow



Selection depends on

+ Required precision
+ Pipe diameter

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What do we need to control?

Pumps

- ⇨ On/off
- ⇨ VSD (0-100 %)

Valves

- ⇨ Open/close
- ⇨ 0-100 %

3 way mixing valves

- ⇨ Open/close, hotter/colder

Other processes

On/off

0-100 %

Controller rack for complex system

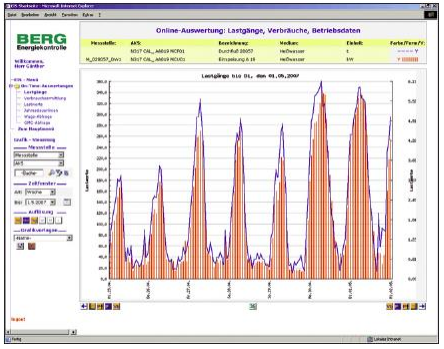
EnMCT - Basics

Systematic energy data management

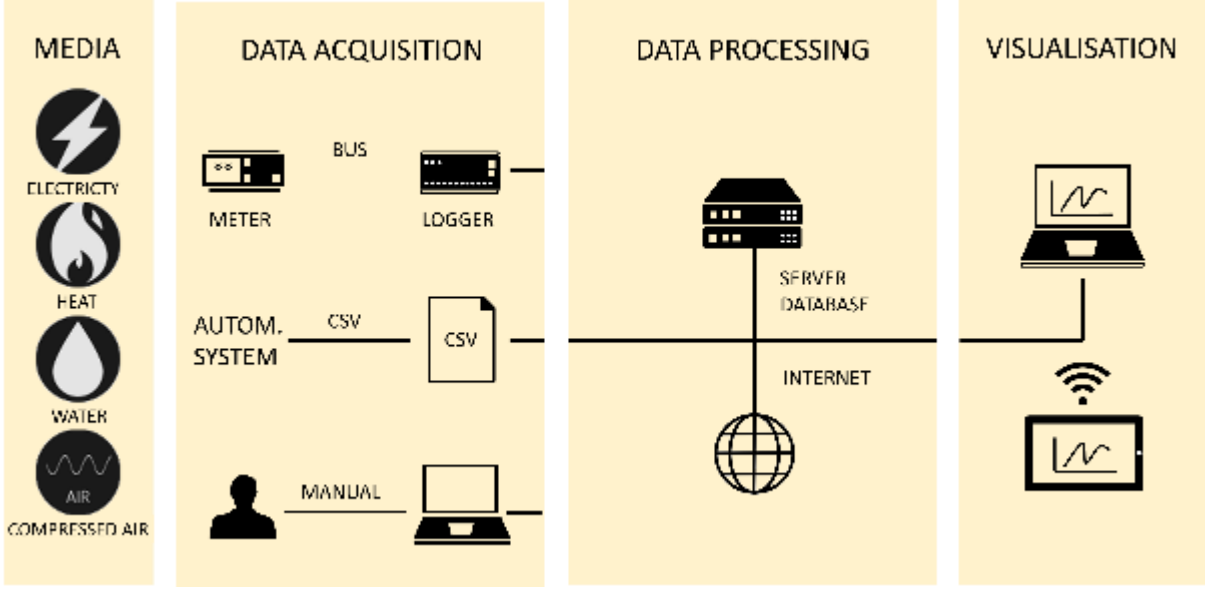
- ⇨ Automatic data acquisition
- ⇨ Real time monitoring
- ⇨ Manual data entry
- ⇨ Import-/Export of data

Processing & storage

Analysis / visualisation / Dashboard



Q: Berg, 2014



Hardware

Quelle: Efficio, BERG

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Data logger

Smart data loggers

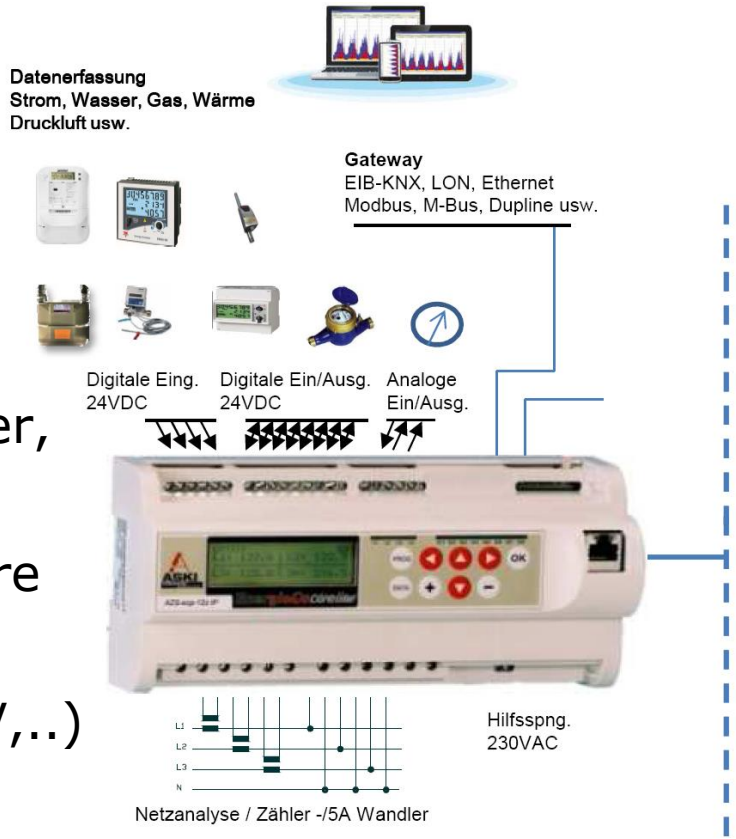
Collecting data of different gateways

Internal storage (SD-card)

Enabled direct connection to local computer, or remote reading

Integrated web browser with small software for visualisation of data

Active controller outputs (switches, 0-10 V,..)



Meat factory

- Output: ca. 100 tons of meat products per day
- 503 staff
- Energy consumption 2012:
  - Electricity: ~ 10 GWh (~ 50 % cooling)
  - Oil: ~ 14 GWh
  - Total: ~ 2 Mio EUR/year

First concept

Final concept

Key data of ST system

1067 m² high temperature flat plate collectors (HT-FPC)

60 m³ storage tank

450 MWh/y guaranteed yield

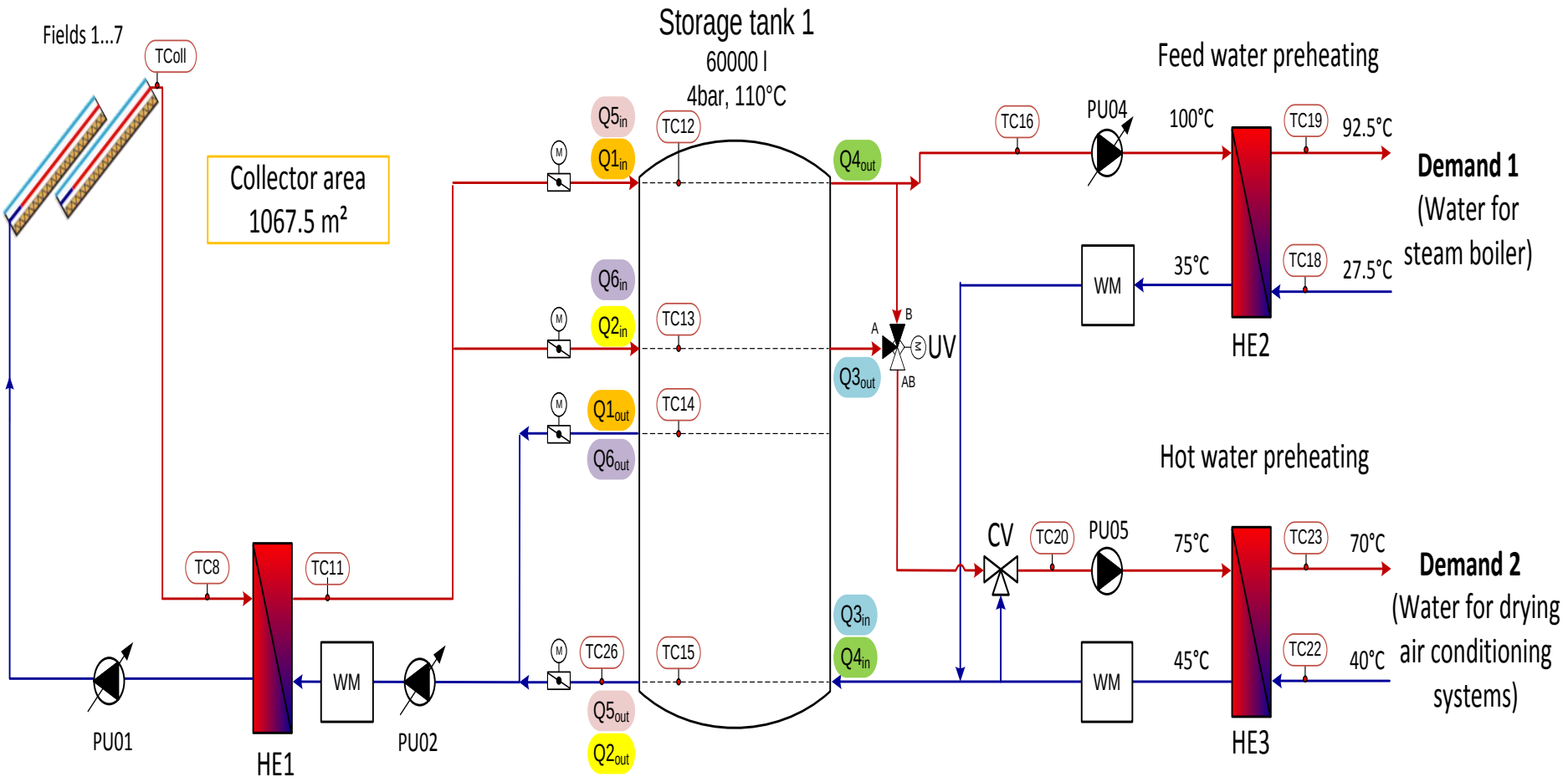
Hot Water:

- 200 kW heating capacity
- 7m³/h hot water demand
- Waste heat usage up to 40°C
- Solar thermal heats up to 60°C

Steam make up water:

- 240 kW heating capacity
- 2,7m³/h water demand
- waste heat usage up to 28°C
- solar thermal heats up to 93°C

Piping and instrumentation scheme



Foundation for storage tank

Delivery of storage tank

Errection of tank

Cladding of tank

Foundation for collector field

Collector mounting structure

Mounting of collectors

Finished collector field

Balance of system

Balance of system

Piped storage tank

HX for hot water

HX for make up water for steam

Construction phase

Construction period: 5 months

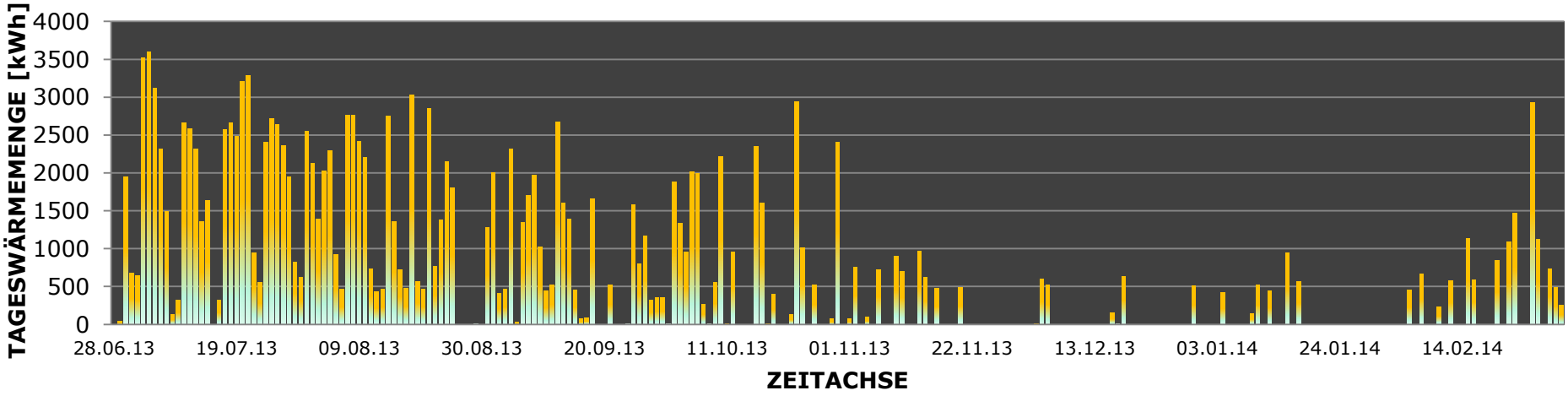
2 months for foundation, storage tank

3 months for collector field, piping, start-up

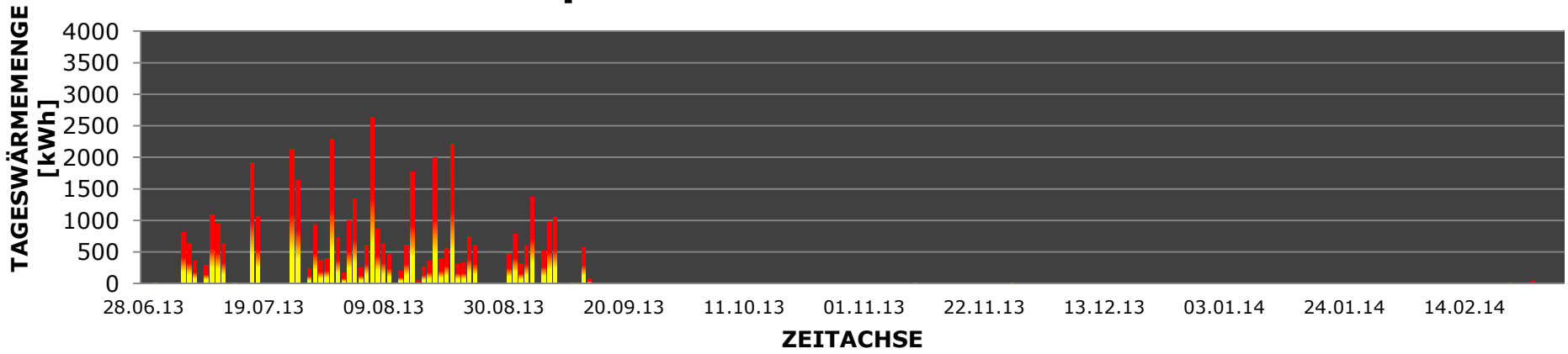
Investment: 780.000 €

Monitoring results

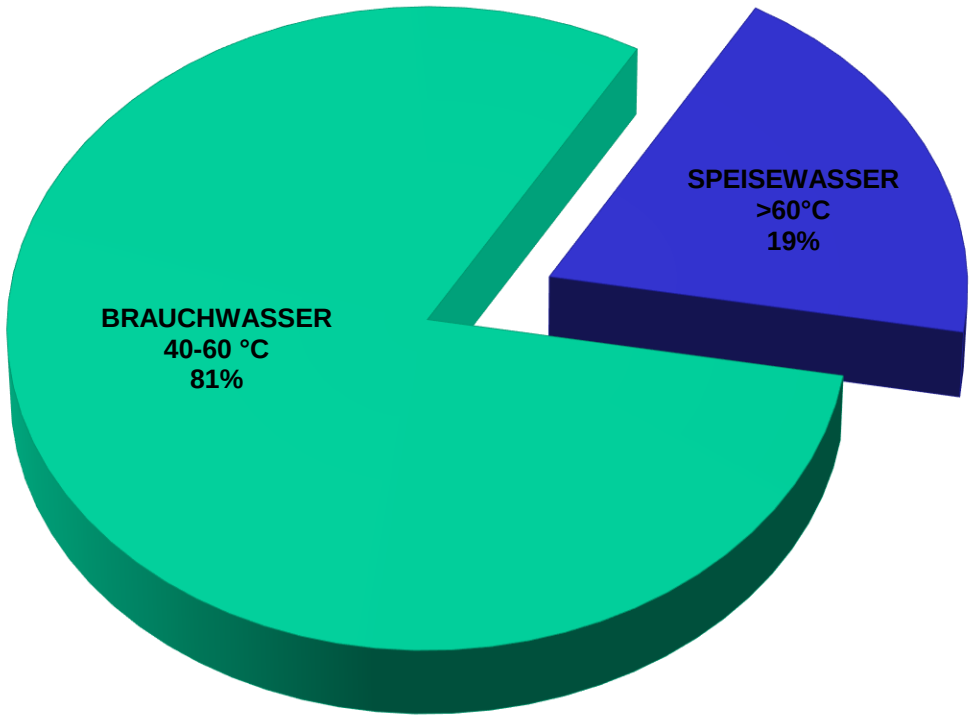
Brauchwasser 40 - 60 °C



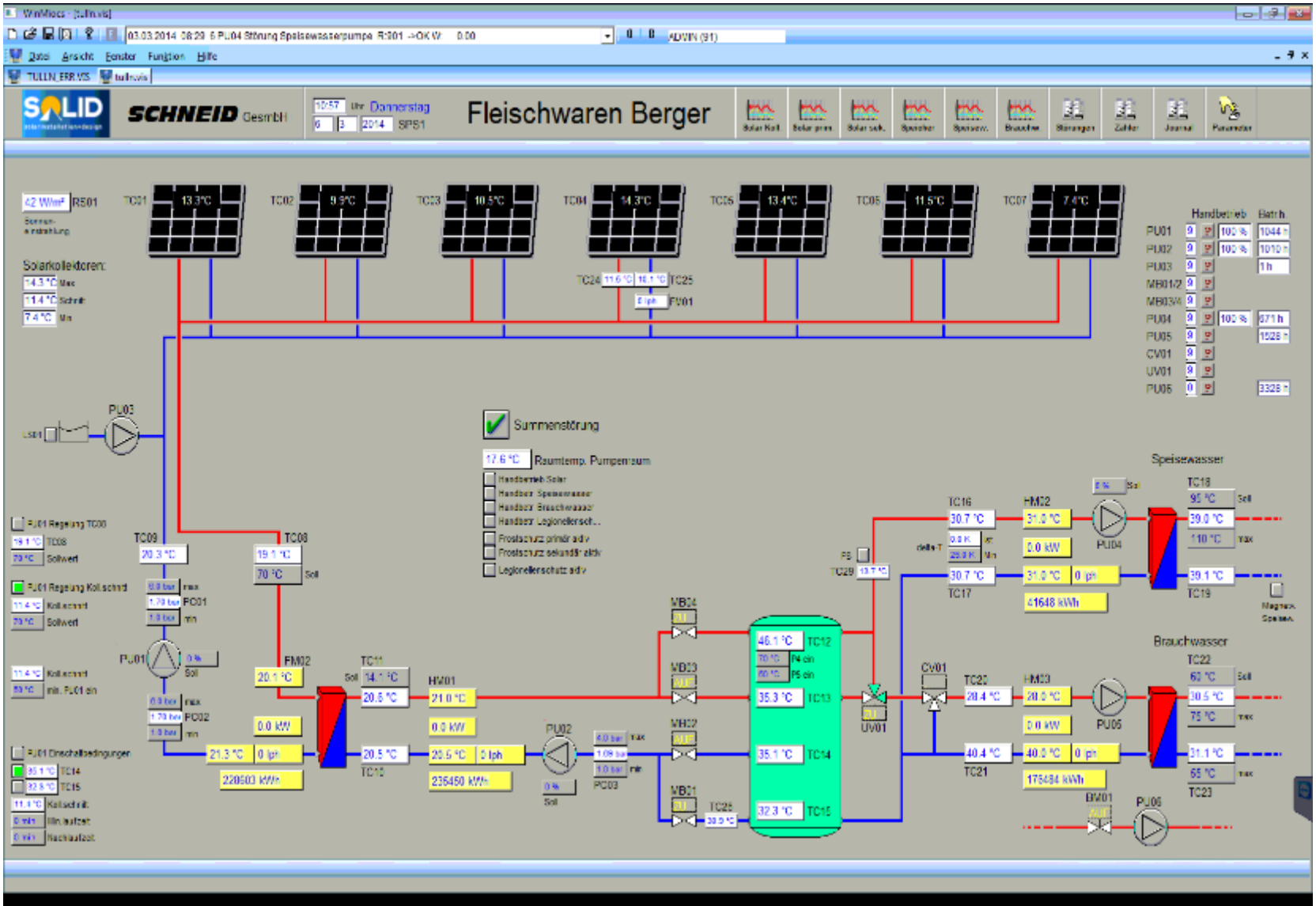
Speisewasser > 60 °C



Share of contribution to hot water / make up water

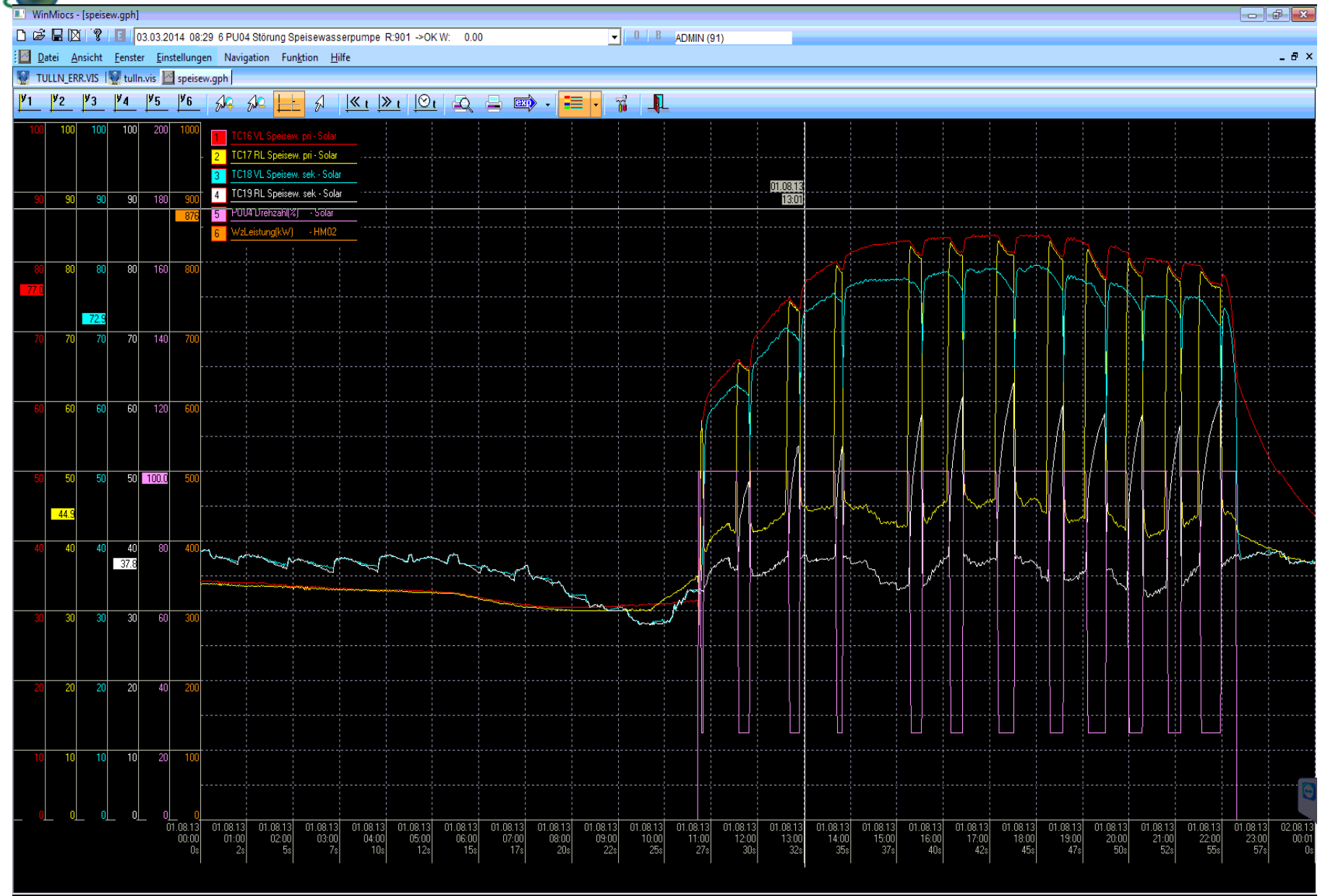


Monitoring screen

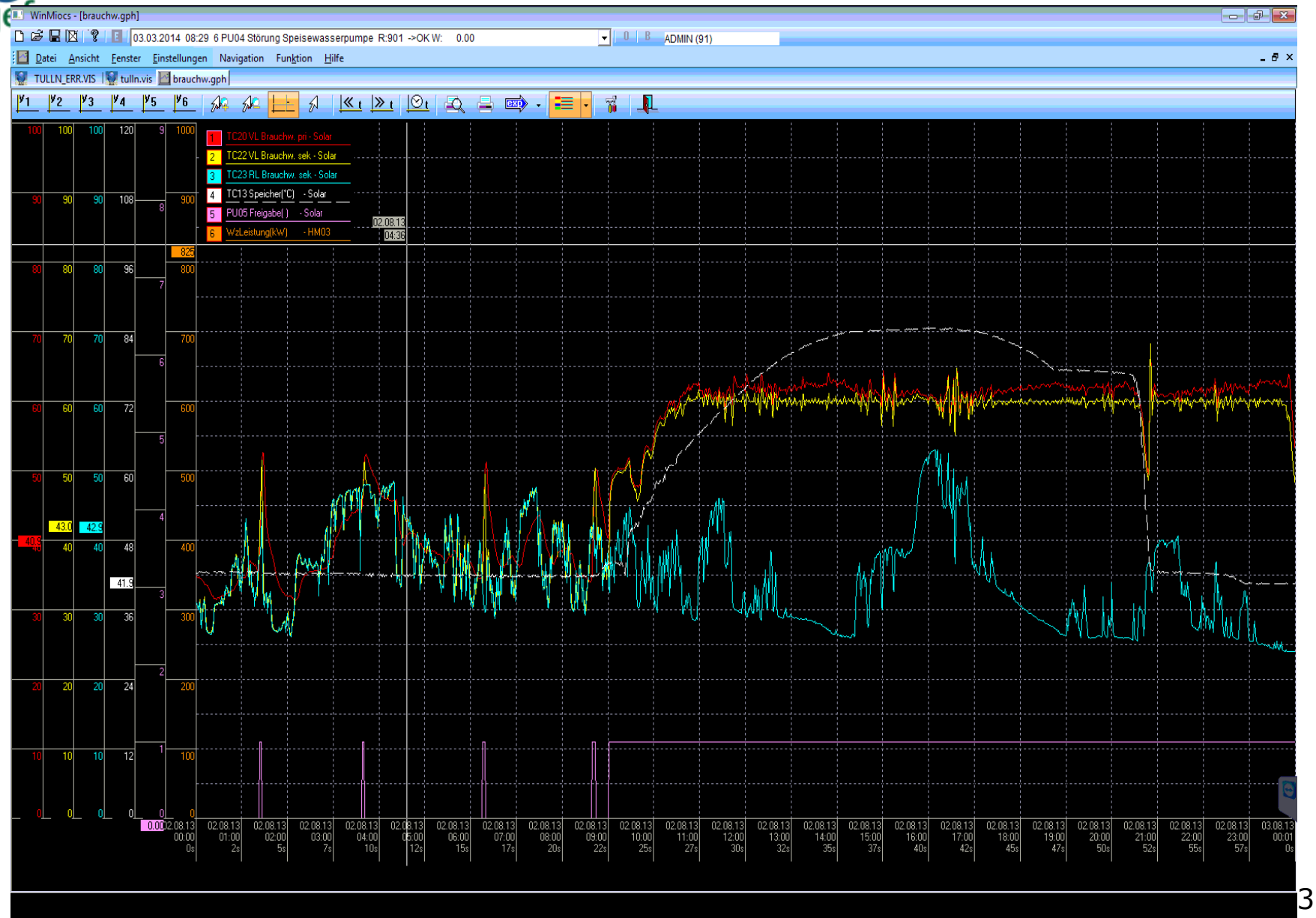


Loading of storage tank in summer

Typical summer



Hot water preparation



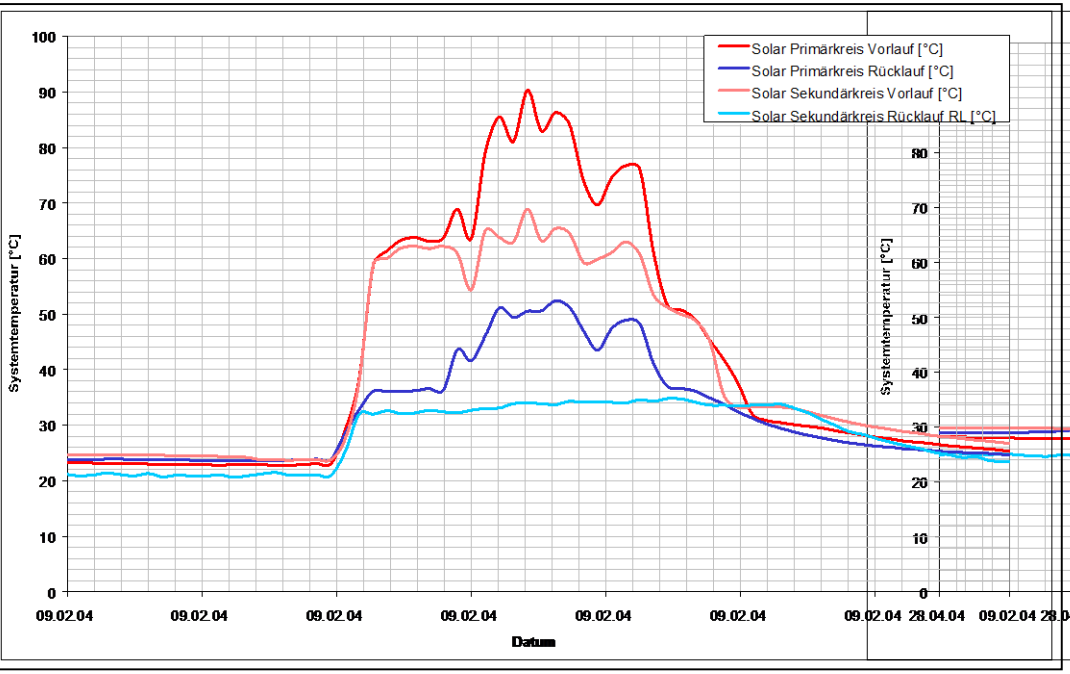
Storage temperatures in winter

Optimisation through monitoring

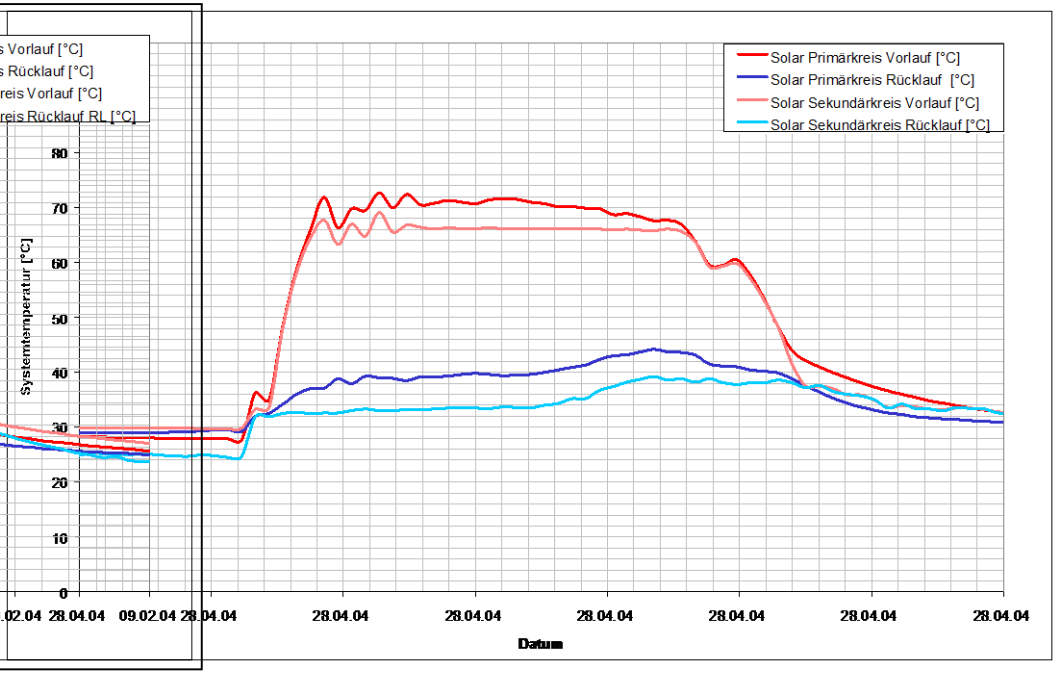
Control issues of variable speed drive for pump

Air in the collector loop

Before

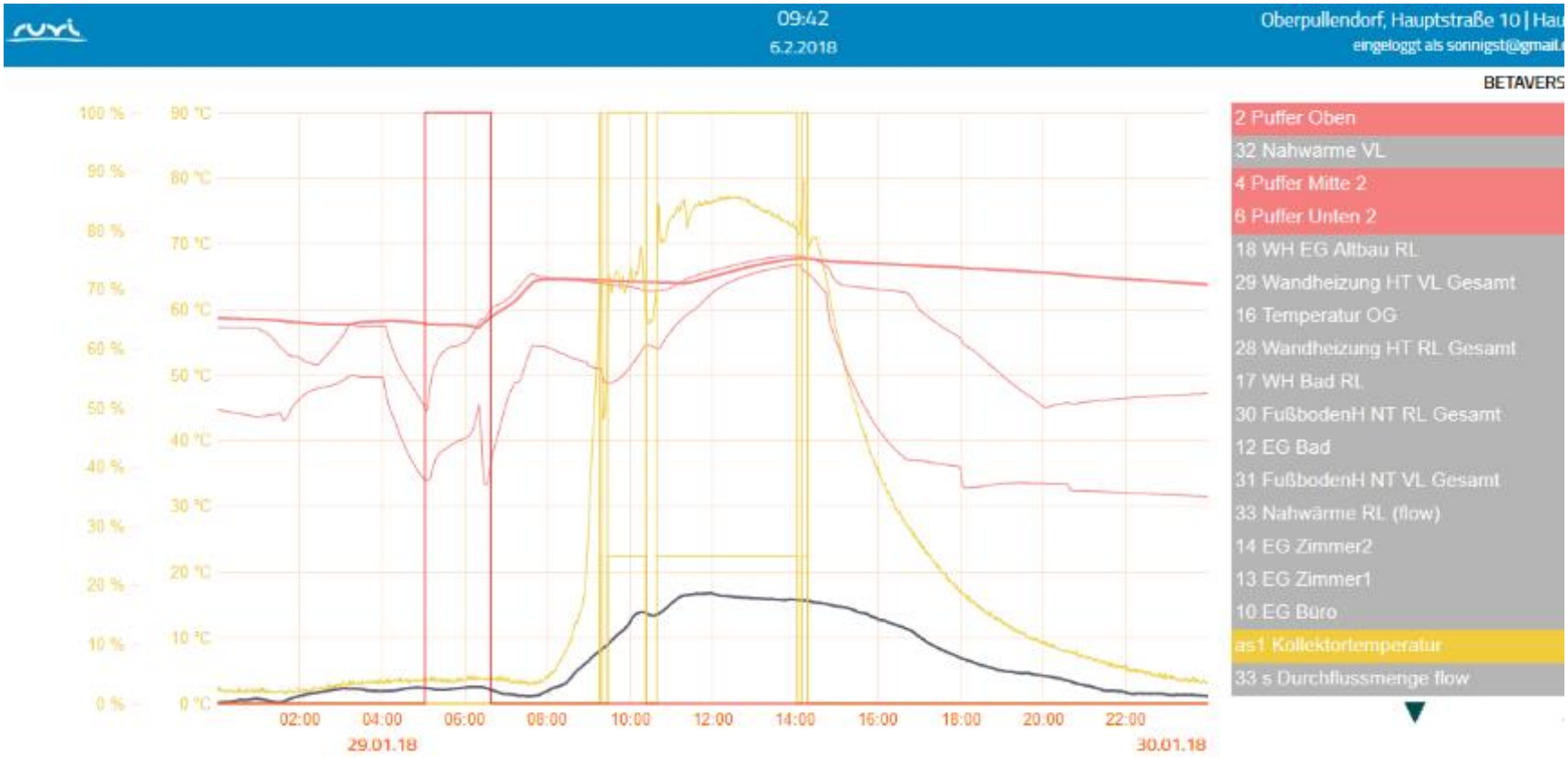


After



Small scale monitoring

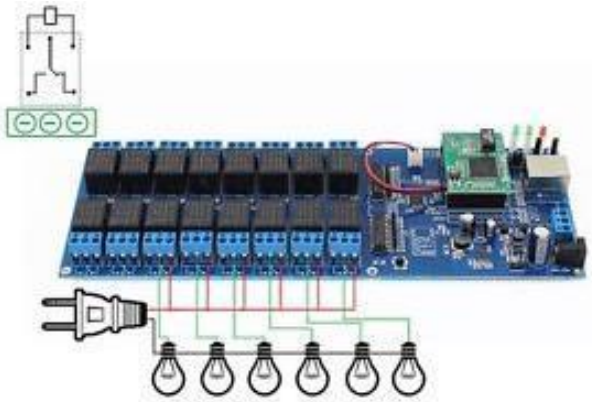
- Control & Monitoring system with on-site Raspberry Pi, digital temp. sensors and a TCP/IP switch board
- Access through internet (cloud)



Components of DIY controller system

+ Micro-PC
+ Raspberry PI, 50 USD

+ Digital Temperature sensor
+ Ds18b20, 1.50 USD



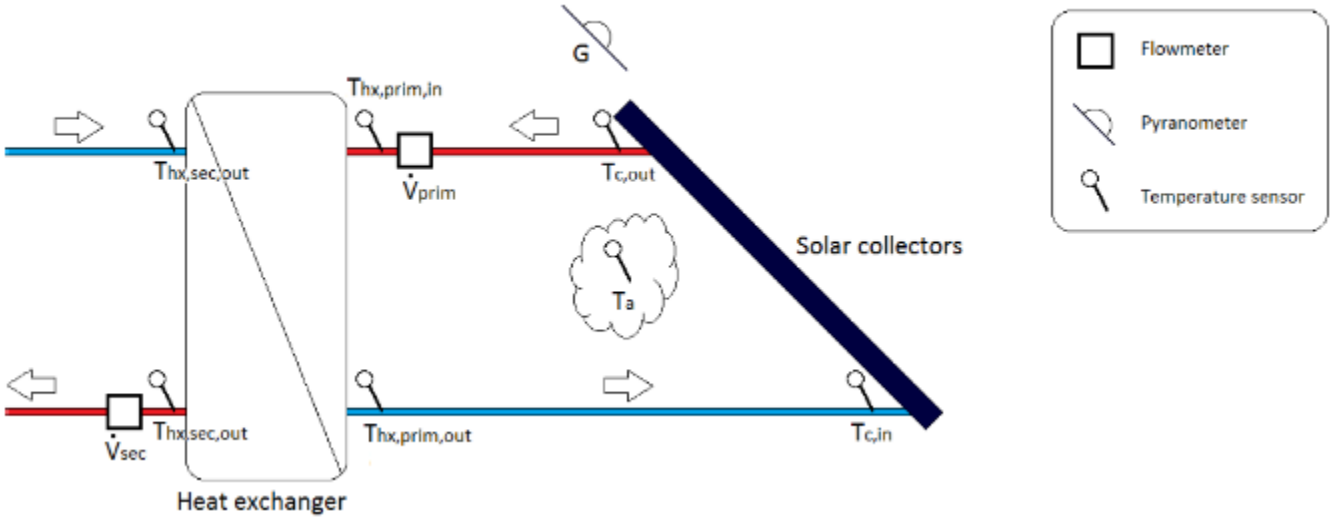
+ TCP/IP control board = relay module
+ Denkovi, 150 USD

Performance guarantee

To check the solar collector field performance guarantee it is necessary (at least) to measure the following

data points:

- ⇨ Tc,out: Outlet temperature from collector field (measured at heat exchanger inlet) [°C]
- ⇨ Tc,in: Inlet temperature to collector field (measured at heat exchanger outlet) [°C]
- ⇨ Phx: Thermal power supplied to (or from) heat exchanger [W] (or kW)
- ⇨ G: Solar irradiance on collector plane [W/m²]
- ⇨ Ta: Ambient air temperature (shadowed and ventilated) [°C]



Performance guarantee

To check also the guarantee on the heat exchanger the following additional points shall be measured:

- W_{prim} Capacity flow in collector loop primary side (glycol mixture side) [W/K]
- $T_{hx,sec,out}$ Outlet temperature from heat exchanger secondary side (water side) [°C]
- $T_{hx,sec,in}$ Inlet temperature to heat exchanger secondary side (water side) [°C]
- w_{sec} Capacity flow in heat exchanger secondary side (water side) [W/K]

Requirements:

- Logging time ≤ 2 minutes
- Recording time = 1 hour
- Time and date for all recorded data are needed. The values in the record shall represent the average values over the last hour. (ex.: data in the record saved 2011:04:31:12:00 represent the average values in the hour from 11:00 to 12:00 on April 31st 2011).
- Time indication shall always be ‘standard time’ (not daylight saving time or summer time)