Presentation of demo sites in Spain and Poland

EINSTEIN PROJECT: EFFICIENT INTEGRATION OF SEASONAL THERMAL ENERGY STORAGE SYSTEMS IN EXISTING BUILDINGS

Einstein Workshop 22-23rd September 2015, Warsaw

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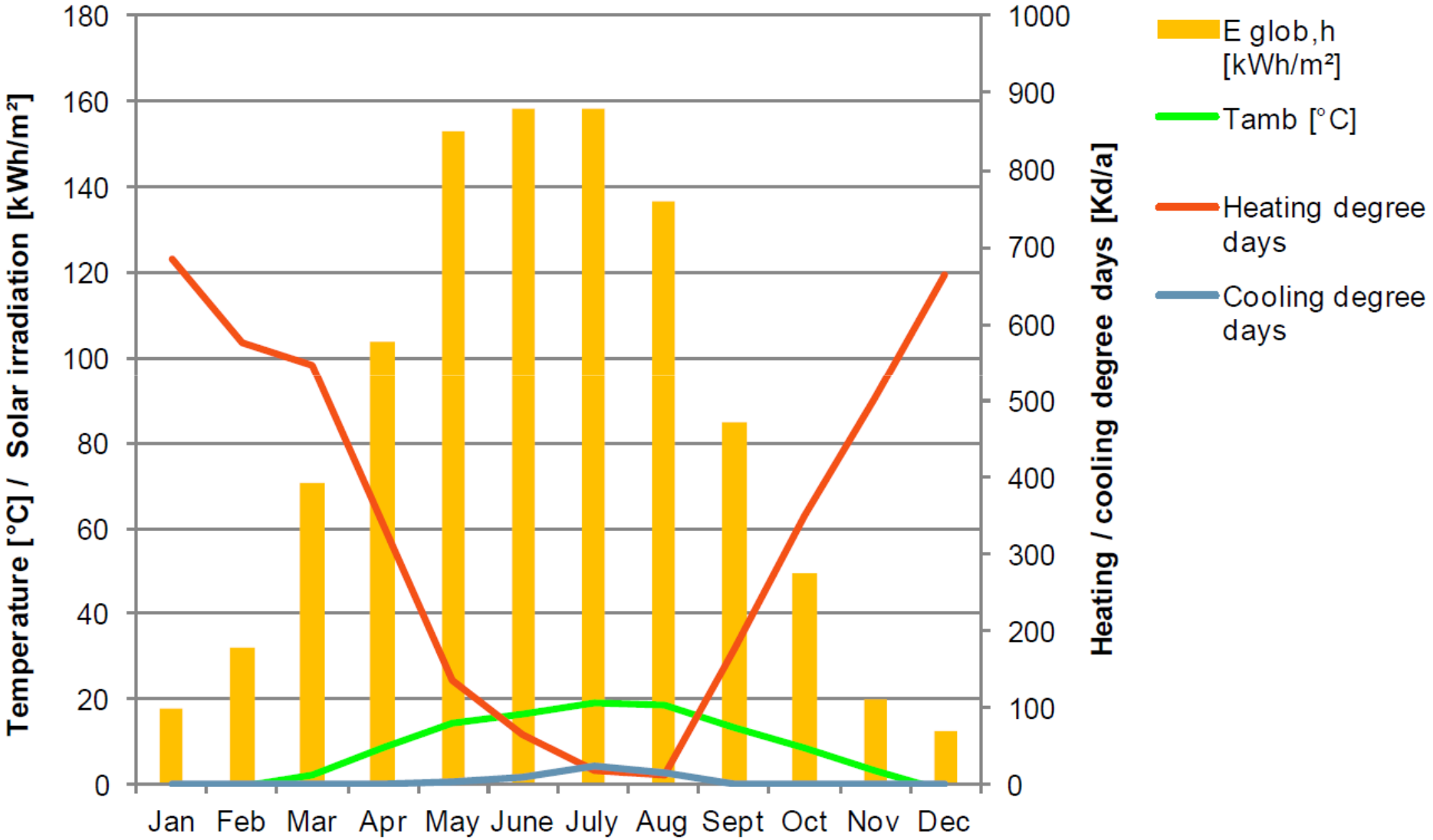
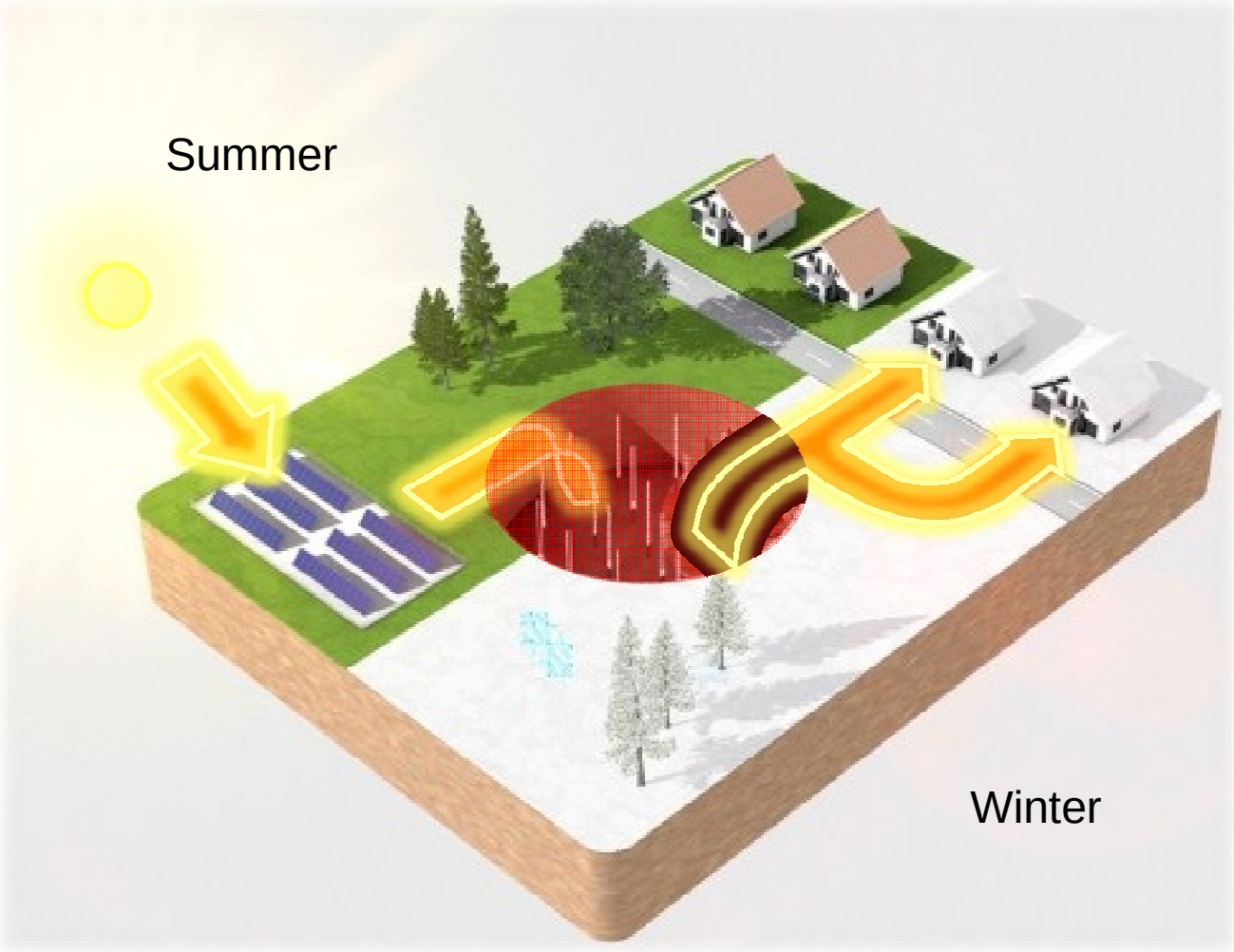
PROJECT PARTNERS

- General objetives of the EINSTEIN project
- Seasonal thermal energy storage basics
- Bilbao pilot plant
- Warsaw pilot plant

- Develop, evaluate and demonstrate low energy heating systems based on Seasonal Thermal Energy Storage systems (STES) concept combined with heat pumps in renovated buildings.
- Heat obtained form solar thermal thermal collectors is stored in a water tank (up to 90°C) to be used in winter for space heating and domestic hot water use.
- This system can be used for at building level (Bilbao demo) or District level (Warsaw).

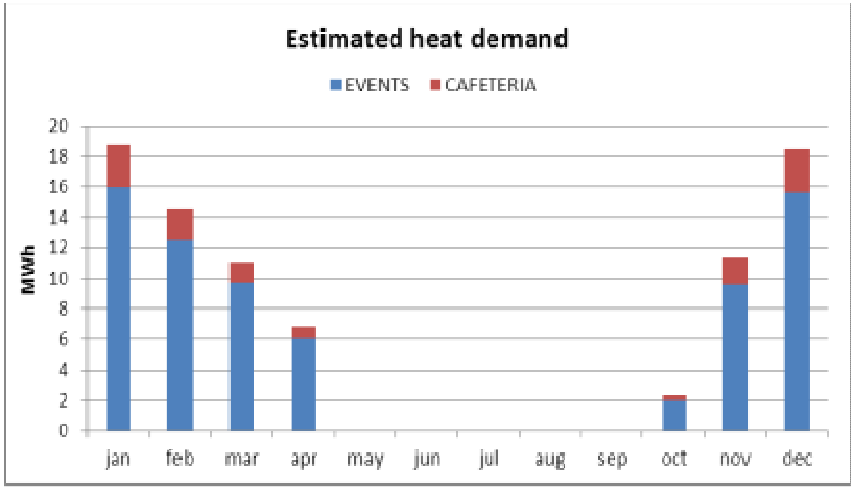

Temperature [°C] / Solar irradiation [kWh/m²]
Heating / cooling degree days [Kd/a]
180
160
140
120
100
80
60
40
20
0
1000
900
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
E glob,h [kWh/m²]
Tamb [°C]
Heating degree days
Cooling degree days


Summer
Winter

Bilbao pilot plant

Site description

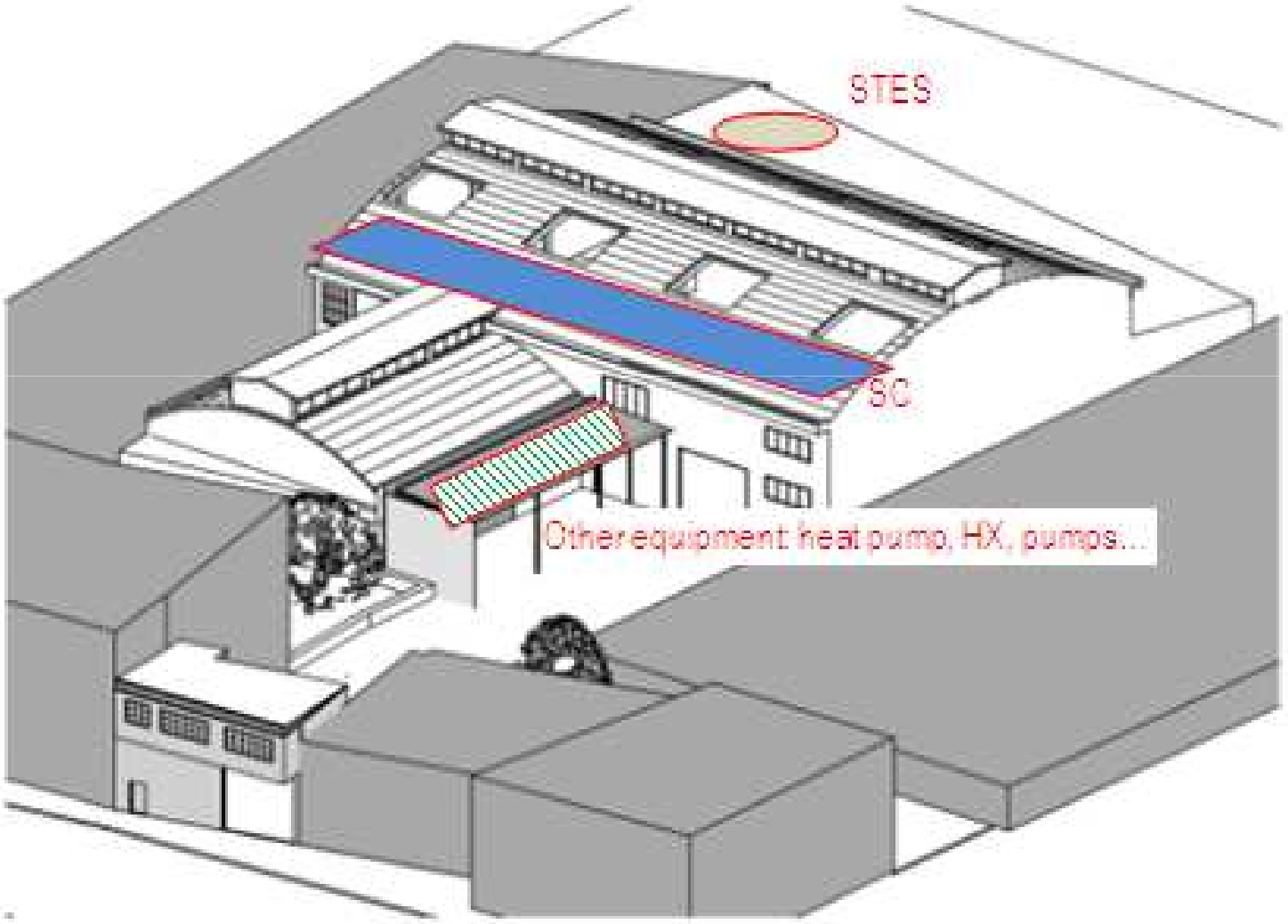
- In total ≈1.050m²; (max. capacity 400 people) divided into two areas:
  - Area 1: ≈250m² (cafeteria). Use: Exposition events (art expositions)
  - Area 2: ≈800m². Use: cultural events will be organized.
- Heat demand has been estimated (only space heating, no DHW): 83 MWh/a.



	kWh/year	kWh/m2·year
Events area	71.300 kWh	88,5 kWh/m2
Cafeteria	11.970 kWh	47,0 kWh/m2
Total	83.270 kWh	78,5 kWh/m2

BILBAO PILOT PLANT

BILBAO PILOT PLANT

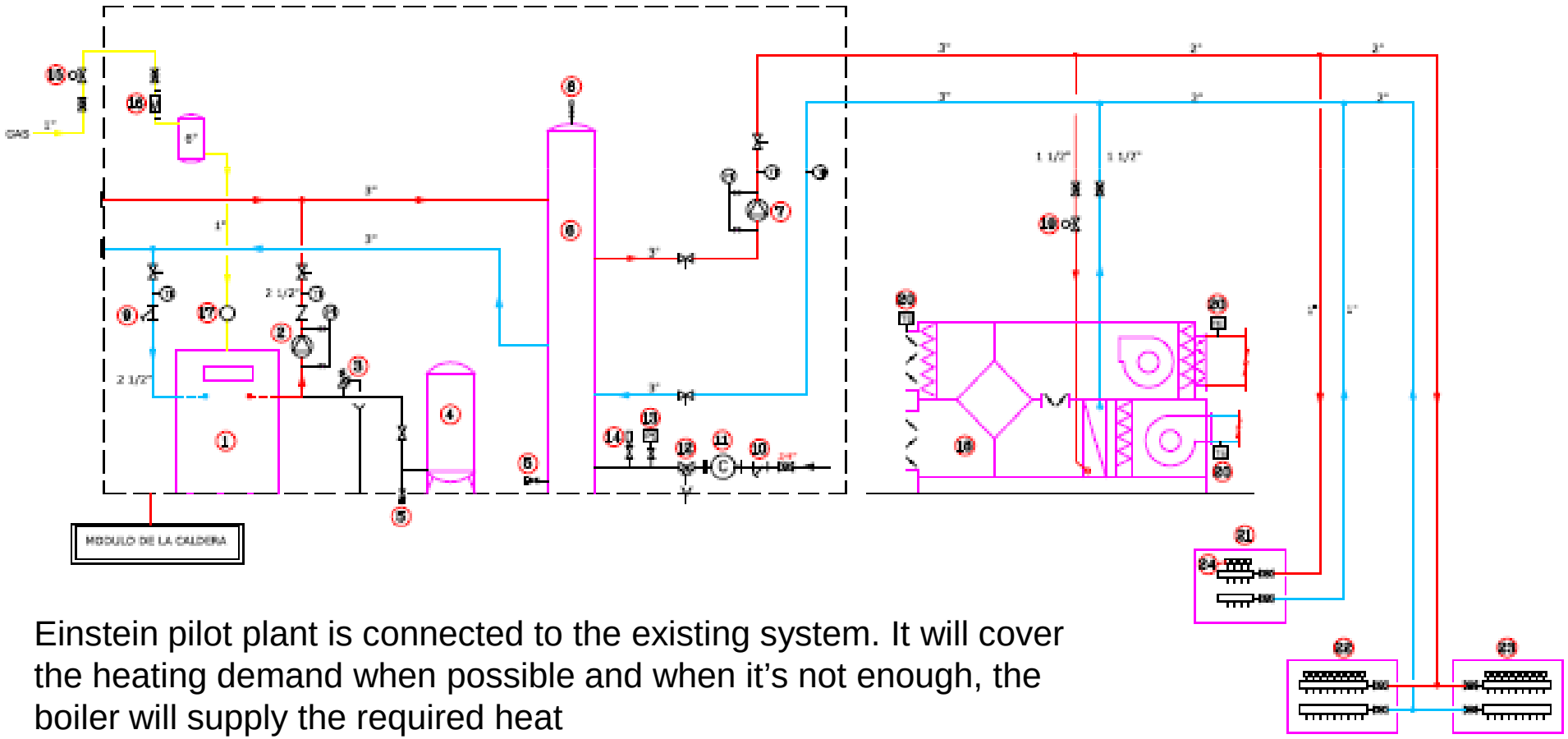


View of the 800 m^2 surface heated with underfloor heating system

View of the 250 m^2 surface heated with underfloor heating (cafeteria)

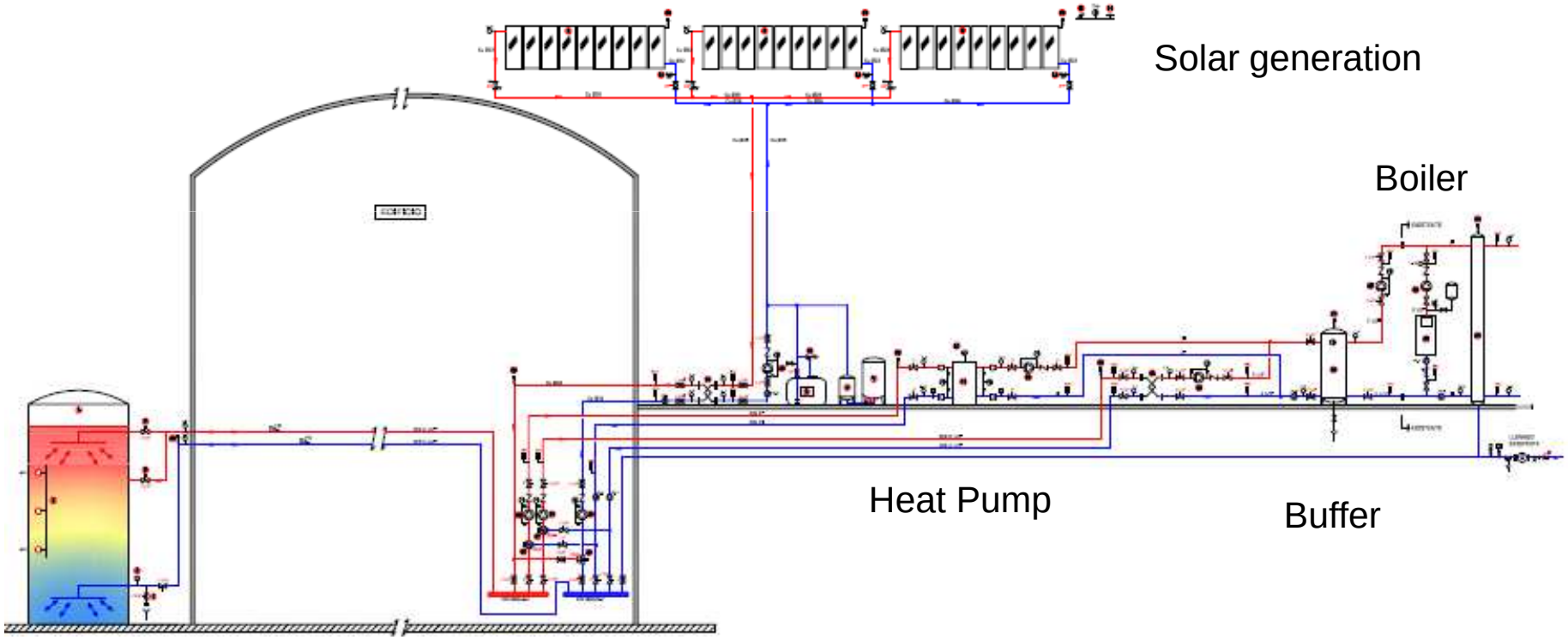
Existing thermal system:

- Low T gas boiler, ground floor heating system and Air Handling Unit
- Supply/return temperatures: 45/35ºC
- Boiler and load side hydraulically separated by a collector
- Gas boiler: 190 kW nominal capacity (can be reduced up to 30%)



Einstein pilot plant is connected to the existing system. It will cover the heating demand when possible and when it's not enough, the boiler will supply the required heat

Hydraulic scheme



Hydraulic installation

- Size of installation has been calculated by means of TRNSYS simulations.
- Solar collectors, 62 m^2 (primary circuit: glycol)
- Standard HP, 69 kW (thermal)
- STES, 180 m^3
- Pumps, pipelines, HX
- Pipelines isolation
- Buffer, 2 m^3

- ***Solar collectors, 62 m²***

- ***Standard heat pump (69 kWth)***
- It is used when temperature of STES water is between 40 – 10 C. Can heat water up to 55 °C

- ***Pumps, pipelines, HX, buffer tank***

Heat exchanger primary/secondary circuits

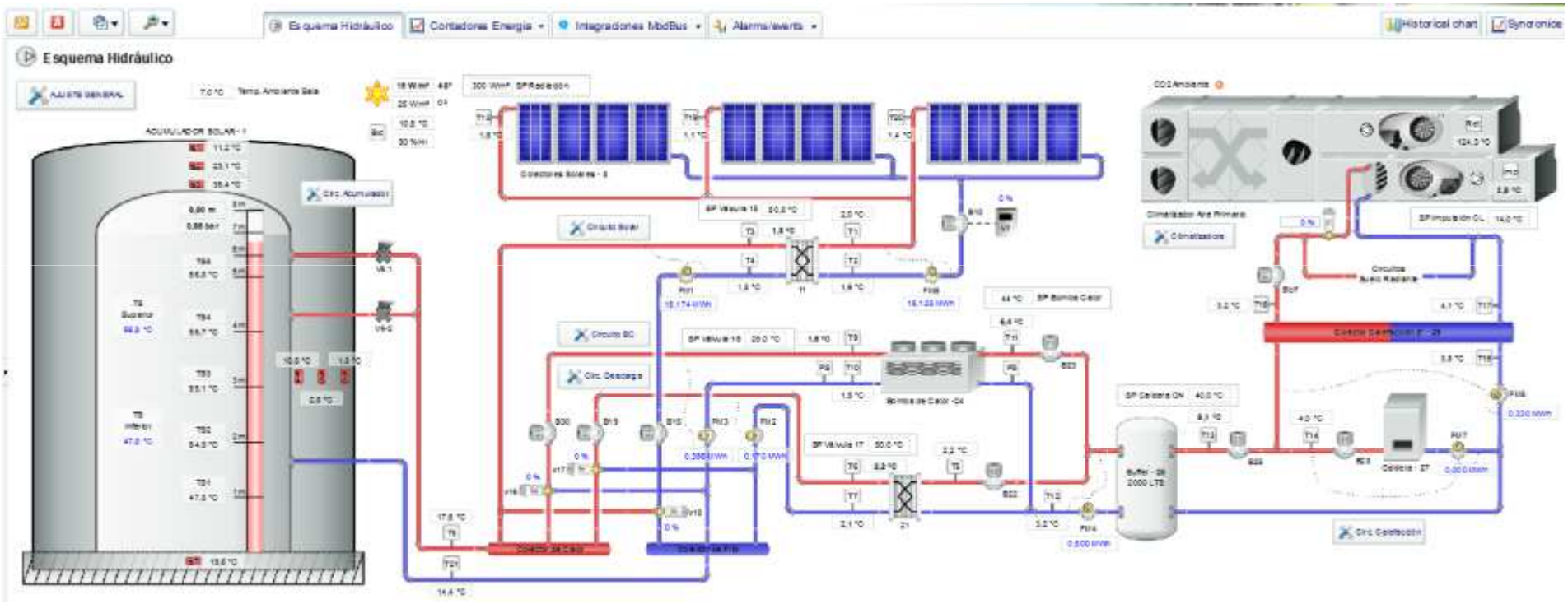
Buffer tank, 2 m^3

Secondary circuit, hydraulic collectors

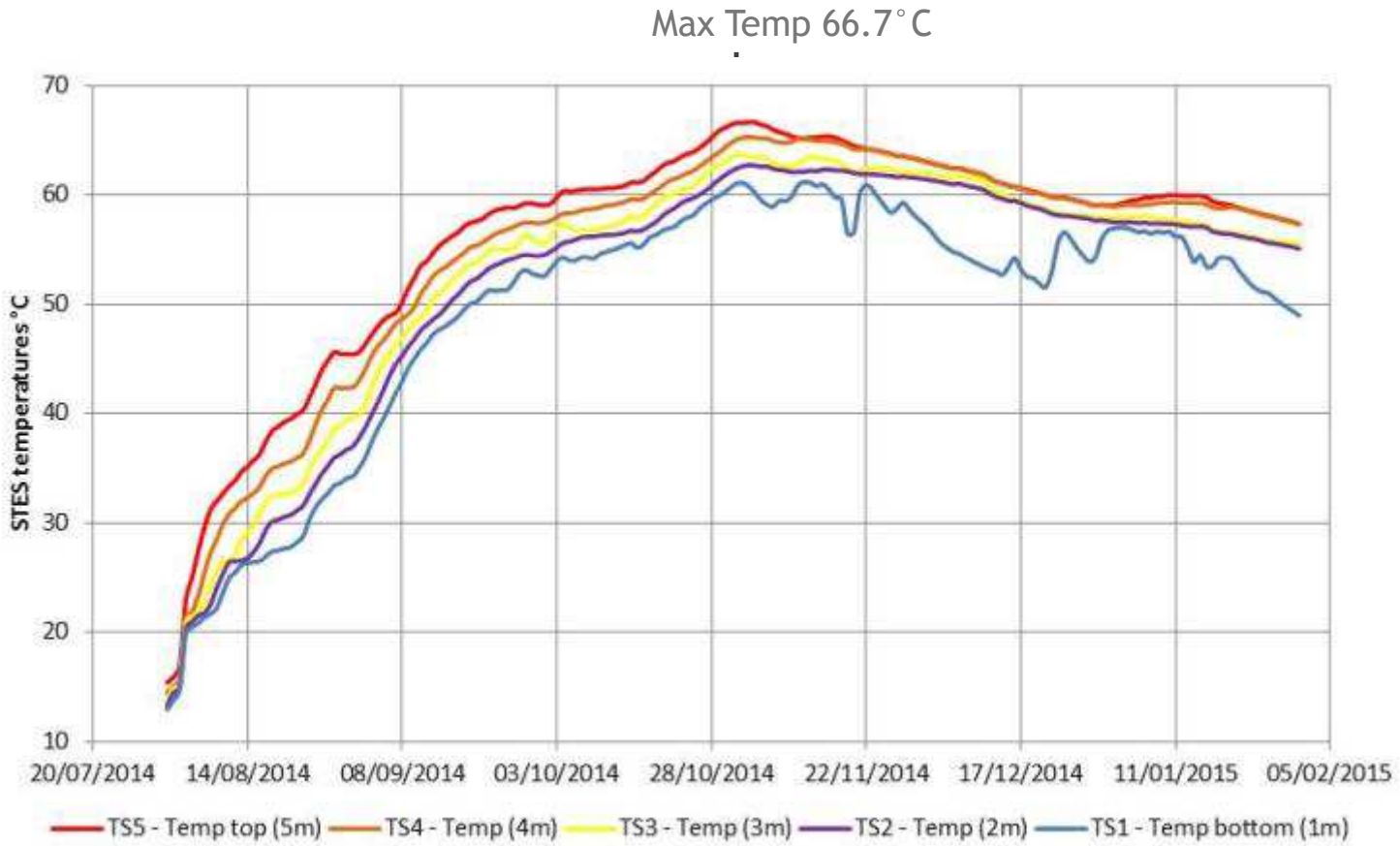
Control and monitoring elements

- Thermocouples (Pt-100/Pt-1000)
- Solar radiation probe
- Heat meters (water flow and temperature)
- Control level (pressure) in the STES tank
- Exo-Scada base
- Data acquisition (remote control)

Lay-out


Esquema Hidráulico
Esquema Hidráulico
Contadores Energía
Integraciones ModBus
Alarmas/events
Historical chart
Synoptics

Charging of STES tank



STES Volume 180 m³ Innovative design

Double independent tank. Modular construction.

- Inner tank: ∅ 6 m ; Height 6.45 m wet (6.70 total)
- Outer tank: ∅ 7.10 m; Height 8,05 m
- less thermal bridges due to absence of supports

Innovative insulation.

Bottom insulation over the ground:

- 0.45 m Expended clay granulates.
- Regular distribution of charges over the ground (not increased in perimeter)

Lateral and upperside: new PUR recycled granules.

- Lateral side 0.55 m; upper side 0.87m
- Blowable type insulating material.

Site preparation

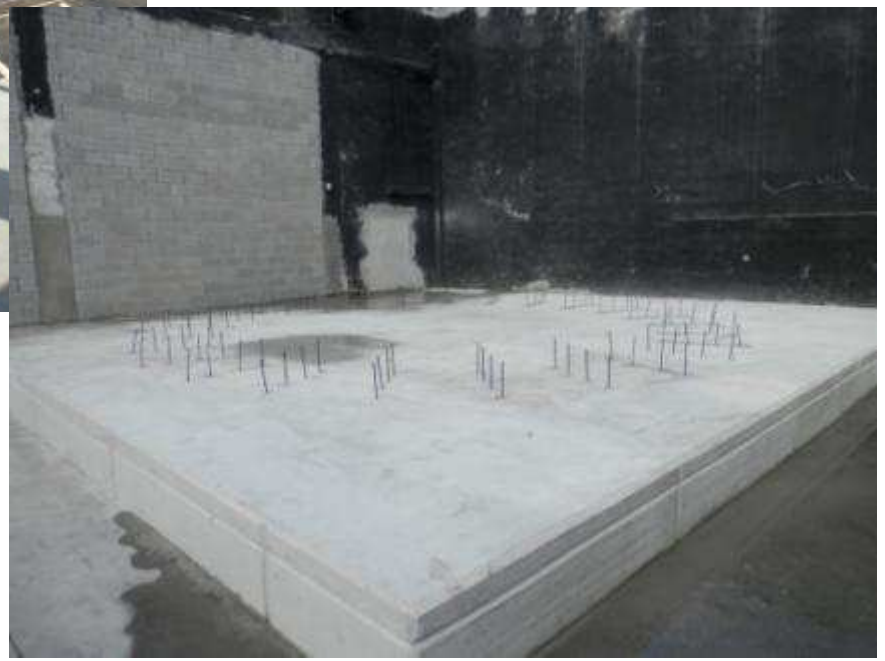
Original status

Final state

Foundation slab

Metallic structure

Foundation slab



Tank assembly

Modular building

Insulation

Bottom Expanded Clay

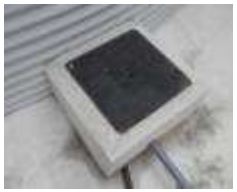
Upper PU sandwich panels

Granular PU between tanks
(lateral and upperside)

Hydraulic Details

Spillway

Upper access closing



Drain manhole

Stratification devices

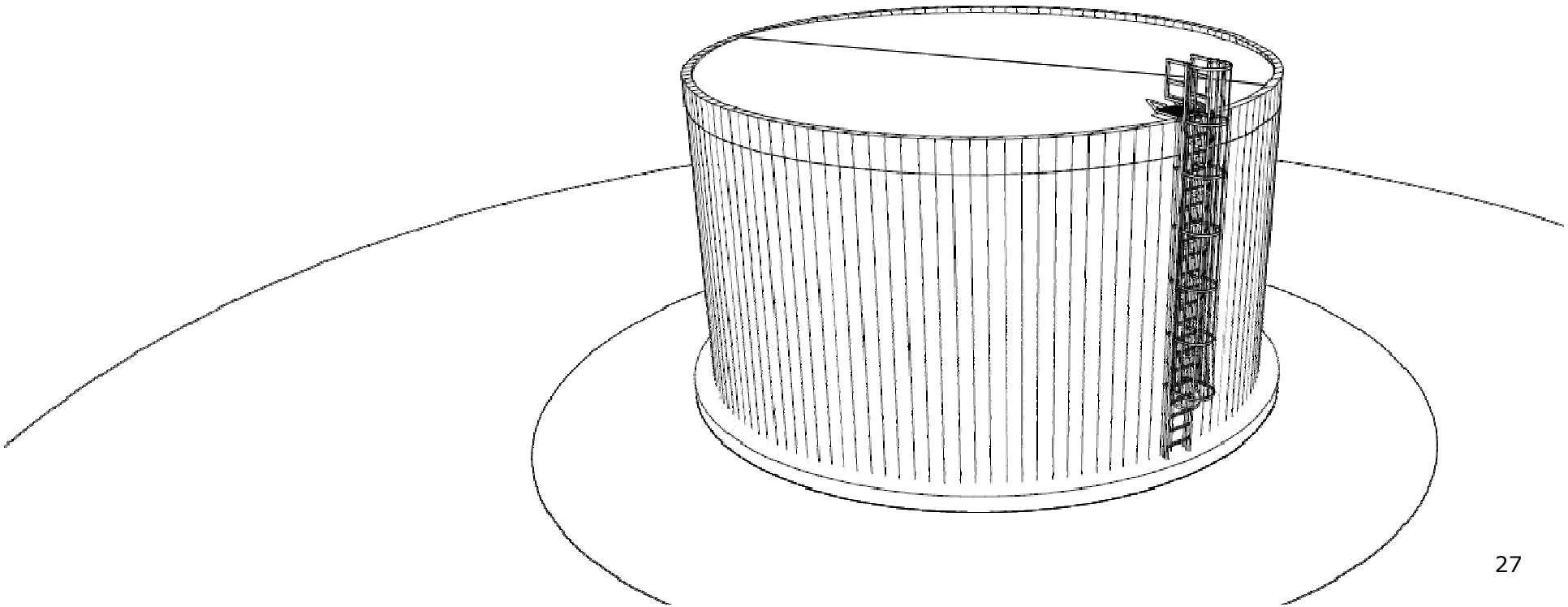
Monitoring inside the tank details

Conductions for under tank temperature and pressure sensors.

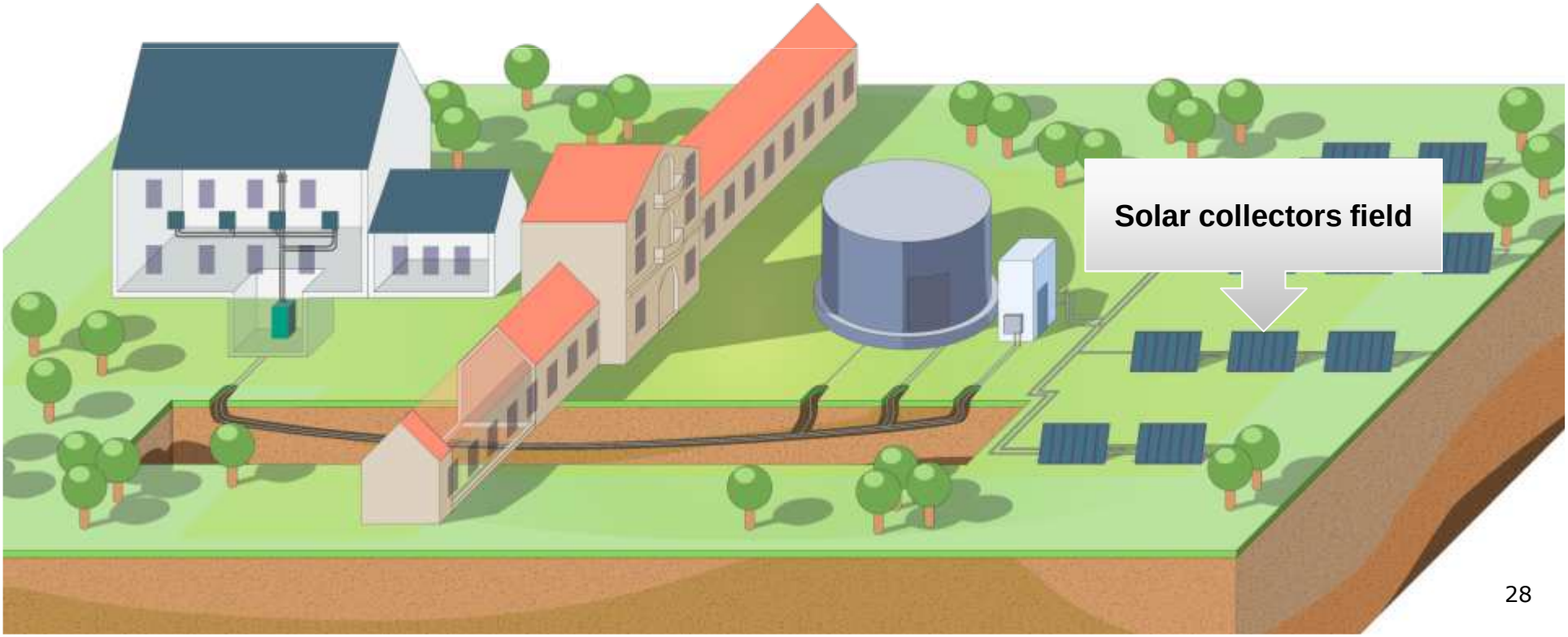
Monitoring of tank temperatures

Extracting inner tank temperature sensors

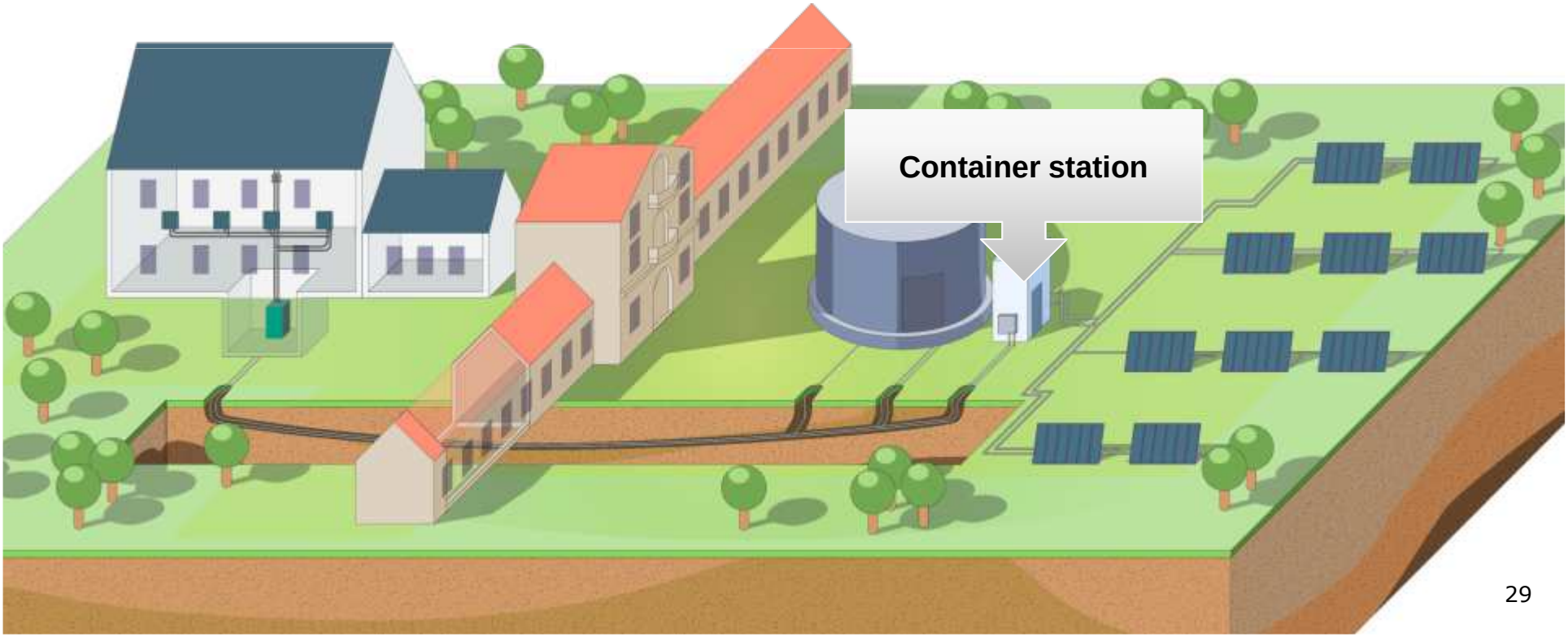
Polish pilot plant



- 150 m^2 (netto) of flat solar collectors
- 78% maxium efficiency
- 40˚ collectors installation angle
- Facing south
- Glycol as a working fluid
- Temperature measurements

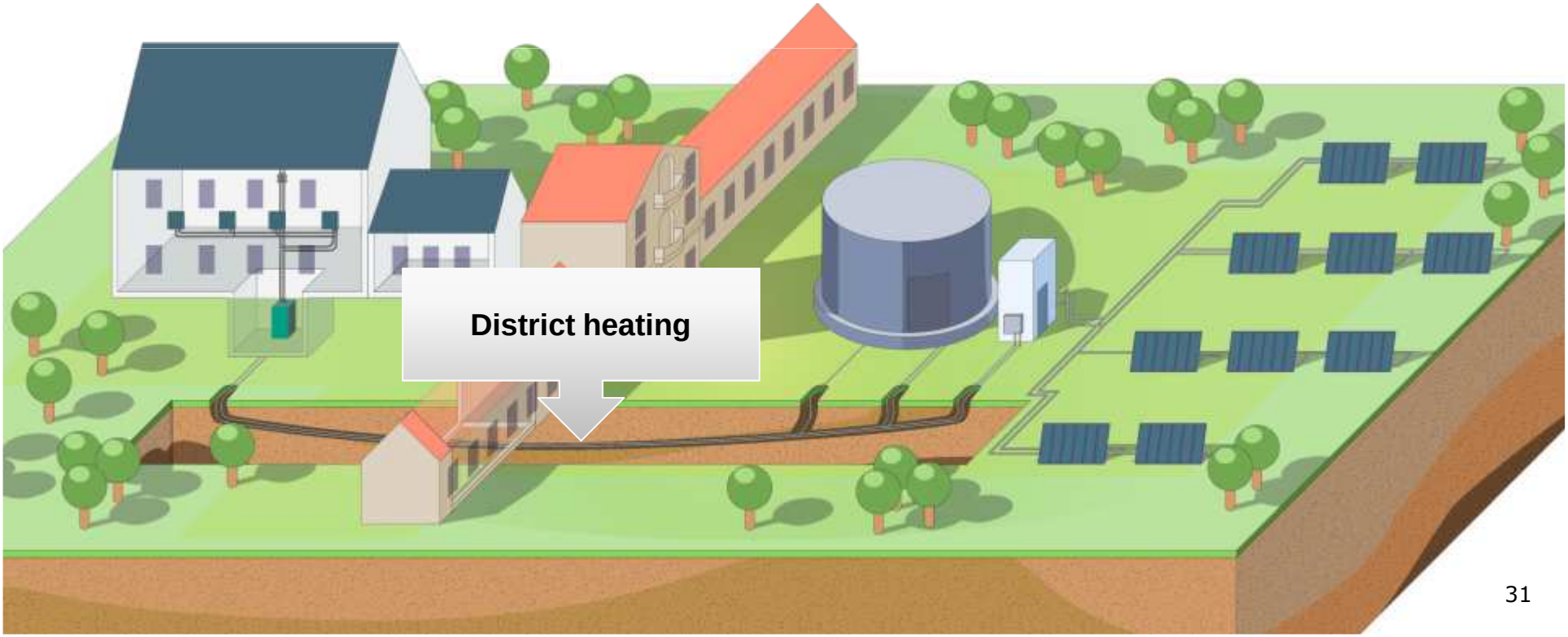


- Insulated container station
- Glycol/water heat exchanger
- Flow measurements
- Temperature measurements
- Pressure measurements
- Safety equipment

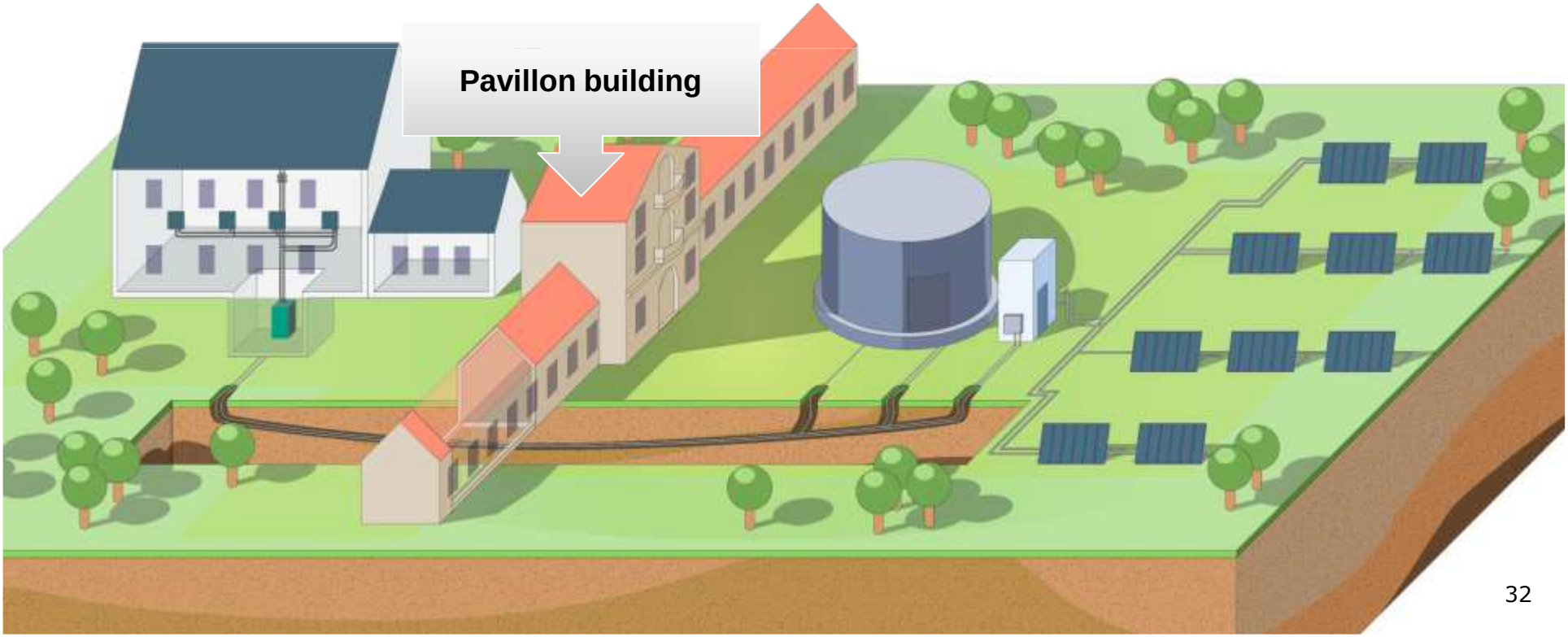


- 800 m3 water volume
- Heavily insulated
- Equipped with stratification device
- Temperature measurements
- Pressure measurements
- Safety equipment

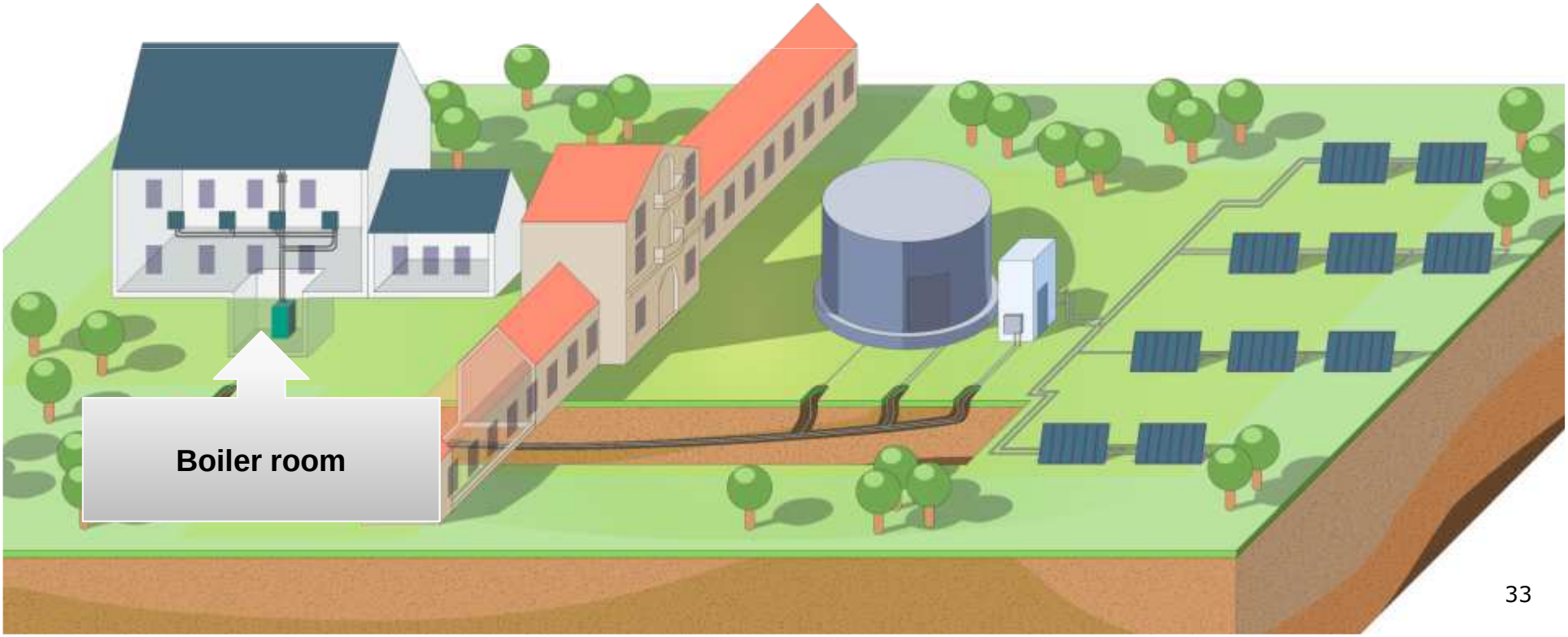
- ~150 m district heating
- 2x De65 flexible, preinsulated polibutylene pipes in PEHD casing
- Integrated fiber-optic cable
- Horizontal directional drilling under Pavillon building
- Pavillon building structure measurements during drilling



- Pre-war building structure
- Under protection of the conservator of monuments



- 90kW gas boiler with 2-stage burner
- Temperature control according to external weather conditions (heating curve)
- Heat exchanger & prototype high temperature heat pump (connected in parallel)
- 1 m^3 heat pump buffer
- Flow measurements
- Temperature measurements
- Pressure measurements

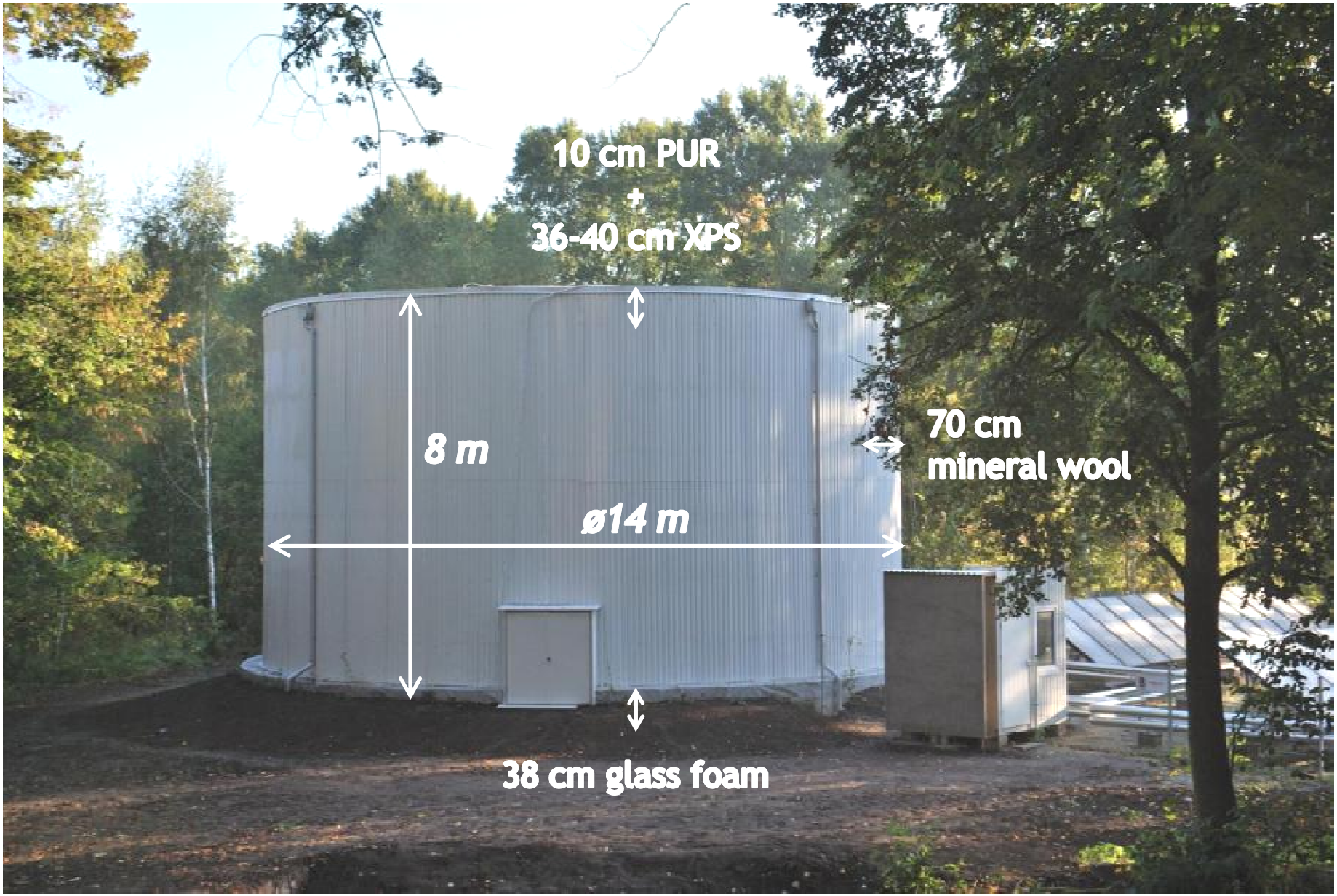


- 793,7 m^2 of usable area of the building
- 4842,6 m^3 of building space
- 75 kW of peak heat demand
- Not insulated, old windows with low U value
- High temperature heating installation

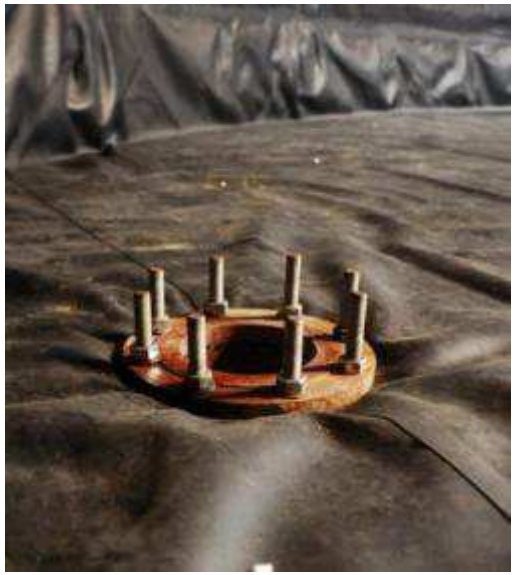
Solar collectors field

Container station

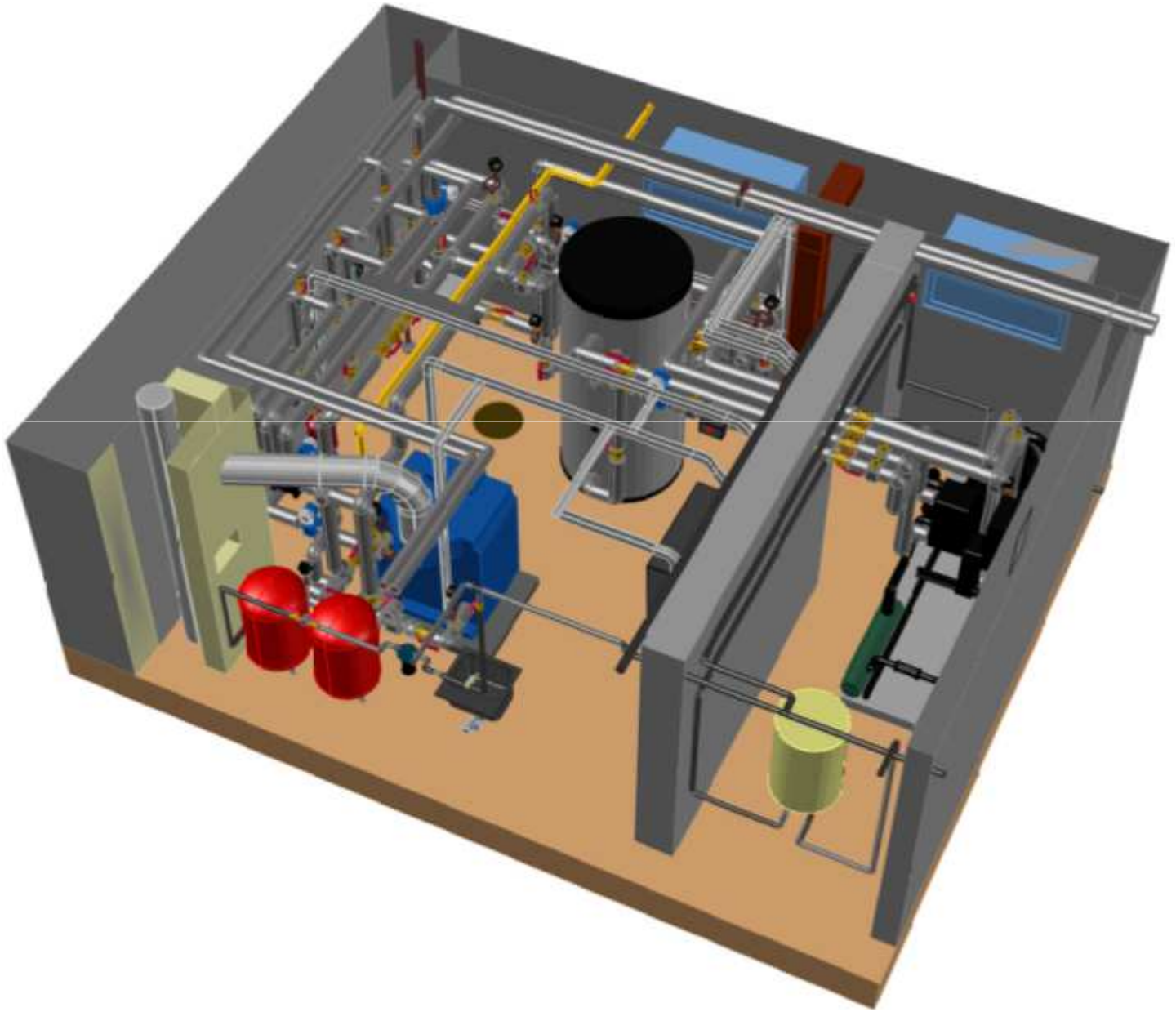
STES tank


10 cm PUR
+
36-40 cm XPS
8 m
ø14 m
70 cm
mineral wool
38 cm glass foam

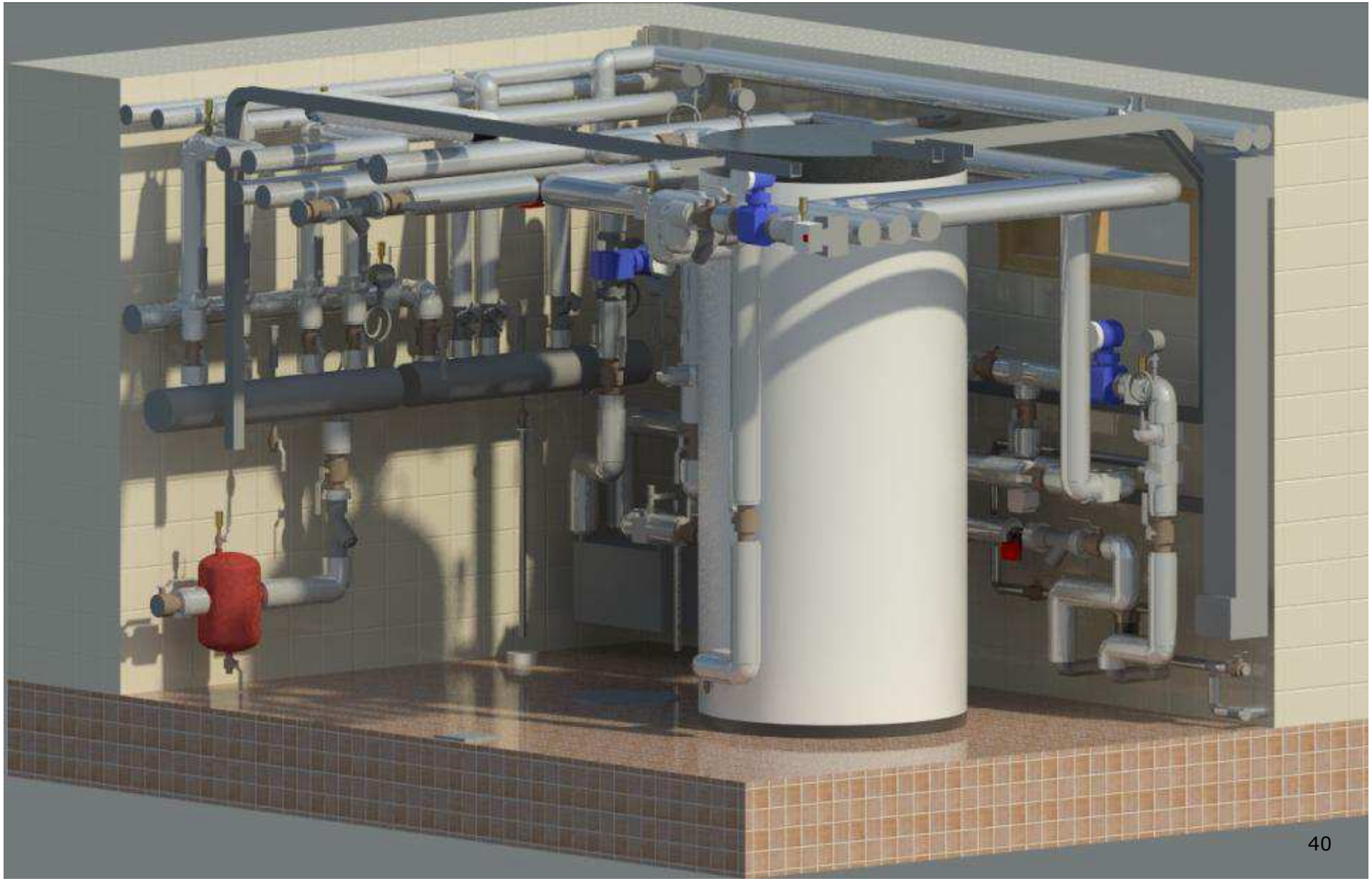
Piping of the tank



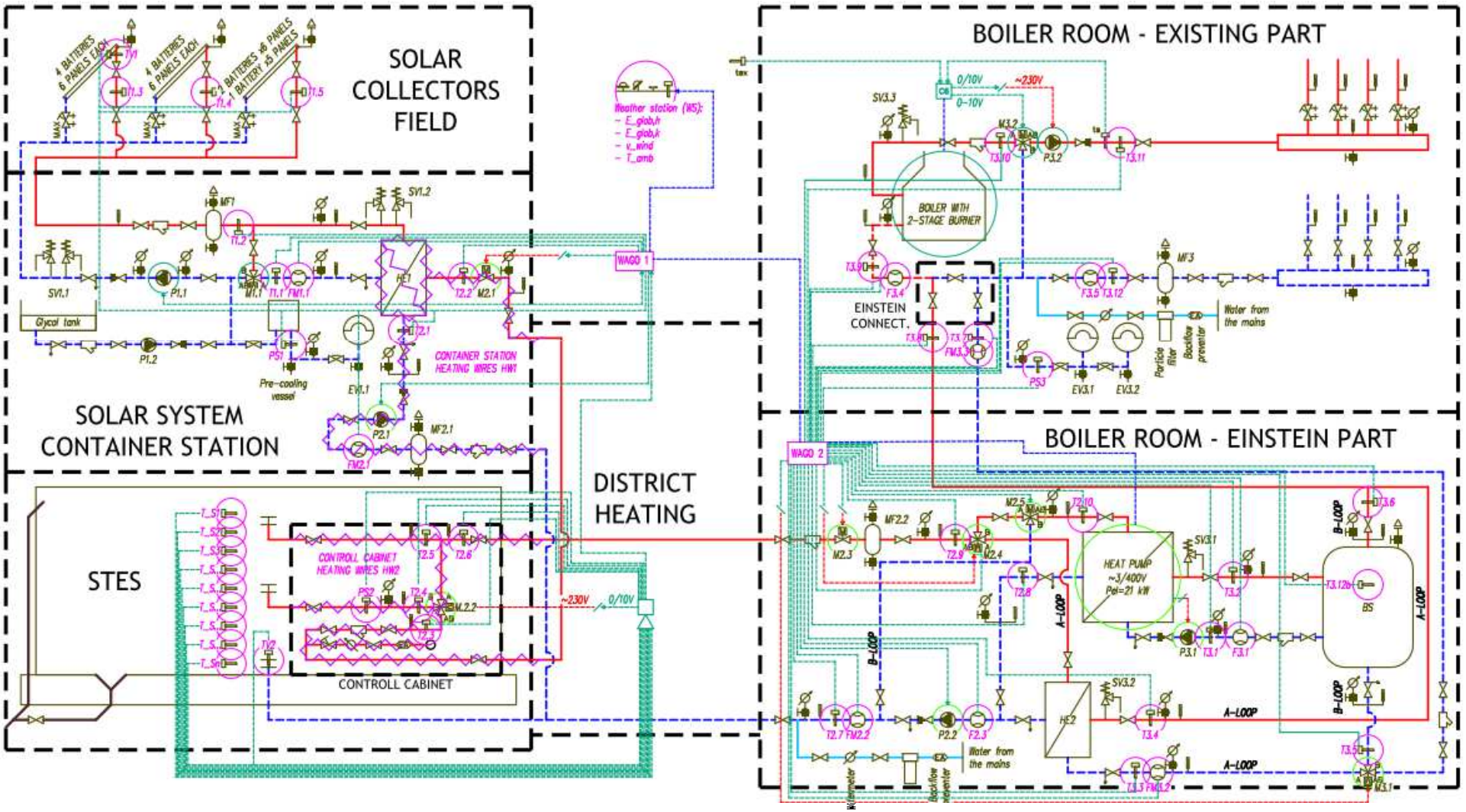
Boiler room visualisation



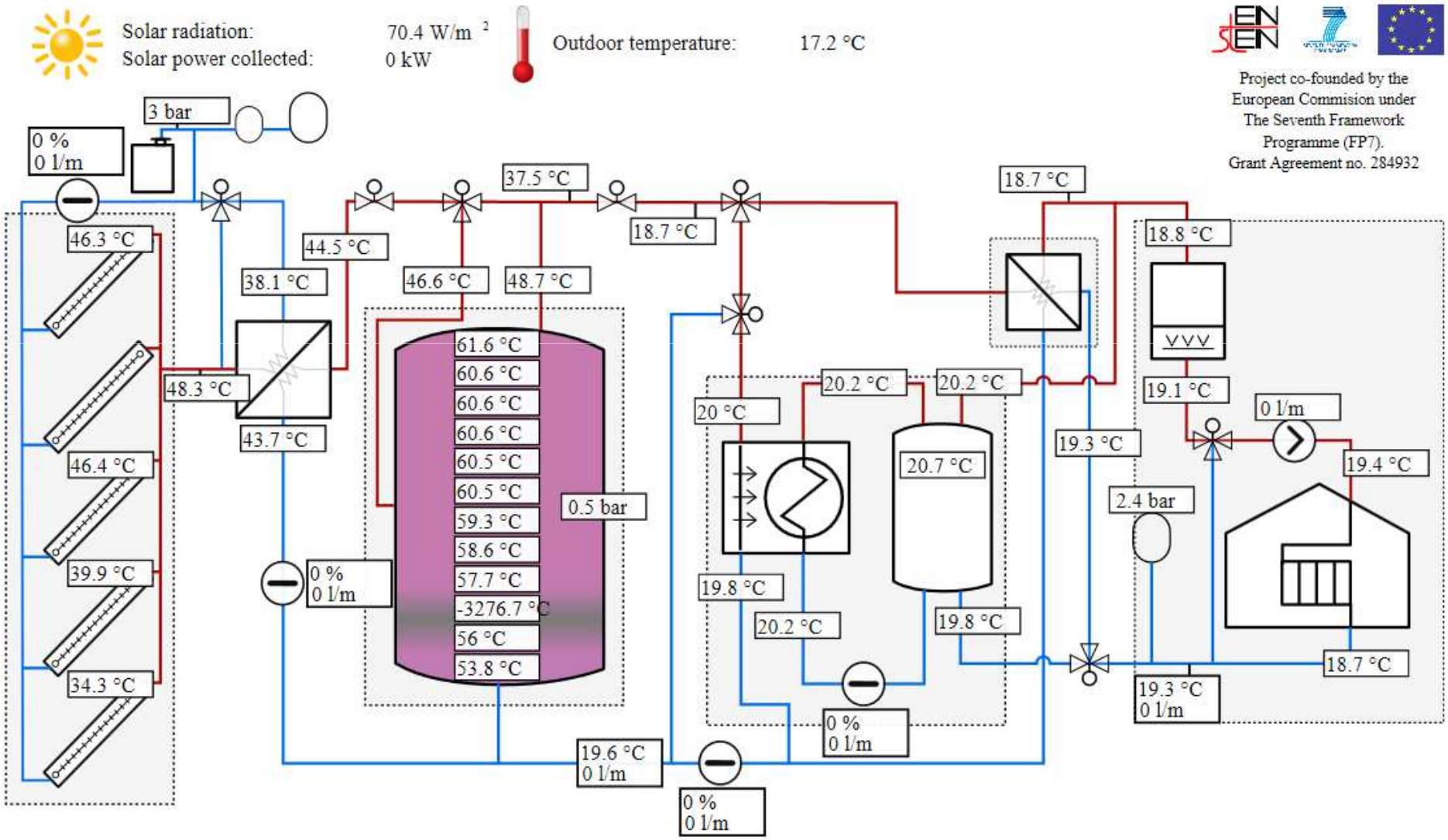
Boiler room visualisation



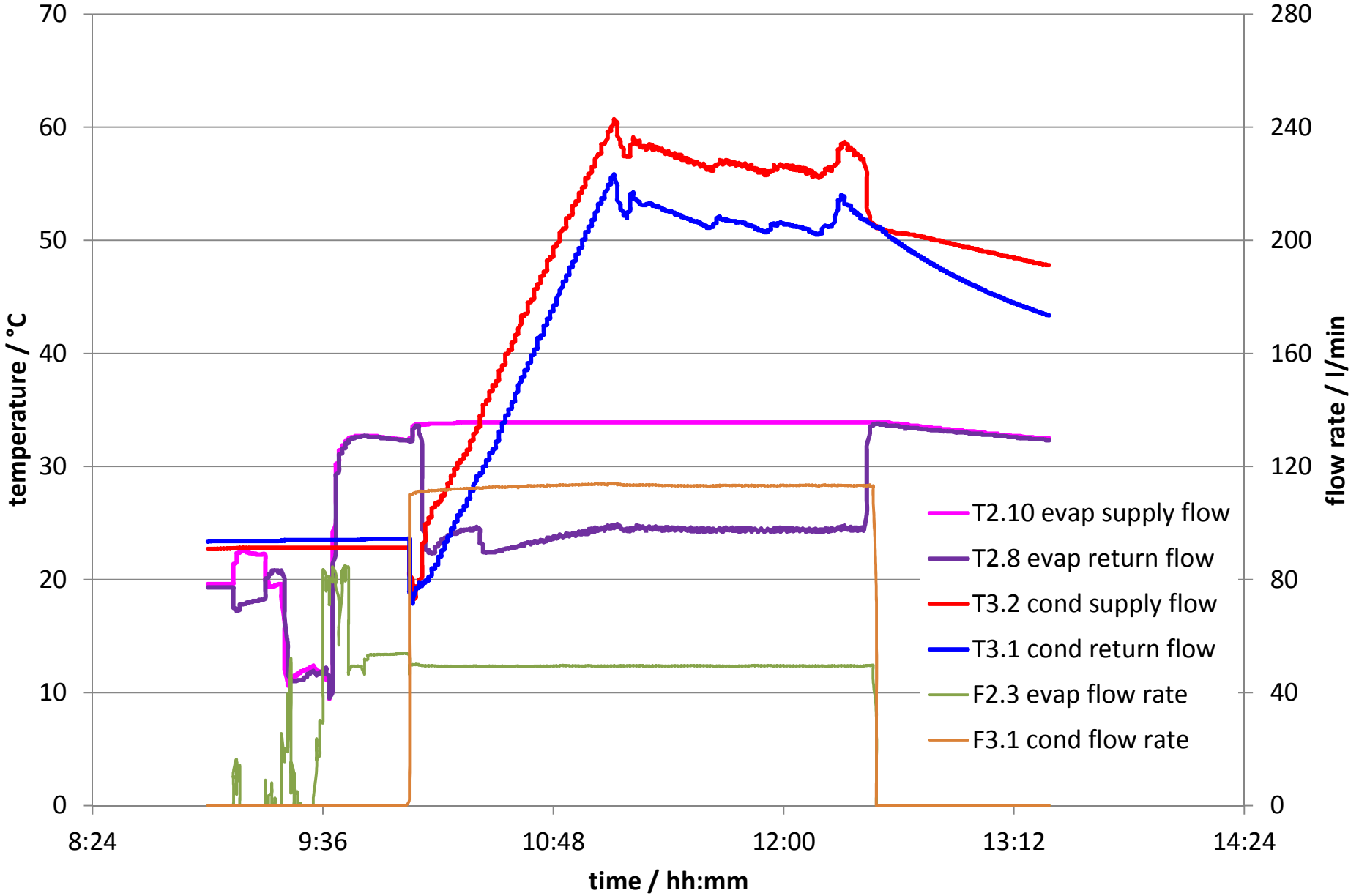
Hydraulic & DAQ scheme of Polish pilot plant



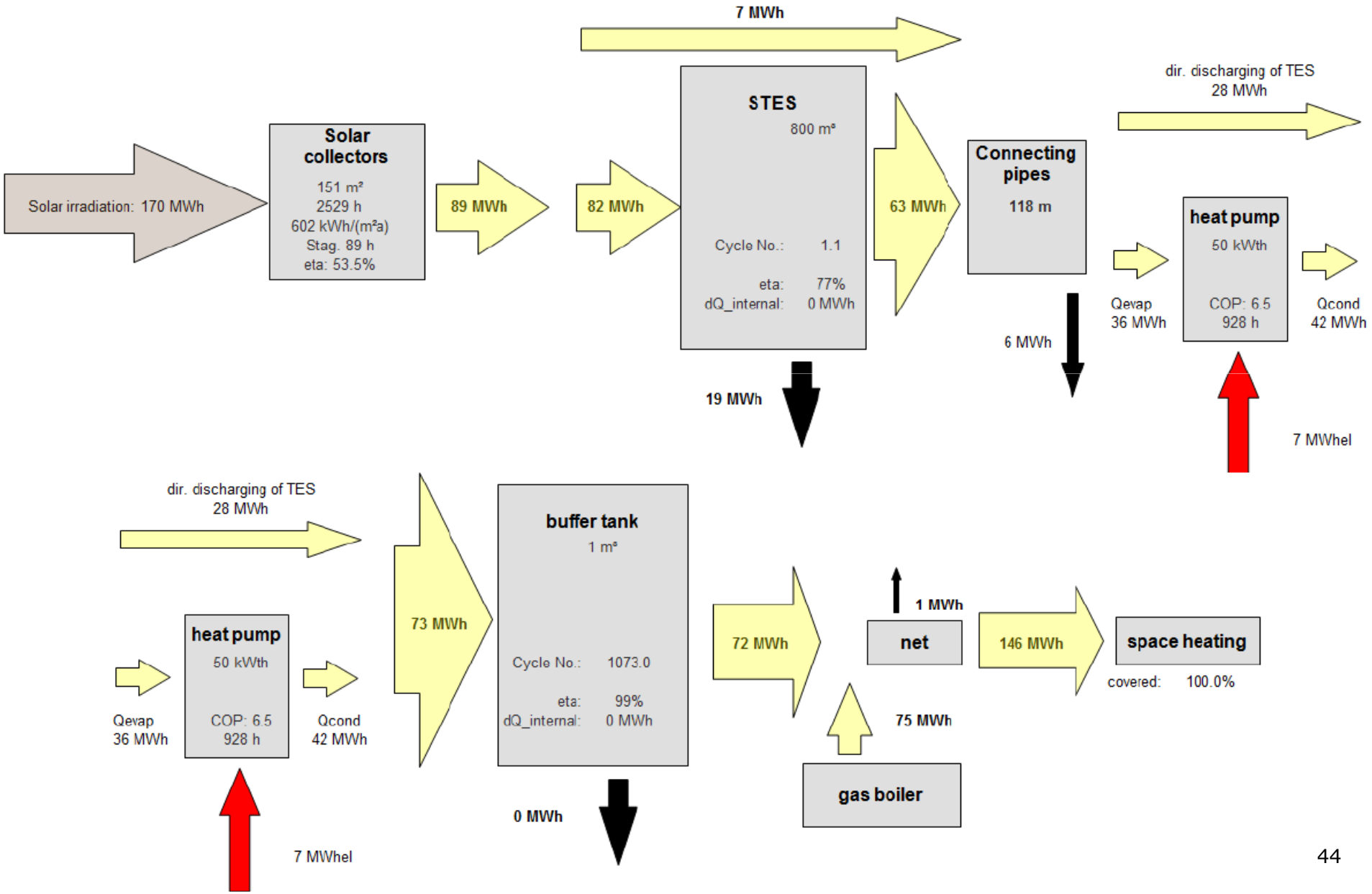
Pilot Plant in Ząbki, Poland, EINSTEIN Project



Sample graph chart from DAQ system of Polish pilot plant



Demo plant efficiency goal



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Thank you for your attention!