



International Conference

# GEO4CIVHIC

**Most Easy, Efficient and Low Cost  
Geothermal Systems for Retrofitting  
Civil and Historical Buildings**

15th November 2023

**Grand Hotel Excelsior** - Great Siege Road, La Valletta - Malta



# Real Case Study Historical Residential Building in Wicklow (Ireland)


## NAME

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## ORGANISATION



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## About the Case Study Site



- Residential 165m<sup>2</sup> house constructed in 1856
- Gas Fired Central Heating and DHW with electric immersion
- Listed Building with low potential for fabric intervention
- Roof and attic space insulation completed in 2005
- Existing High temperature terminals - radiators



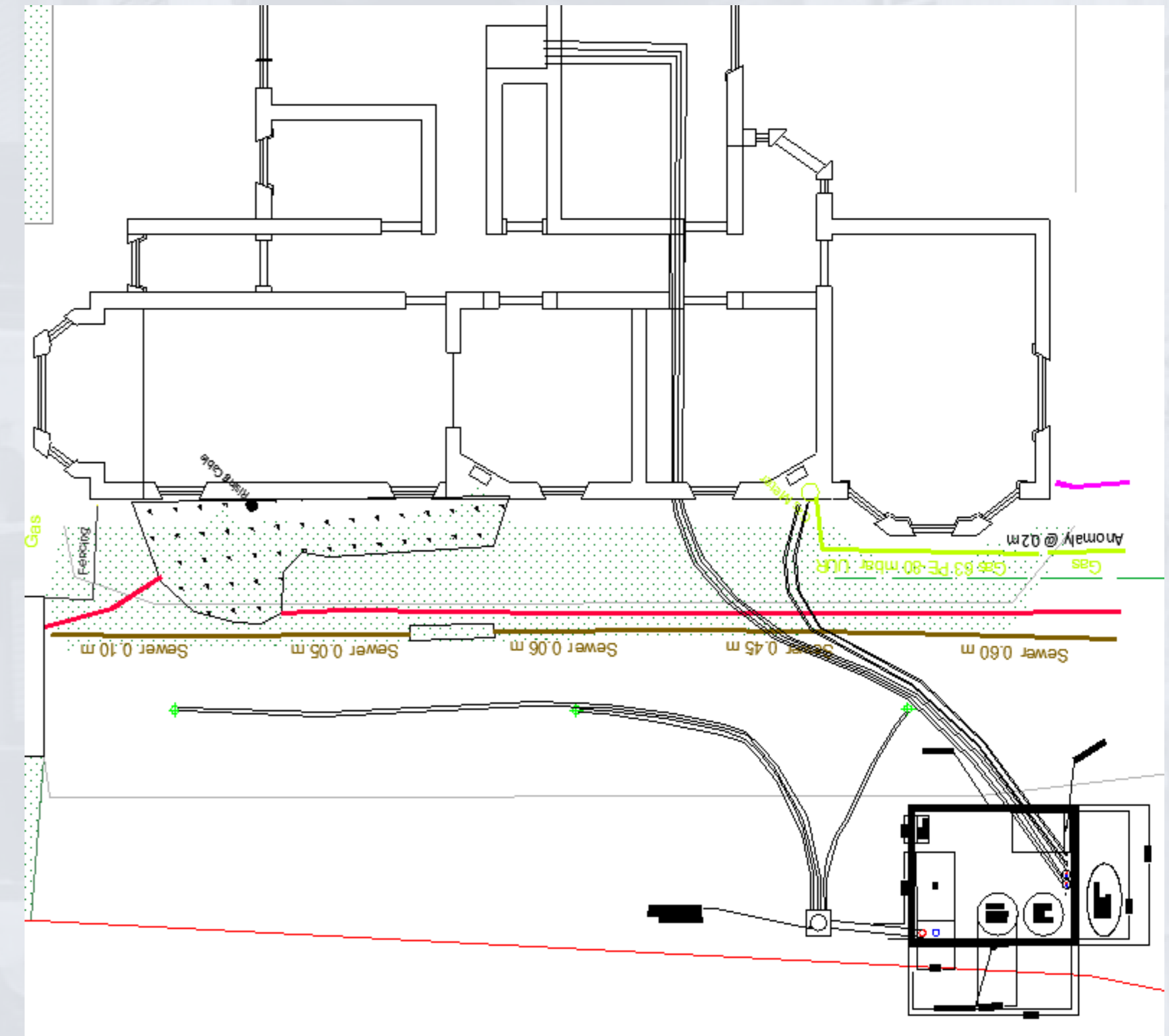
# Drilling Operations

- Drill With Vibro-drill Of Terra-infrastructures Using Compressed Air
- 3 BHEs of 60.3 mm diameter and a total length of 220 m



# Surface Connections & Plant Room

- Borehole Connection with pre-insulated pipework and connection to a central manifold chamber
- Construction of a new dedicated plant room and connection to existing user terminals and DHW
- Re-Instatement of the site



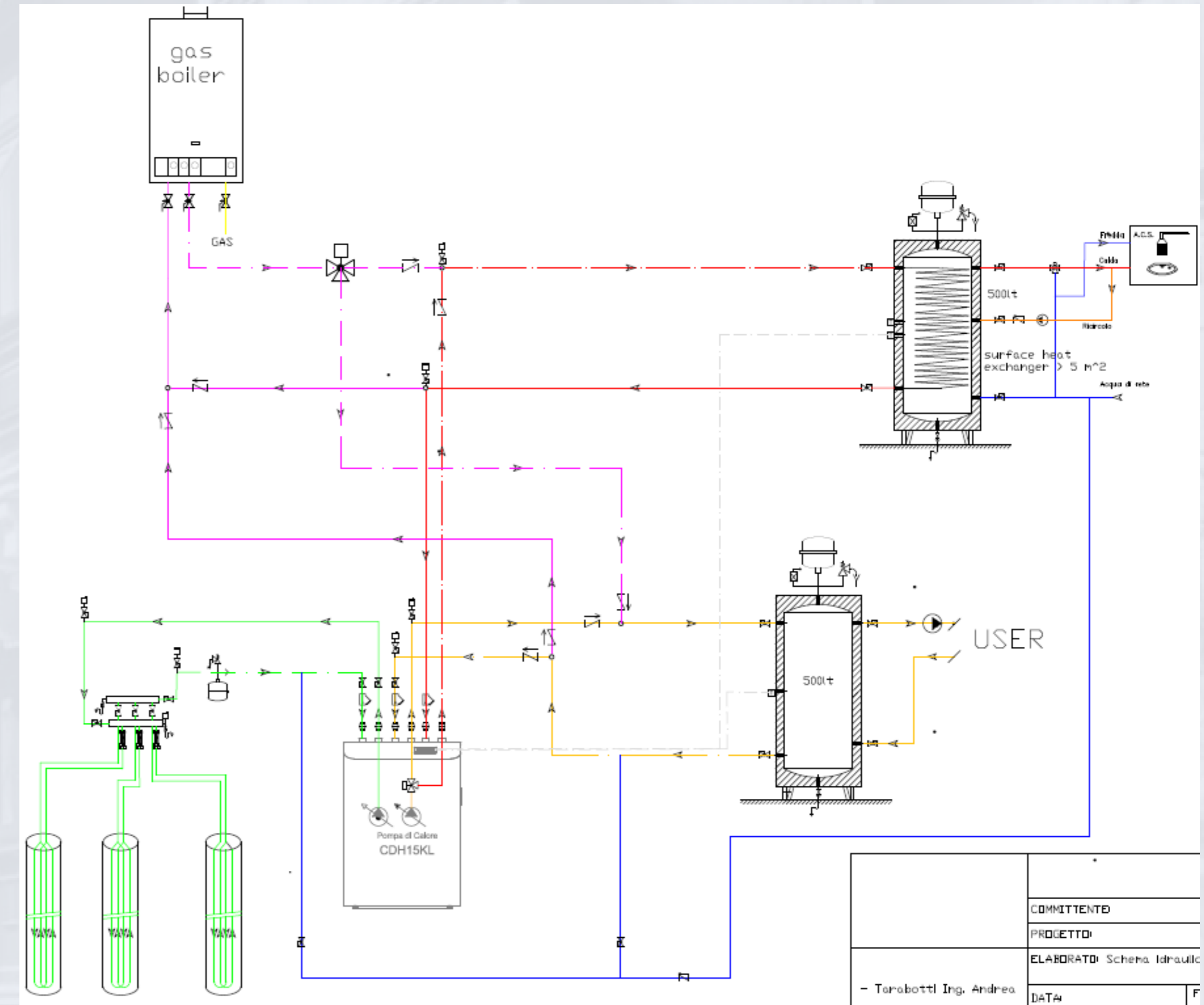
# Plant Room & System Schematic

## HEAT PUMP

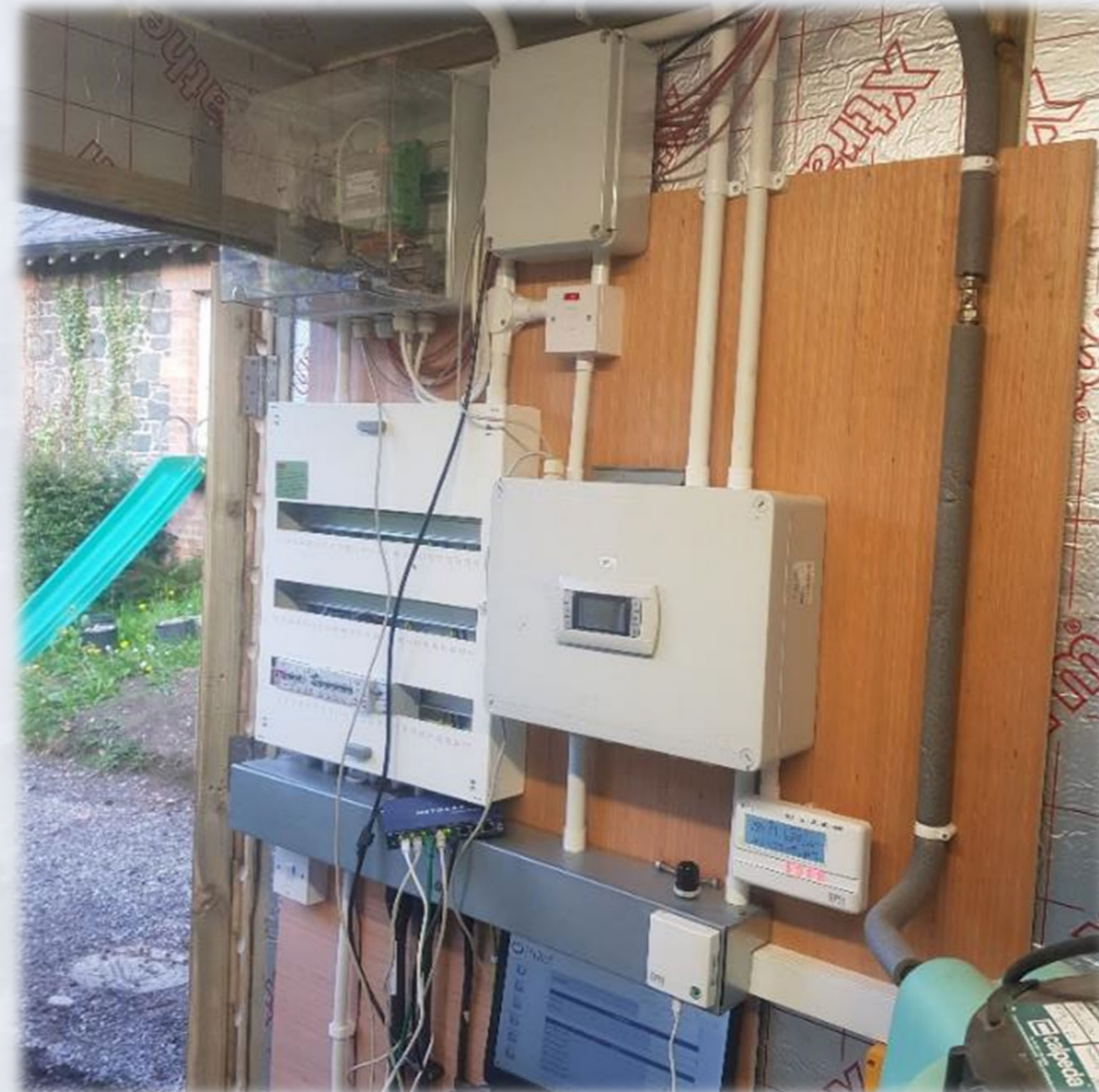
- Dual Stage (2 Compressors, Co<sub>2</sub> In One Stage)
- High Temperature Supply To Radiators
- Room Heating And Domestic Hot Water Supply

## CHANGES IN THE ORIGINAL SCOPE

- New Technical Room With Buffer Tanks
- New Piping To The House
- New Back-up Gas Boiler
- Management System Integrating Back-up Boiler In Automatic Mode



# Completed Plant Room



# Monitoring System

**Electrical energy analysers for electrical power and energy measurements**

**Sensors for thermal energy measurements**

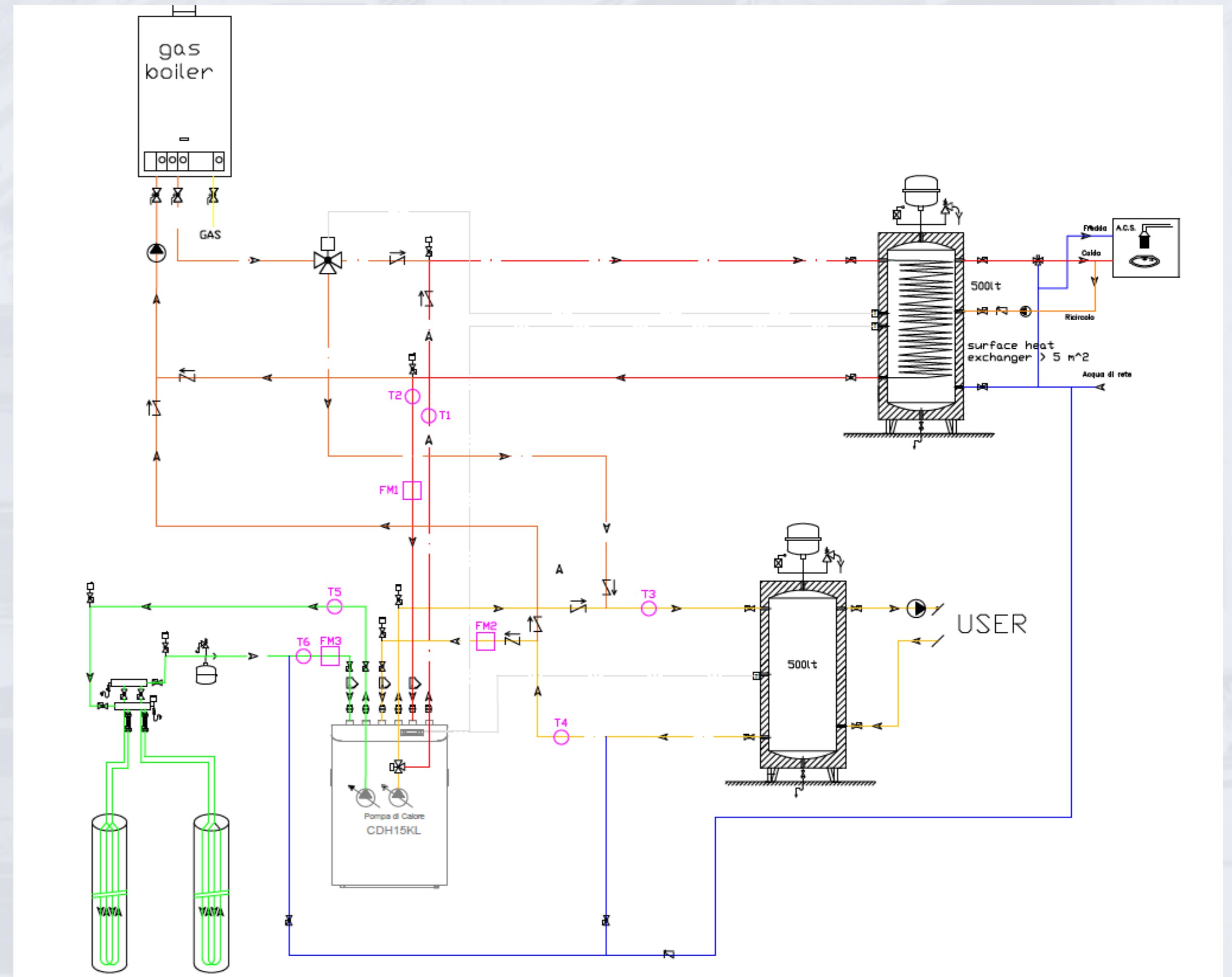
- 3 electromagnetic flow meters
- 6 PT-100 temperature sensors

**Gateway**

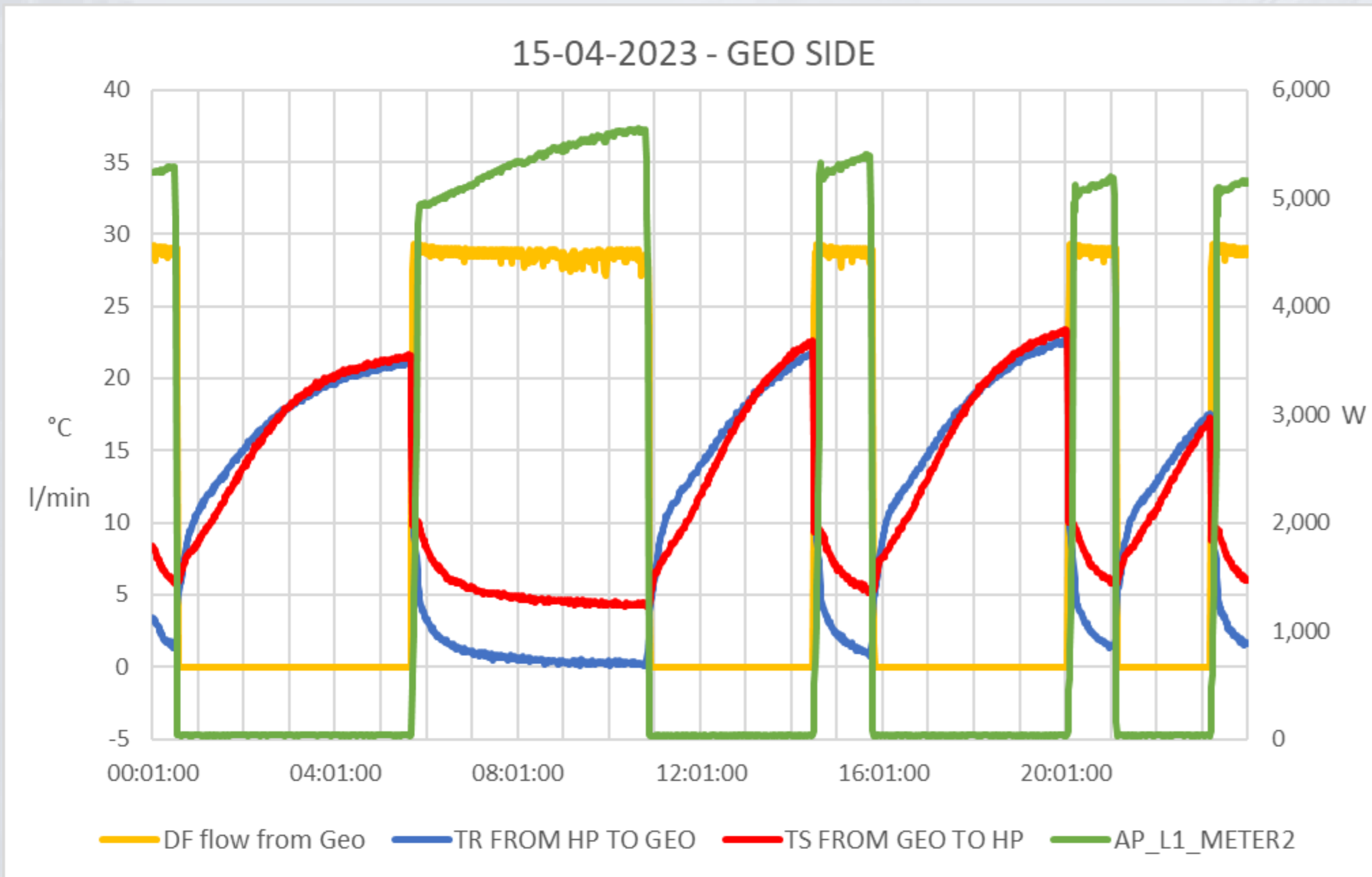
- Reading resistance from PT-100 sensors
- Counting pulses from flow meters
- Interrogates in MODBUS the registers of the electrical analysers
- Transmit the monitoring data via FTP to a hosting server

**Concordia platform**

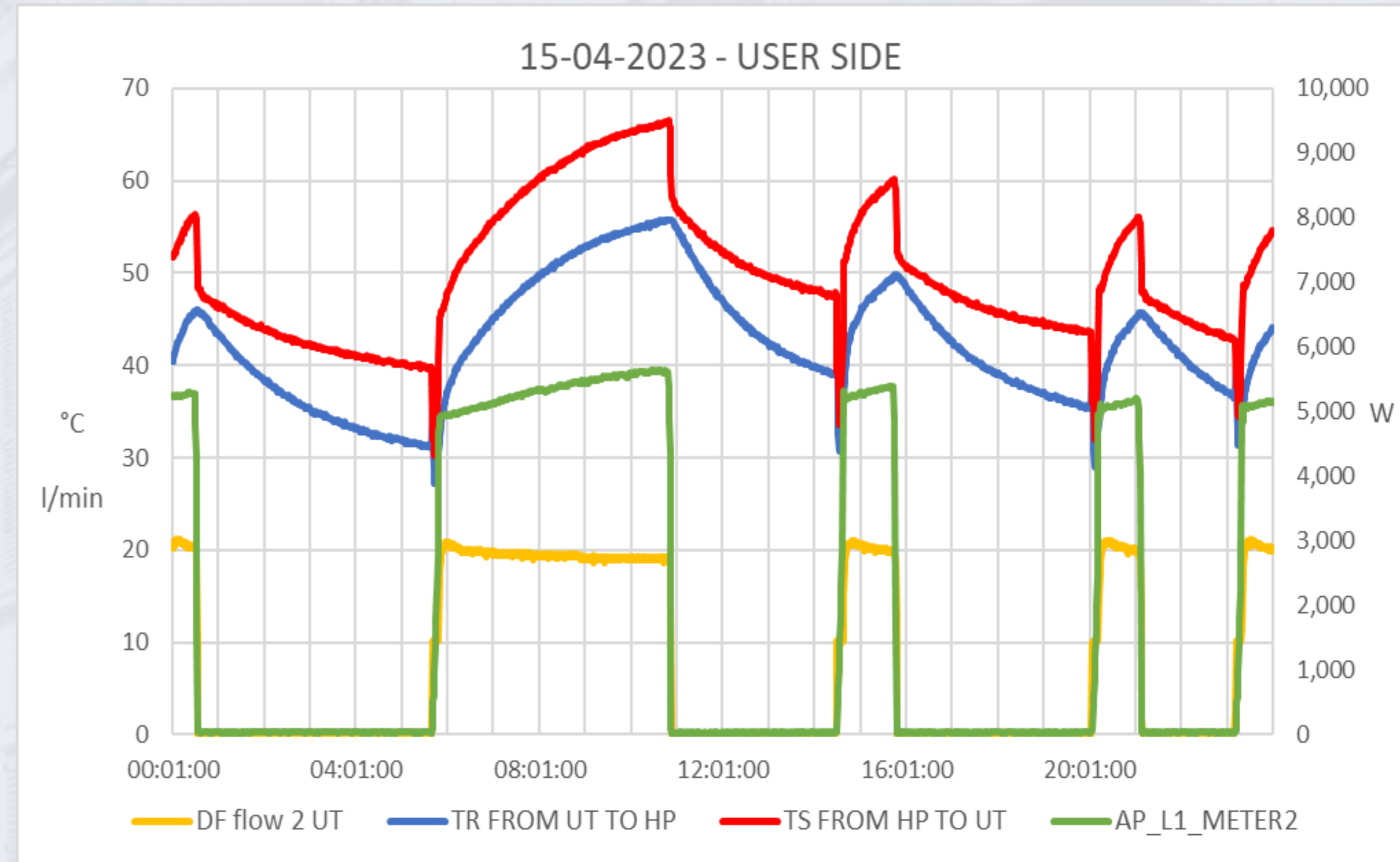
- Stores and processes the data received from the gateway
- Provides user interface to extract the data, makes reports in graphical or table format
- Possibility to create SCADA of the installation



# System Operational Parameters



Geothermal flow, supply return temperatures and compressor power



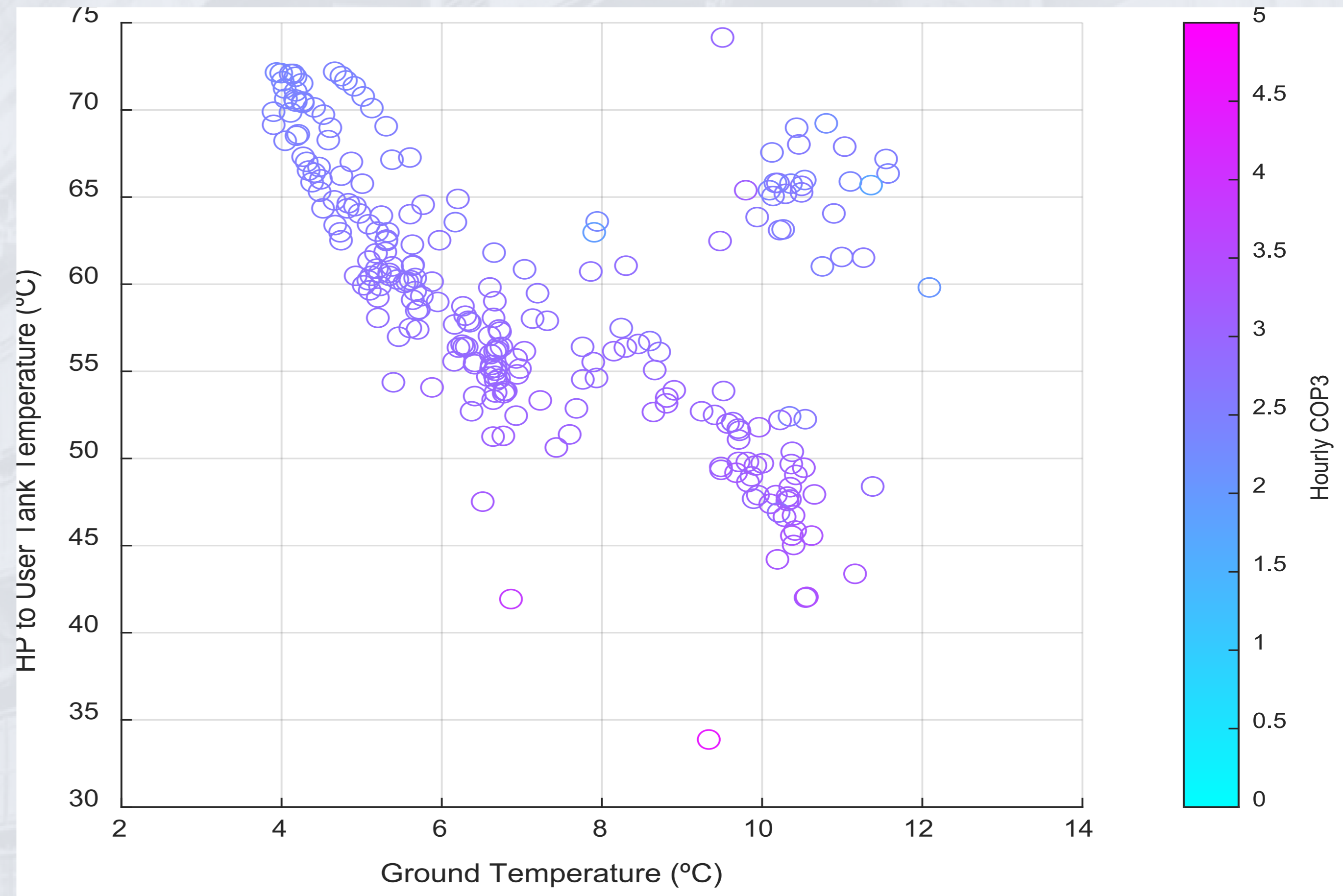
Graph with flow to user tank, supply and return temperatures and compressor power

# Thermal and electrical energy measurement during two different days and COP calculation

OPERATING MODE		-	HEATING	
DATE		-	15/04/2023	20/04/2023
TOTAL ELECTRIC ENERGY	COMPRESSOR 1	kWh	22.34	18.30
	COMPRESSOR 2	kWh	-	-
	USER PUMP	kWh	0.29	0.24
	SOURCE PUMP	kWh	1.01	0.84
	TOTAL HEAT PUMP	kWh	44.47	35.63
TOTAL THERMAL ENERGY	USER	kWh	124.05	101.45
	GEO	kWh	71.72	59.33
	DHW	kWh	0.00	0.00
ENERGY BALANCE DEVIATION		kWh	9.16	7.57
		%	7.38%	7.46%
COP	WITH AUXILIARIES	-	2.79	2.85

# Main Findings - Heat Pump Operation

- Heat pump functions as expected
- Achieves temperatures up to 70 °C
- Average Achieved:
  - sCOP1 : 3.0
  - sCOP2: 2.9
  - sCOP3: 2.63



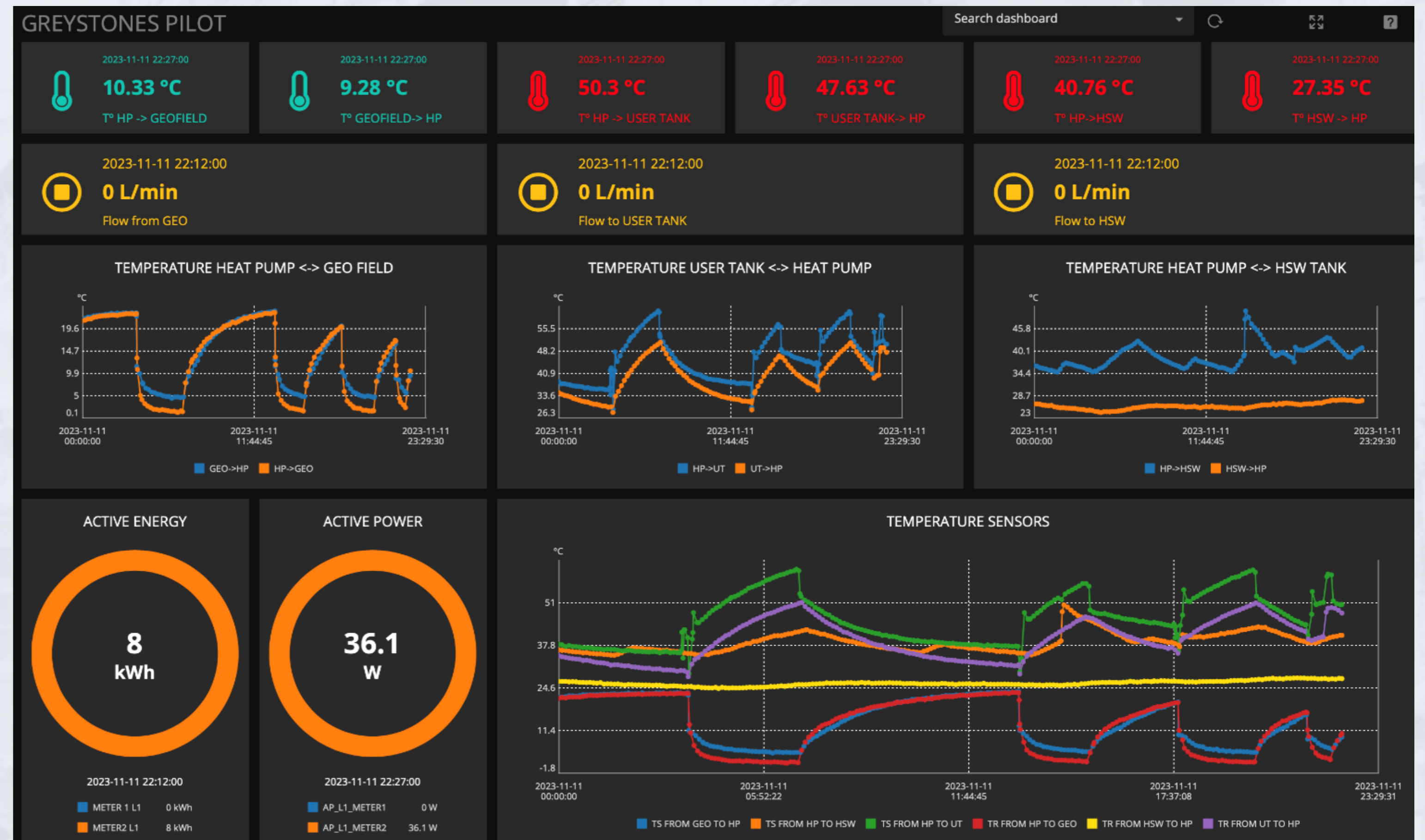
## Main Findings – Drilling Operation

- Vibration frequency MUST be above 80 Hz
- At these frequencies and above
  - Good rates of penetration (up to 0.62 m/min)
  - Low compressed air consumptions (8 m<sup>3</sup>/h)
- Frequencies above 80 Hz need
  - 280 – 300 bar hydraulic pressure
  - Sufficient oil flow to the vibro-drill
- Frequencies below 80 Hz cause resonance and damage

# Ongoing Operational Monitoring of the system

Main Heating Season Covered  
March/April 2023 & after 2nd  
week of October 2023

Average electrical daily  
consumption 30 – 34 kWh per  
day



# THANK YOU

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