ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

eneren

Geothermics and multi-source heat pumps: application case studies

Summary

- Drilling techniques
- The installation phases of the geothermal probes
- Multisource heat pumps
- Case history

Drilling techniques
The installation phases of the geothermal probes

Single head probe drilling without coating pipe

PROS:

- Slightly lower costs
- Faster drilling speed
- “Many” drillers can install them

CONS:

- Bentonite muds alter the ground from the point of view of exchange capacity
- The hole has a low verticality, as the drilling head can deviate easily
- Excessive weights are used, therefore the probes can be damaged during the installation phase
- Groundwater layers in communication

Single head probe drilling with coating pipe

PROS:

- Verticality is guaranteed
- Tubes don’t smash on the hole perimeter
- Tubes spacers can be installed
- Only thermal improved cement surrounding the tubes

CONS:

- More expensive in machinery and time
- Bigger geothermal drillers

Drilling techniques

Circulation of water/bio polymer

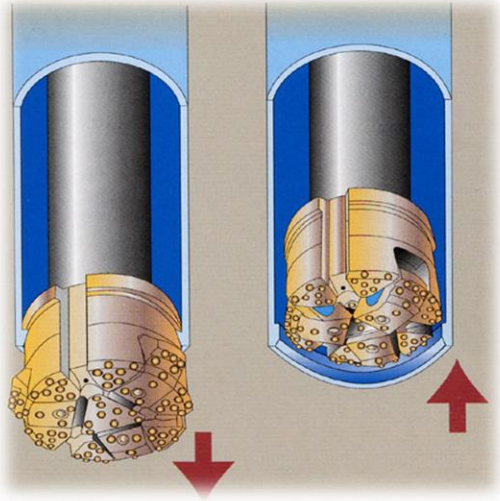
Tool: triblade / tricone

- Fast in loose and fine materials (sand, lime..)
- Lower drilling cost

Compressed air

Tool: hole hammer

- Fast on hard materials (rocks, gravel..)
- Clean drilling



SEQUENCE OF OPERATIONS ON SITE

(Borehole Heat Exchanger execution)

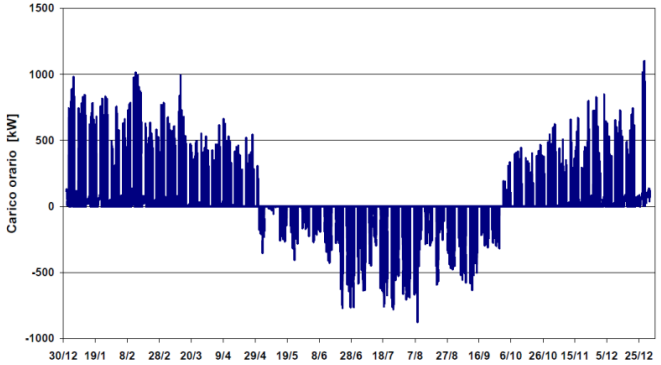
1) Driller positioning
2) Hole execution
3) Recovery of shafts
4) Probe installation
5) Flow test
6) Cementation and coating recovery (with double head drilling)
7) Once cementation is complete: pressure test

Multisource heat pumps

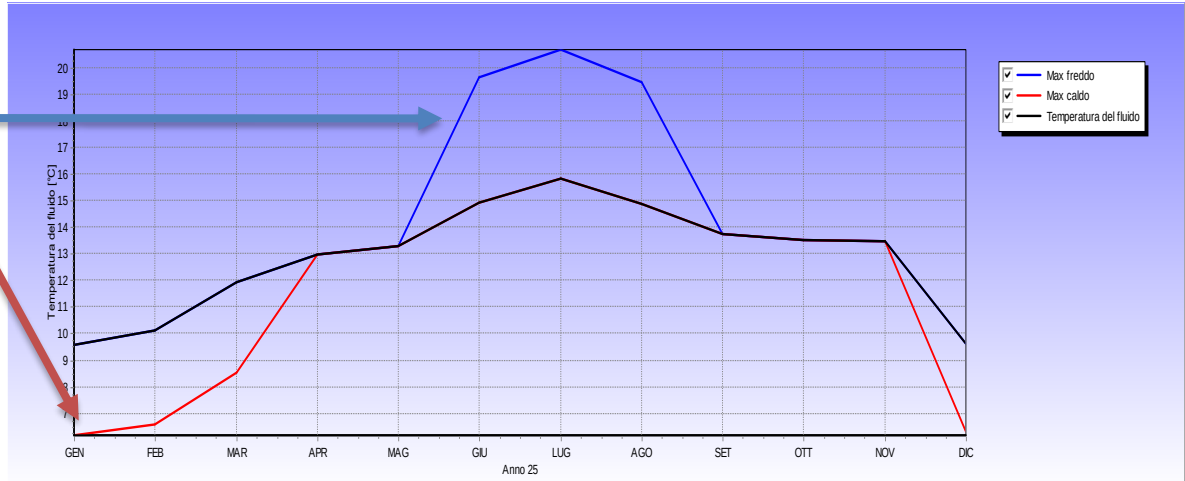
Geothermal plant design:

- Building's energy design in relation to the construction and occupancy characteristics
- BHE Thermal Response Test to obtain ground thermophysic characteristics
- Evaluation of the operation of the geo-exchange plant with simulation software (CFD of finite elements)
- Optimization of the energy obtainable in relation to the total needs

Energy demand



Peak load temperature profile



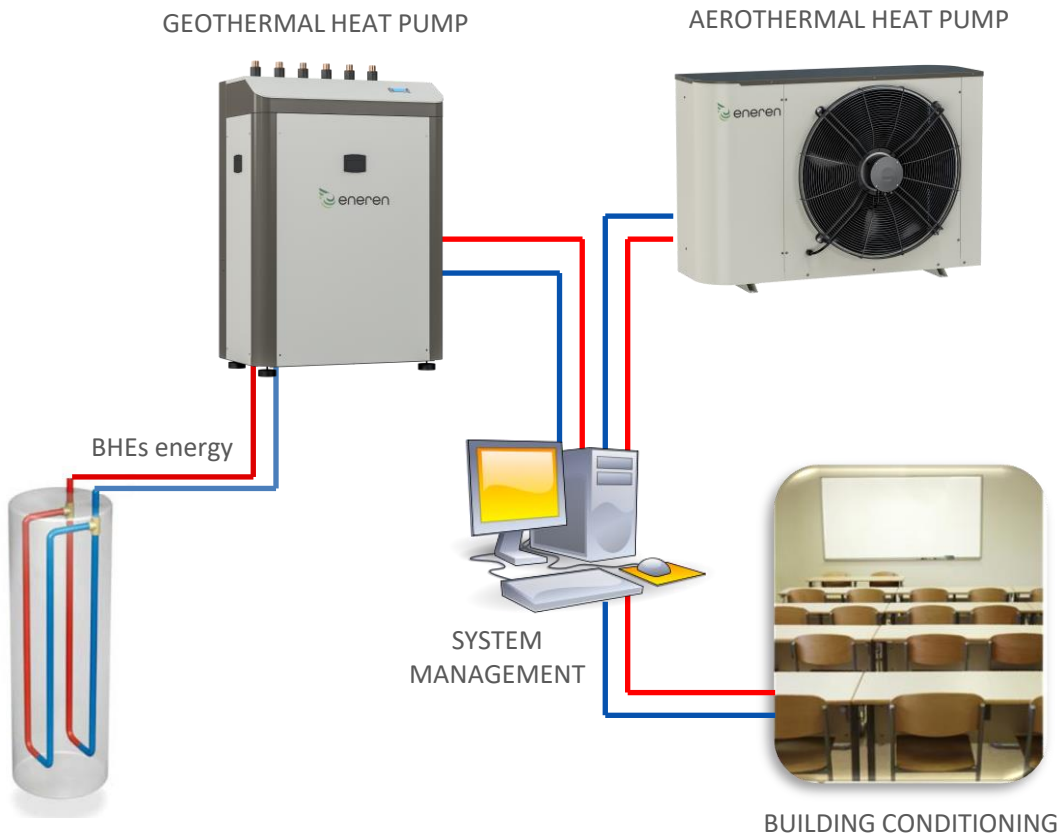
If the minimum and maximum limits set for geothermal energy are exceeded

OR

If there are good air temperatures (ex. mild days in winter)

OR

If the ground is thermally altered (ex. hot springs area)



Multi-Source Geothermal and Aerothermal Unit

- ✓ **Multifunctional or Monovalent**
- ✓ **Multipurpose Total Recovery – 2/4 pipe systems**
- ✓ ***6 - 17 Kw***

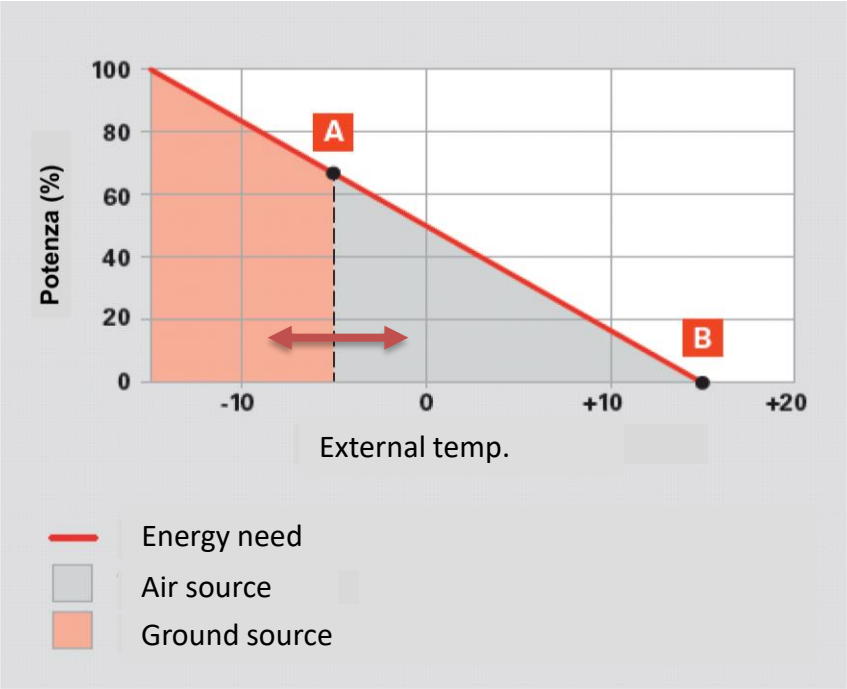
A+++

INVERTER

R-454B

R-410A

CONTROL OPTIONS



FIXED BIVALENT TEMPERATURE

Defrost unnecessary

Less thermal stress on the refrigerant circuit

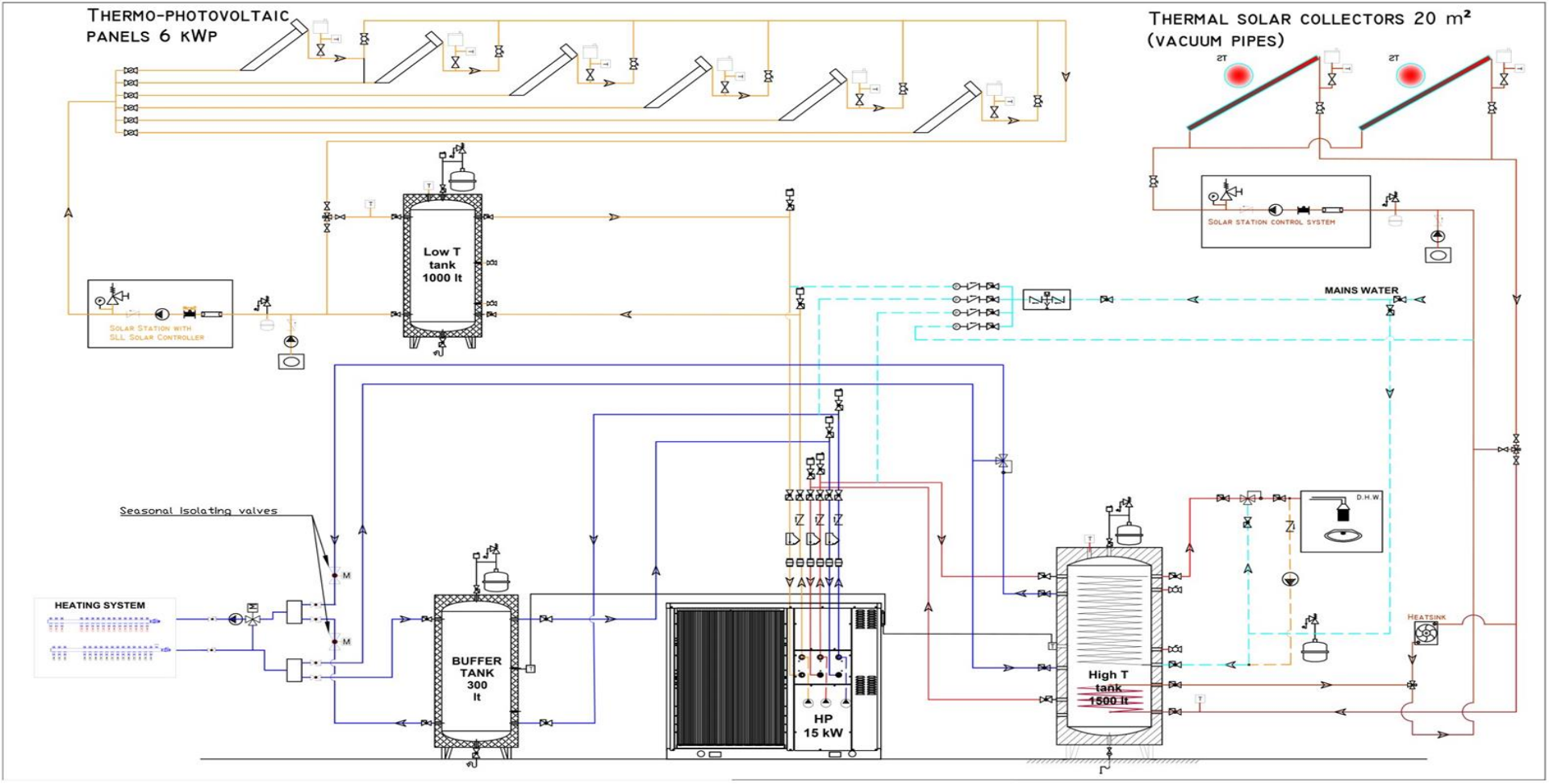
Less power consumption

Avoided oversizing of air to water

AUTOMATIC EFFICIENCY CALCULATION

Optimized seasonal efficiency

Case History n°1
Location: Ferrara


THERMO-PHOTOVOLTAIC PANELS 6 kWp
THERMAL SOLAR COLLECTORS 20 m²
(VACUUM PIPES)
Low T tank 1000 lt
SOLAR STATION WITH SLL SOLAR CONTROLLER
SOLAR STATION CONTROL SYSTEM
MAINS WATER
Seasonal Isolating valves
HEATING SYSTEM
BUFFER TANK 300 lt
HP 15 kW
High T tank 1500 lt
D.H.W
HEATSINK

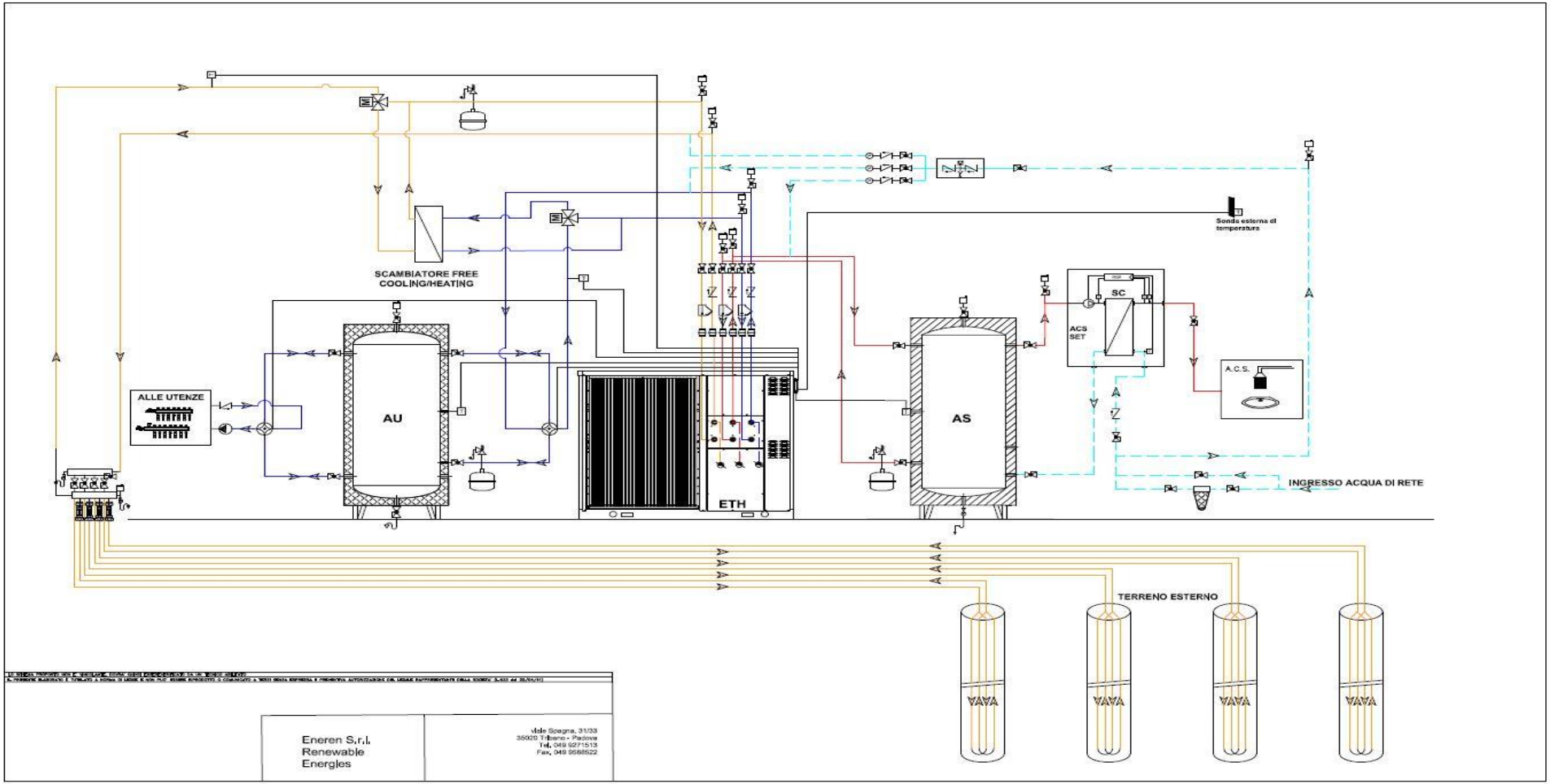
- Multisource Heat Pump with total recovery, full inverter unit
- Low temperature buffer tank User side (heating and cooling)
- Low temperature buffer tank solar-source side
- Hybrid thermophotovoltaic field and solar thermal field

The heat pump determines the best source available between water and air and switches it using always the most convenient.

Moreover, thanks to the use of Brushless motors and components that maximize the efficiency with the technology of total heat recovery for the production of DHW, we obtain:

19% measured increase in seasonal efficiency compared to traditional air-to-water units

Case History n°2
Location: Abano Terme



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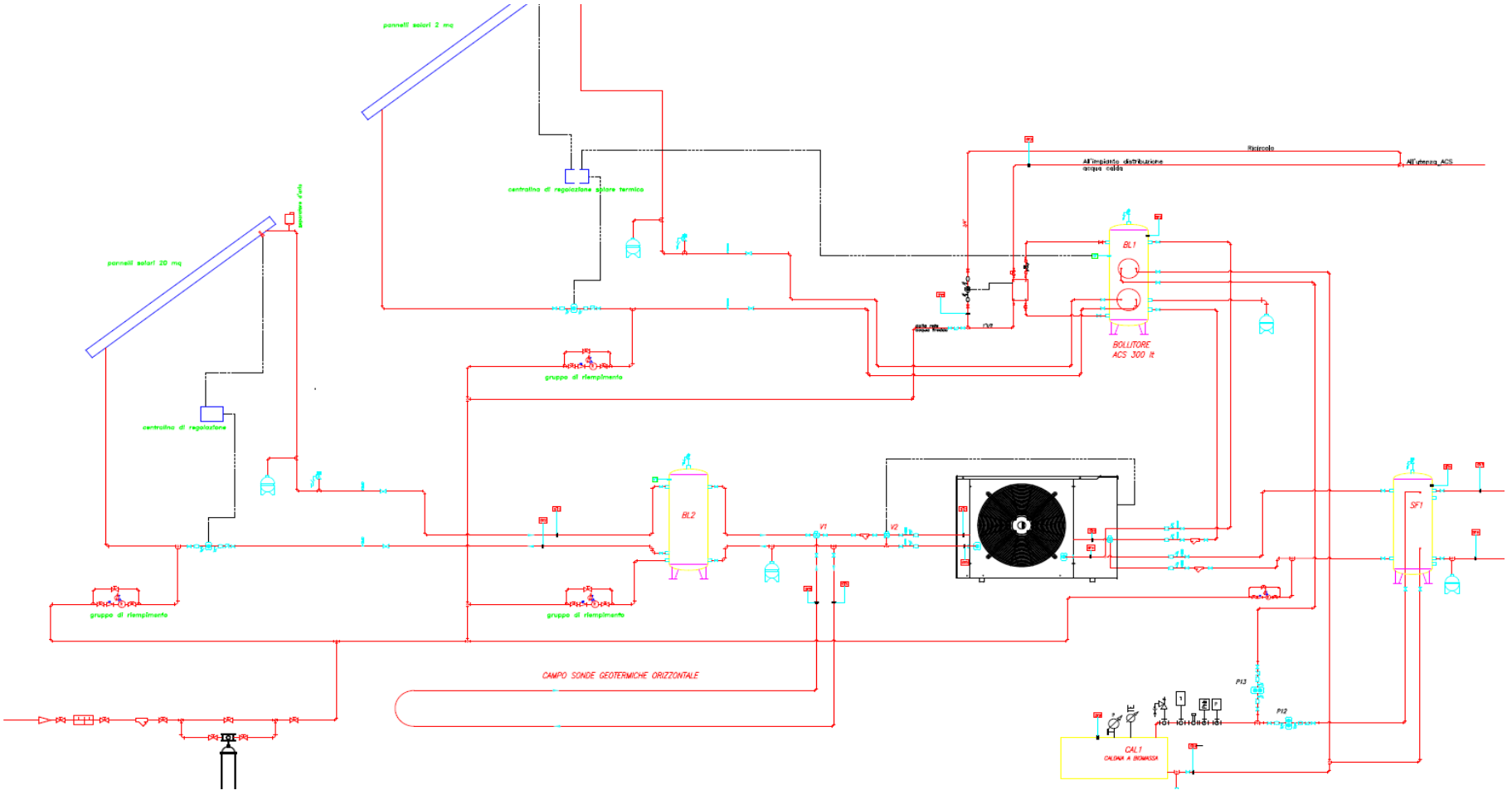
The characteristic thermal gradient produces source water temperatures around **35-40°C**

Heating demand is satisfied entirely with a plate heat exchanger between the BHEs and the floor heating

DHW → always with groundwater source

Cooling → always with air source

Case History n°3
Location: Roma (commissioning within 2023)

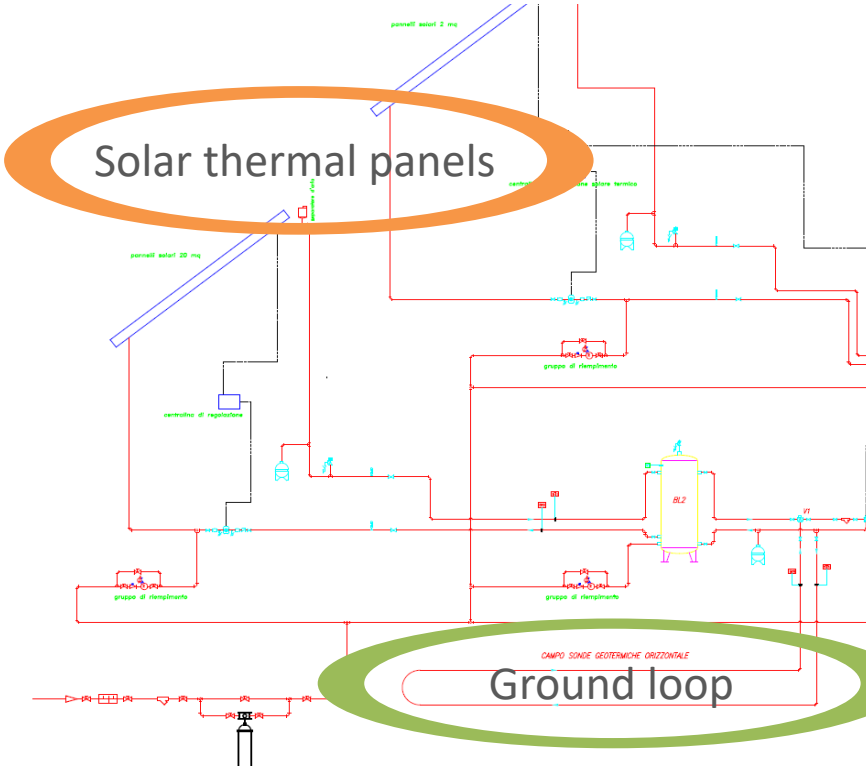

pannelli solari 2 mq
centralina di regolazione solare termica
pannelli solari 20 mq
centralina di regolazione
gruppo di riempimento
gruppo di riempimento
gruppo di riempimento
Ricircolo
All'impianto distribuzione acqua calda
All'utenza ACS
BL1
BOLLITORE ACS 300 lt
BL2
V1
V2
SF1
CAMPO SONDE GEOTERMICHE ORIZZONTALE
P13
P12
CAL1
CALDAIA A BIOMASSA

Ground loop and solar thermal panels both connected the heat pump source side

The control will have the option to choose among three different sources:

1. Geothermal
2. Thermal Solar
3. Air

Ground loop has been undersized, aiming for a temperature restoration with hot water from the solar panels → **less investment costs**



THANK YOU