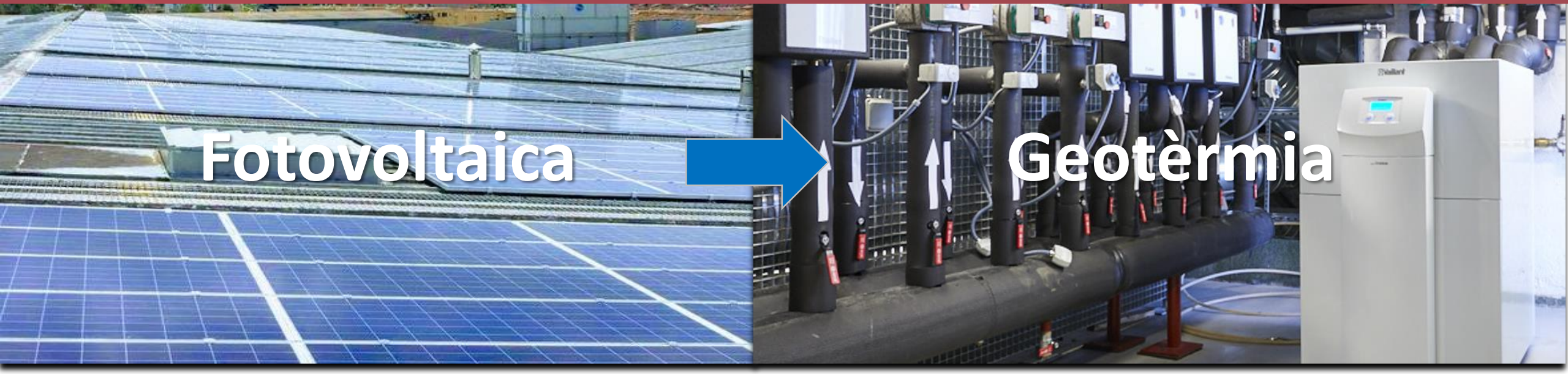
JORNADES TÈCNIQUES “GeoEnergia a Catalunya”. Núm. 01

Sistemes d’autoconsum d’alta eficiència en el marc de la Transició Energètica i el Canvi Climàtic

Instal·lacions híbrides: Energia solar Fotovoltaica/Tèrmica + Energia Geotèrmica

29 de novembre de 2019, a l’ICGC



Organitzen:

Grup de Treball de Geotèrmia
Clúster de l’Energia Eficient de Catalunya

ICGC Institut Cartogràfic i Geològic de Catalunya

CEEC 10 anys 2008 - 2018
Clúster de l’Energia Eficient de Catalunya

Generalitat de Catalunya
Institut Català d’Energia

Patrocinen:

De Dietrich
EL CONFORT DURADERO

NIBE
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Vaillant

ecoFOREST

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ecoserveis

TESSe2b the smart energy storage

10.10 – 10.35	Instal·lació híbrida amb geotèrmia, solar tèrmica i sistema d’emmagatzematge tèrmic latent (TESSe2b). ***Aniol Esquerra, Associació ECOSERVEIS***

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Context of the project

TESSe2b Project

Type of action: **RIA** - Research & Innovation Actions (defined in the call)

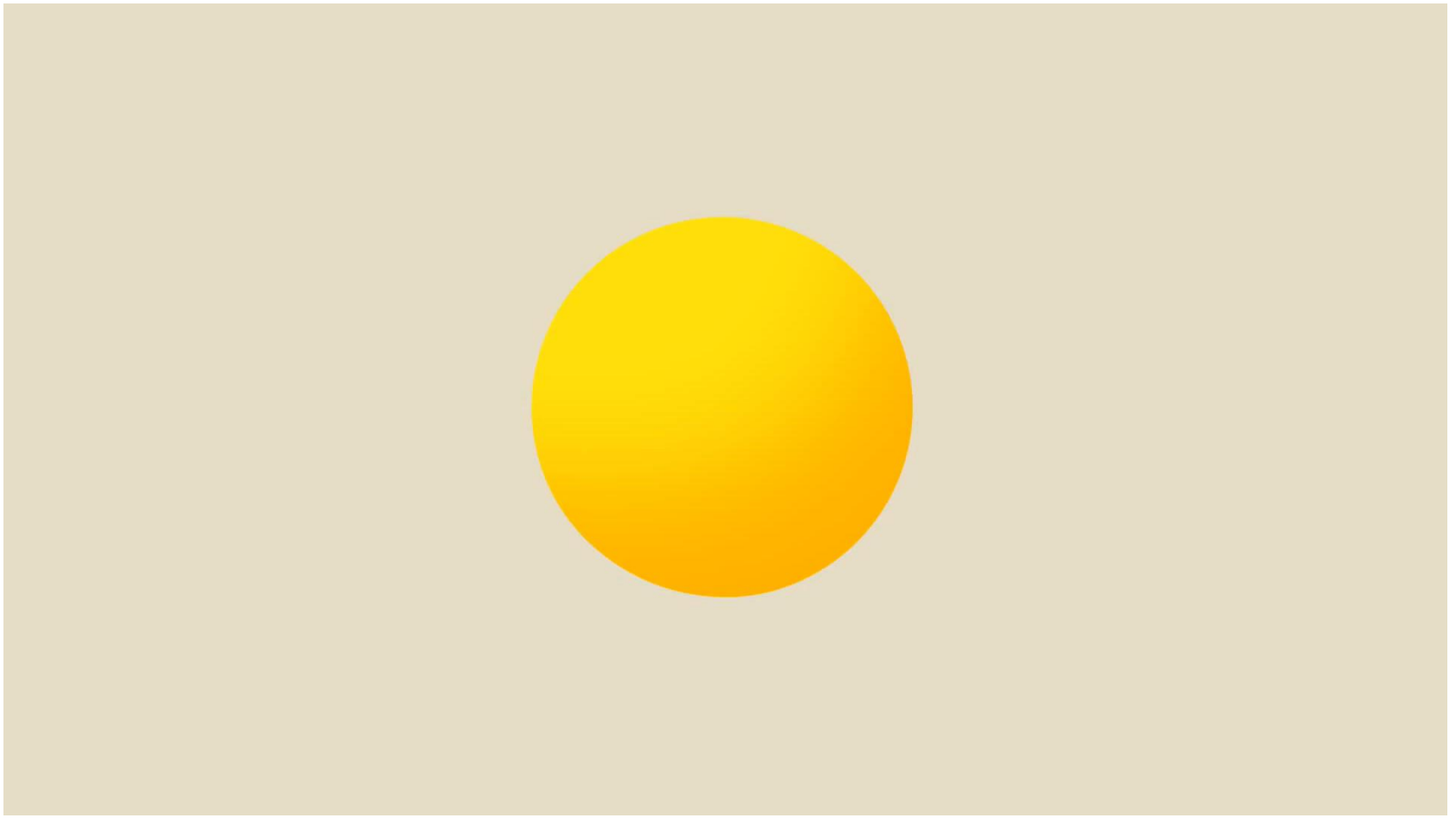
Activities expected to focus on Technology Readiness **Levels 4-6**.

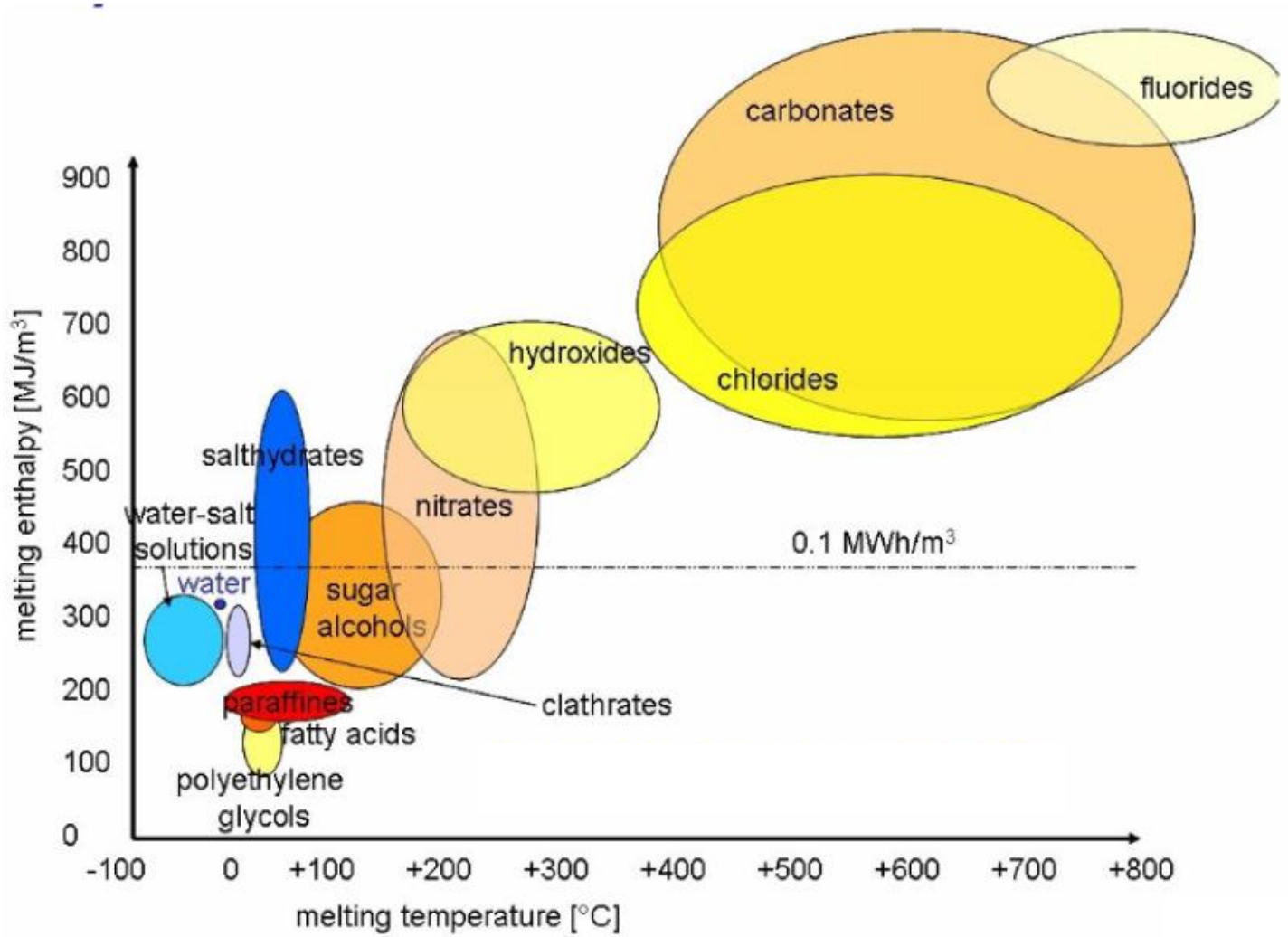
- Budget: 4.311.700 euros;
- Number of participants: 10
- Number of countries: 8
- Starting date of the project: 01/10/2015;
- Duration: 48 months

G. Technology readiness levels (TRL)

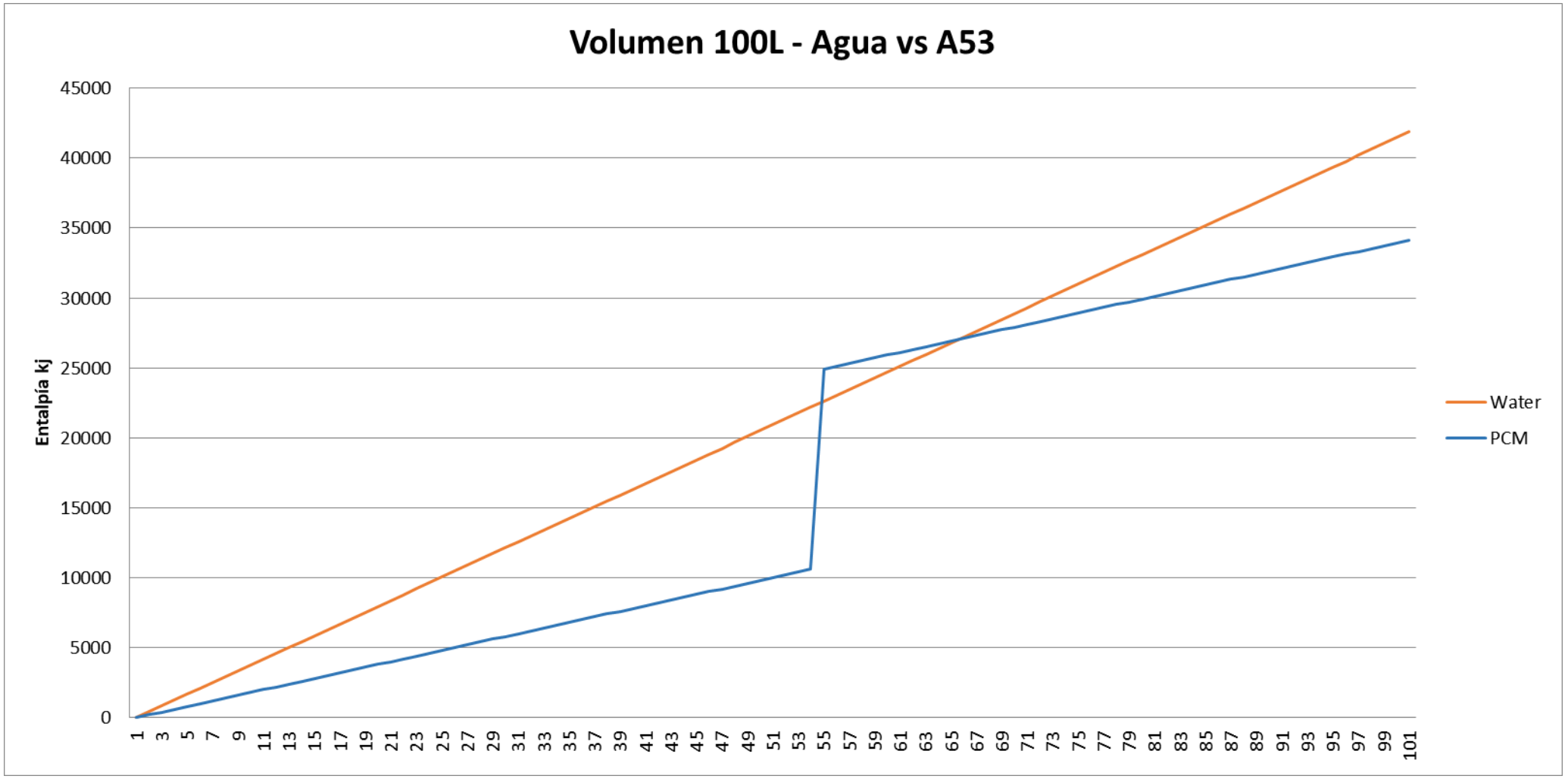
Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

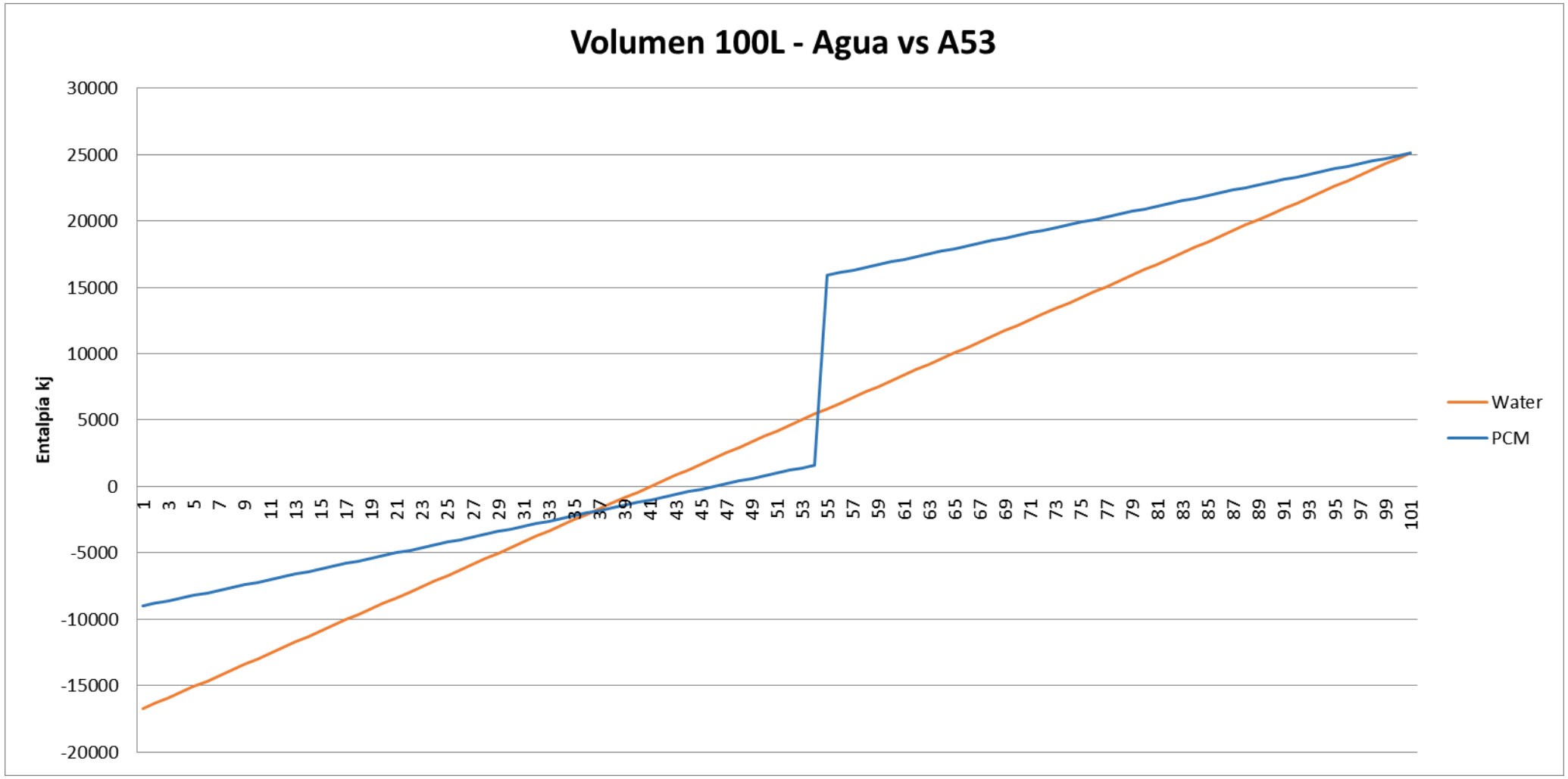



carbonates
fluorides
hydroxides
chlorides
salthydrates
water-salt solutions
water
nitrates
sugar alcohols
0.1 MWh/m3
clathrates
paraffines
fatty acids
polyethylene glycols
melting enthalpy [MJ/m3]
melting temperature [°C]
900
800
700
600
500
400
300
200
100
0
-100
0
+100
+200
+300
+400
+500
+600
+700
+800

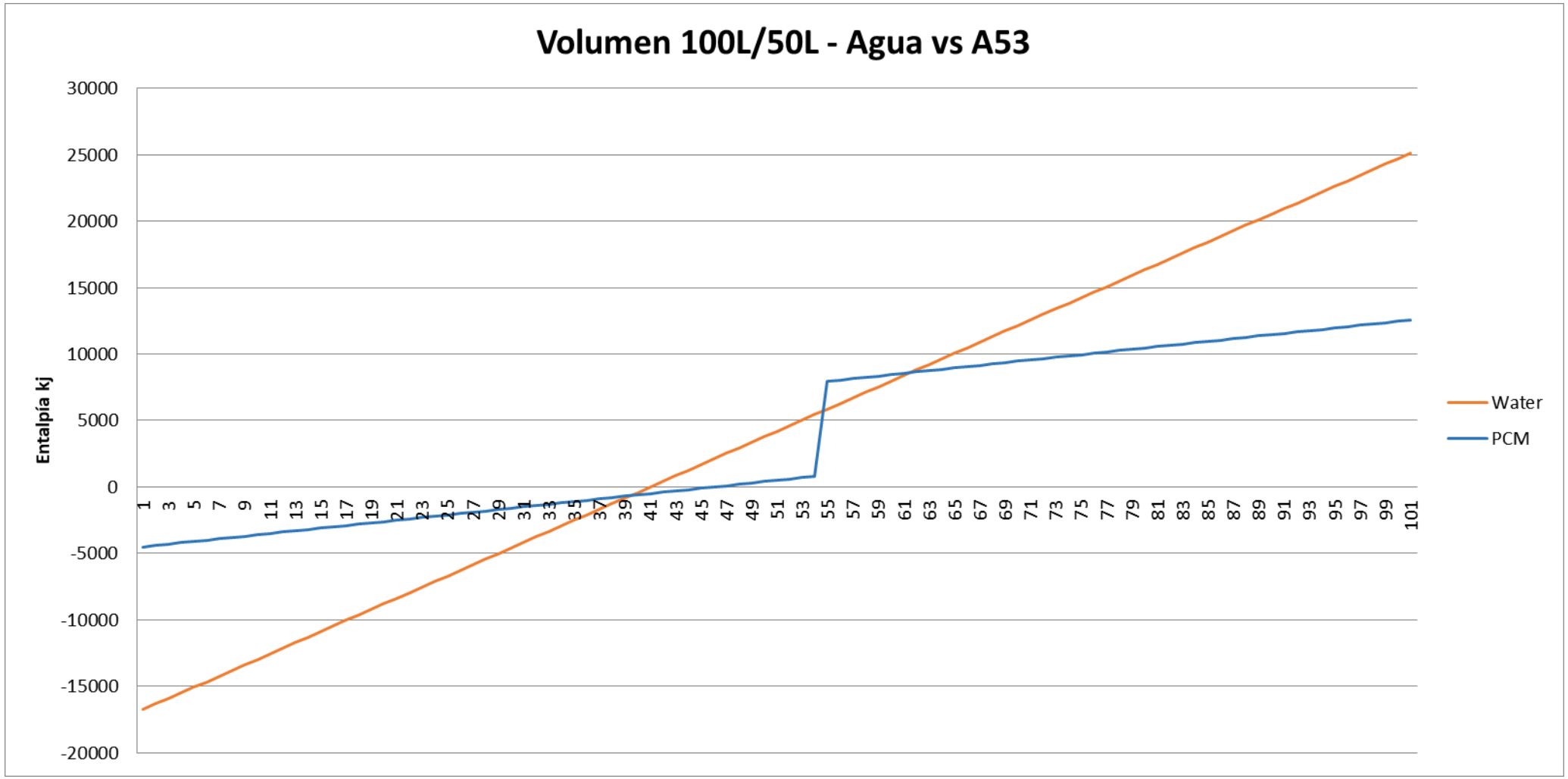
PCM Tanks


Volumen 100L - Agua vs A53
Entalpía kj
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93 95 97 99 101
Water
PCM

PCM Tanks

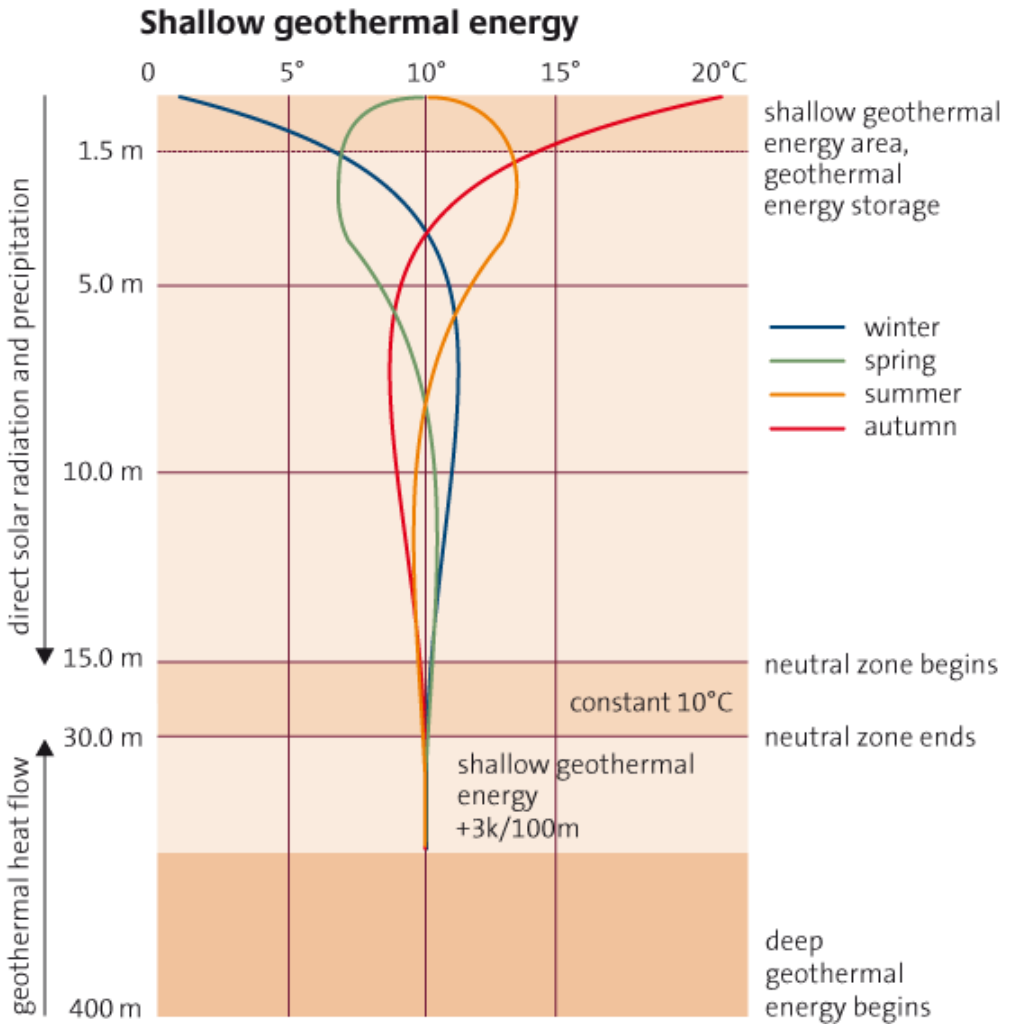

Volumen 100L - Agua vs A53
Entalpía kj
30000
25000
20000
15000
10000
5000
0
-5000
-10000
-15000
-20000
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93 95 97 99 101
Water
PCM

PCM Tanks


Volumen 100L/50L - Agua vs A53
Entalpia kj
30000
25000
20000
15000
10000
5000
0
-5000
-10000
-15000
-20000
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93 95 97 99 101
Water
PCM

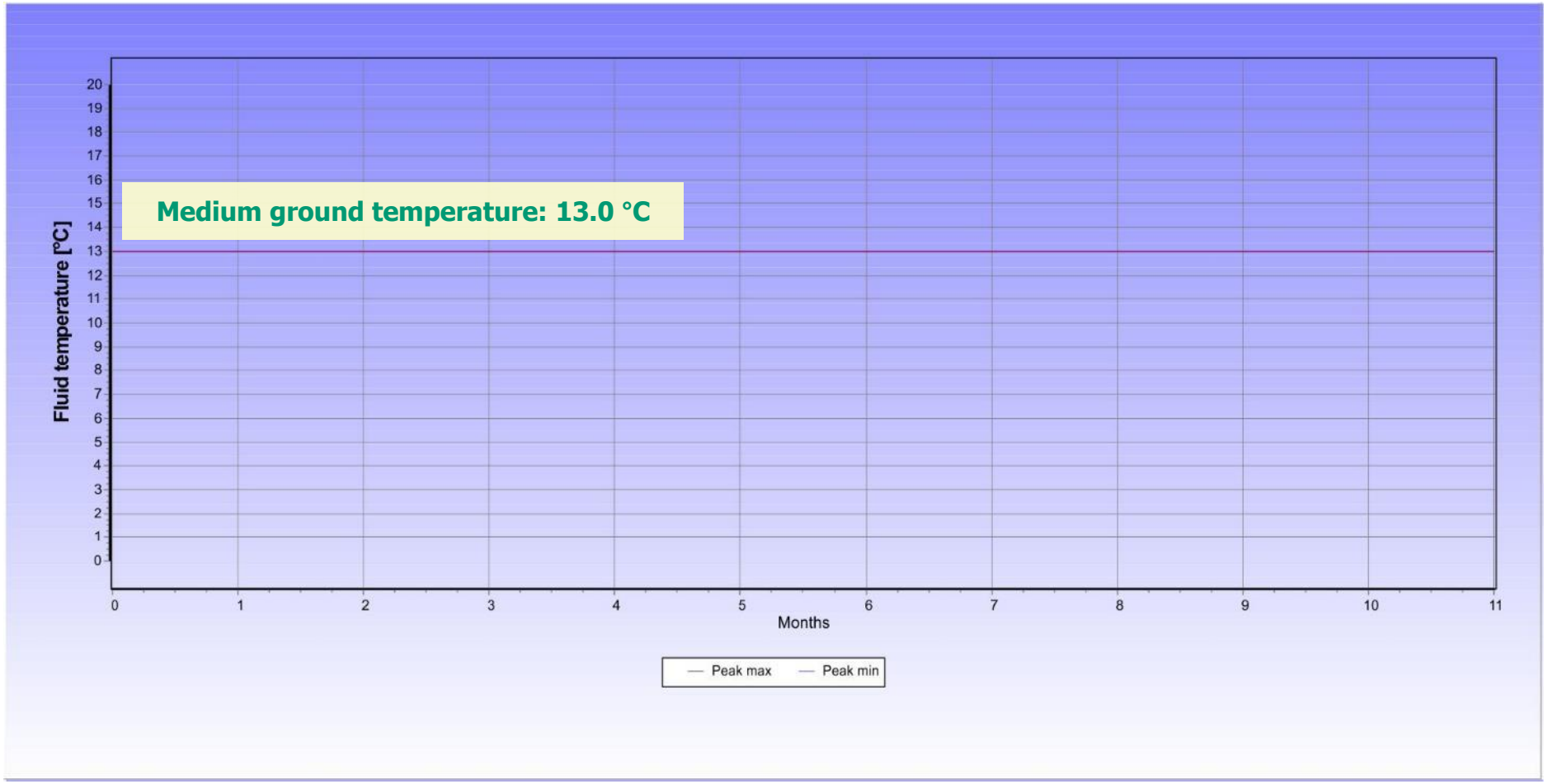
EXPECTED BENEFITS OF ADDING PCM

- Ground temperature influenced by solar radiation and precipitation down to appr.15 m
- Temperature of the neutral zone in non Alpine Regions in Austria:
  9 – 10 °C



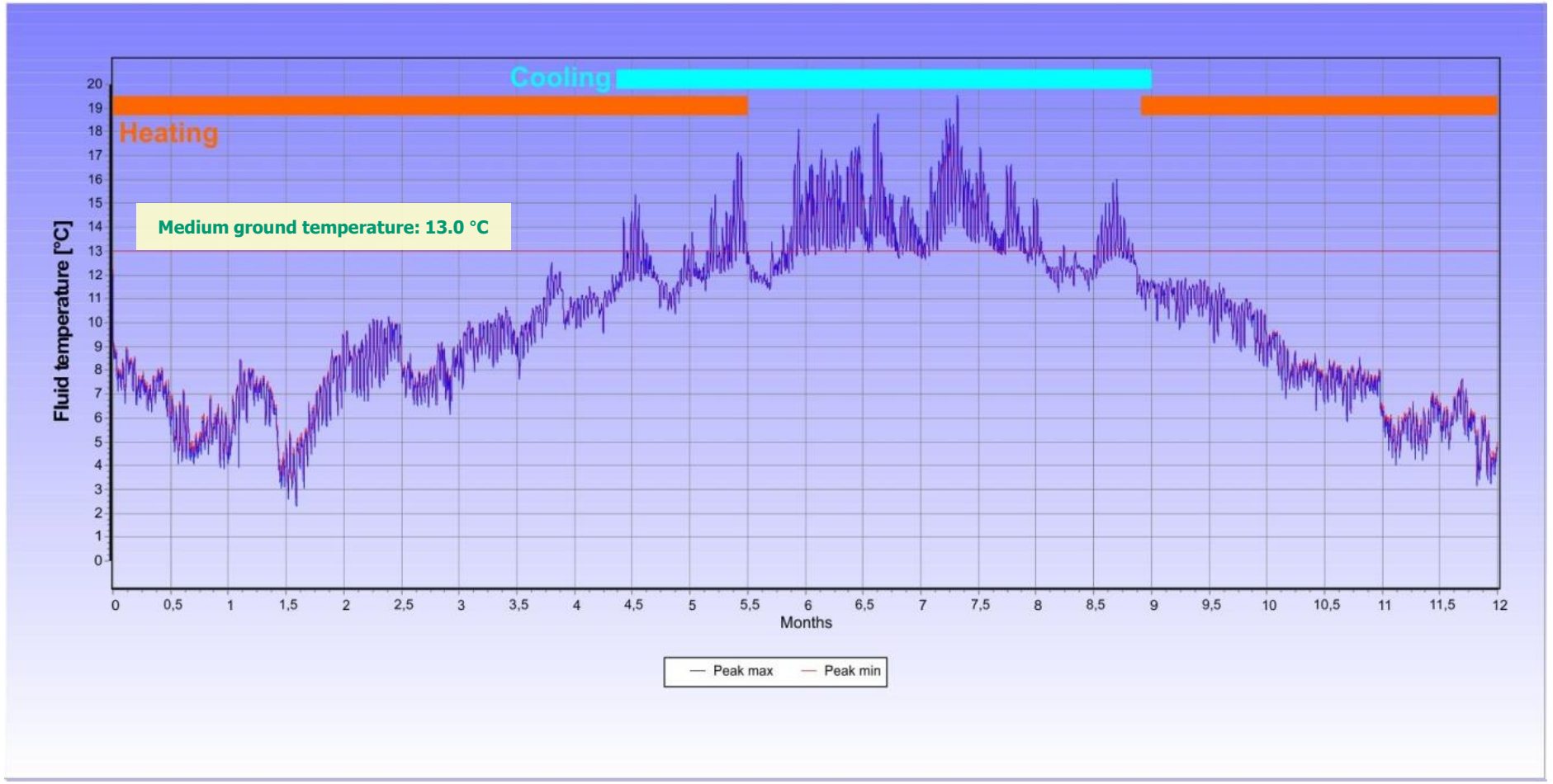
EXPECTED BENEFITS OF ADDING PCM

▷ Medium fluid temperature (BHE 100 m deep) without load:



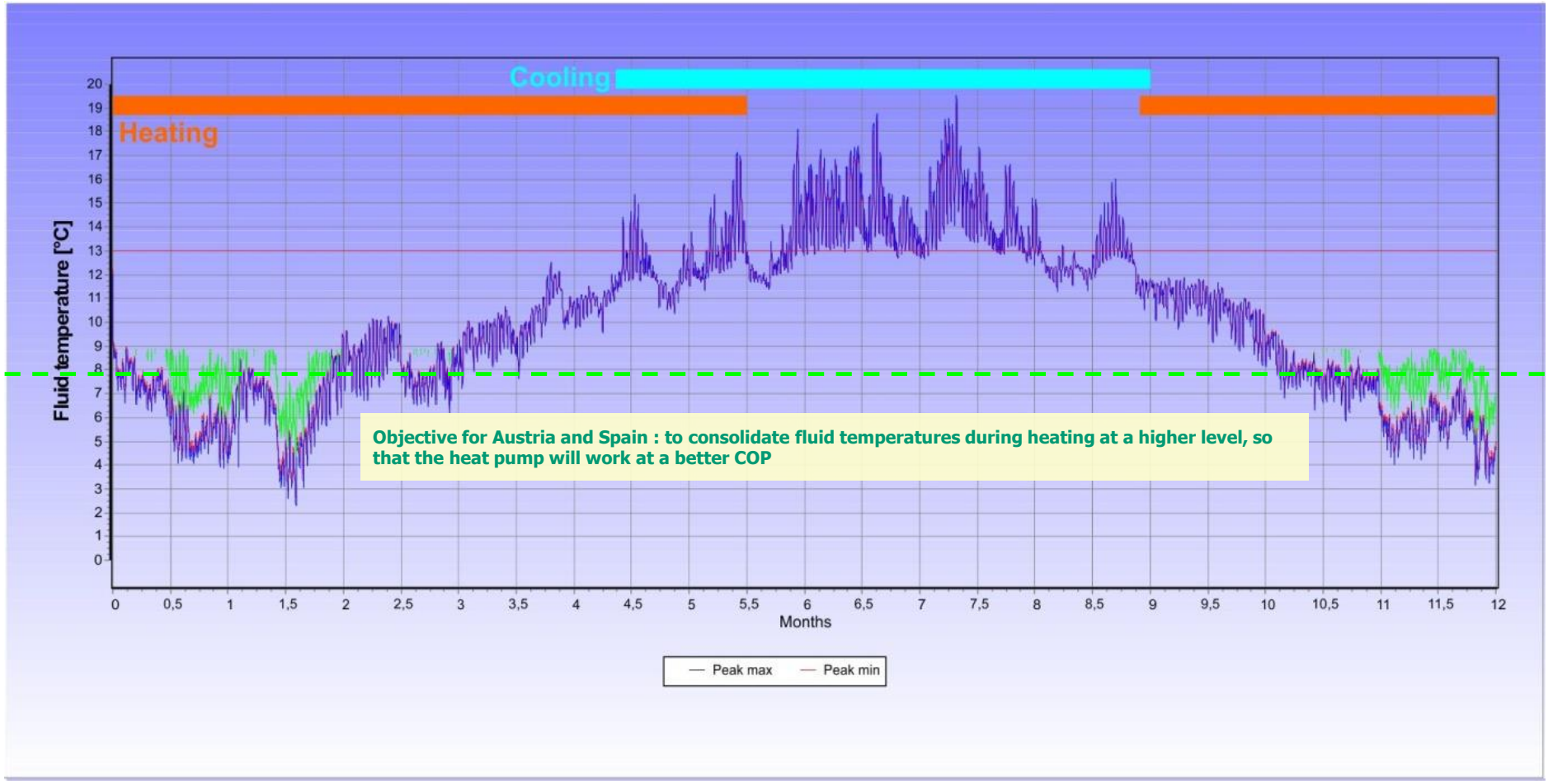
EXPECTED BENEFITS OF ADDING PCM

▷ Medium fluid temperatures for a typical year, heating and cooling load:



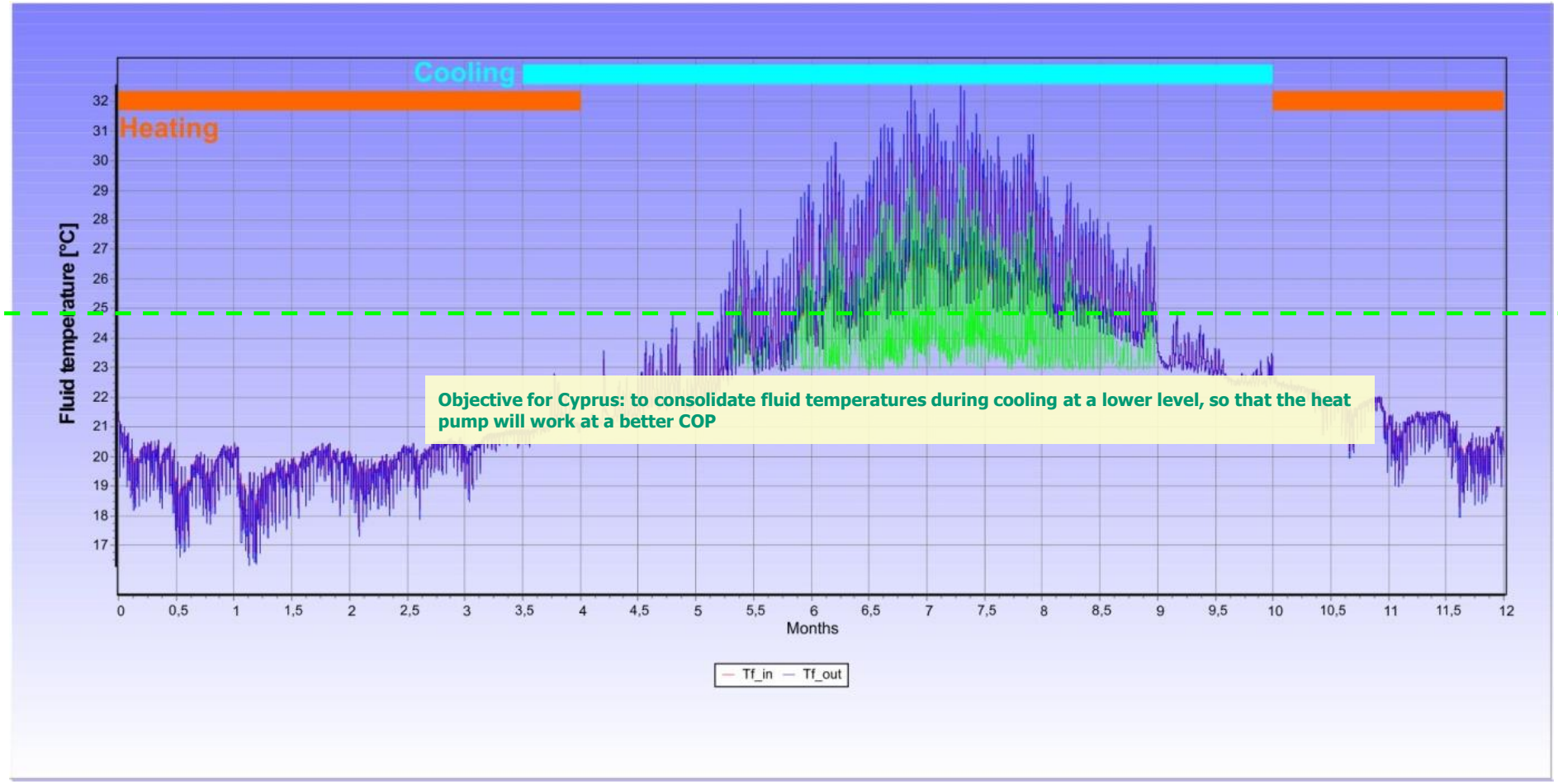
EXPECTED BENEFITS OF ADDING PCM

▷ Medium fluid temperatures within a year, with heating and cooling and PCM:



EXPECTED BENEFITS OF ADDING PCM

▷ Medium fluid temperatures within a year, with heating and cooling and PCM:



LEGAL AND TECHNICAL ASPECTS

- PCMs must not affect:
  - Grout (stability/permeability)
  - Ground or Groundwater

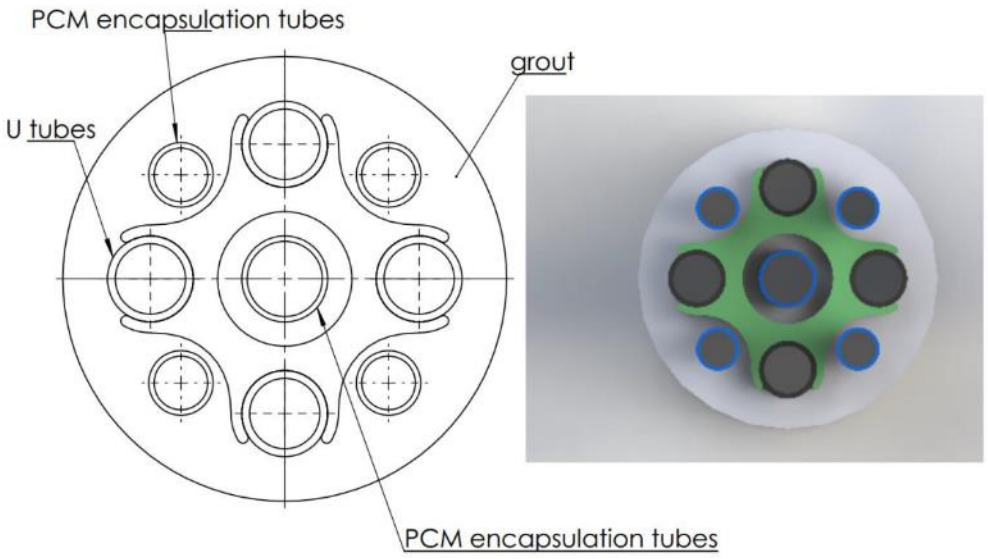
INVESTIGATED METHODS OF ADDING PCM

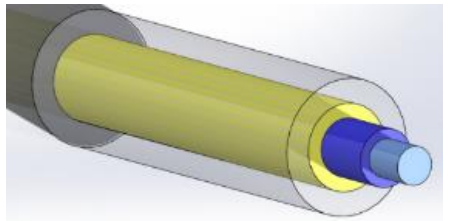
- Microencapsulated powder added to the grout

- Results:
  - 35 % PCM have to be added to the grout to be effective
  - BUT stability of the grout is affected

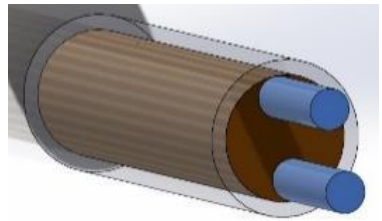
INVESTIGATED METHODS OF ADDING PCM

▷ Macro-encapsulated PCM in tubes

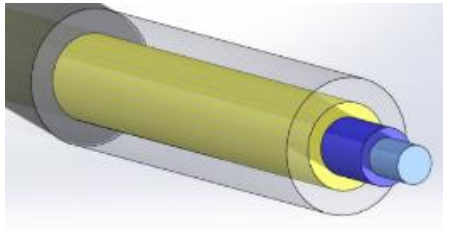




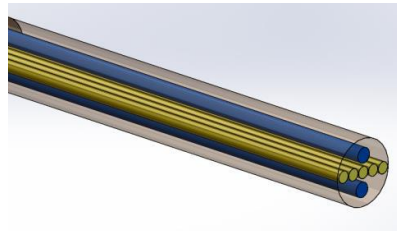
Coaxial - Interior Ring



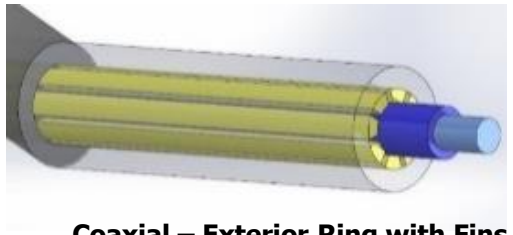
U-Tube with surrounding tube



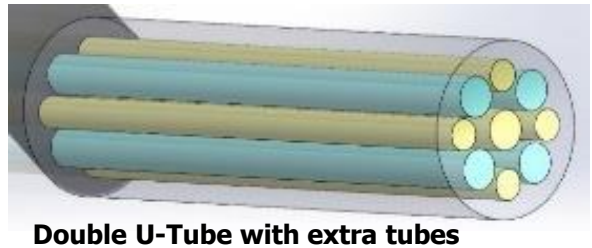
Coaxial – Exterior Ring



U-Tube with extra tubes



Coaxial – Exterior Ring with Fins



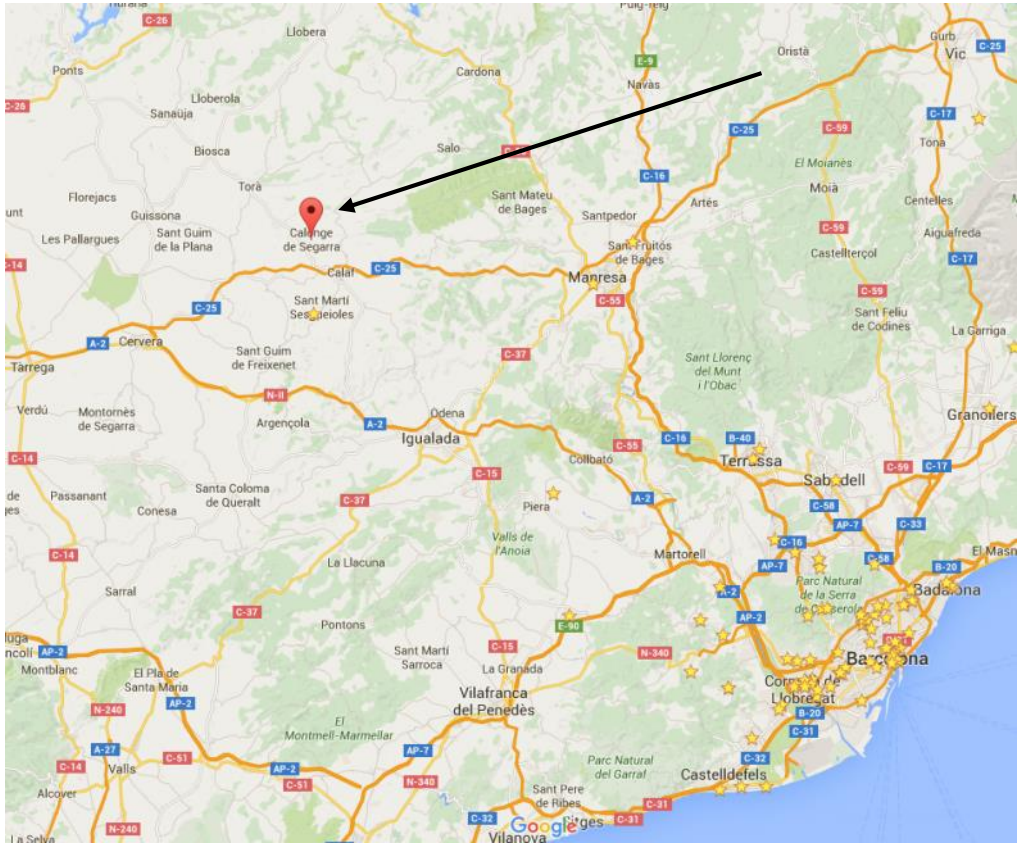
Double U-Tube with extra tubes

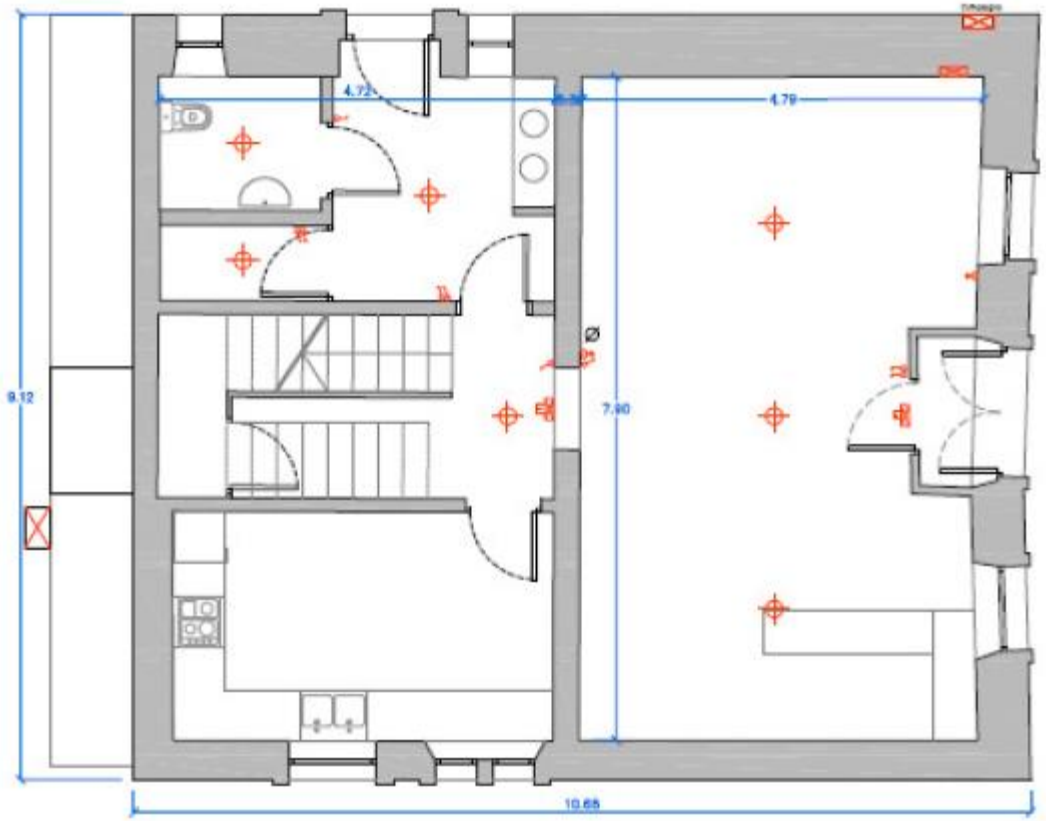
▷ Steps:

- Computational Fluid Dynamics (CFD) simulation to determine the best solution
- 3D numerical simulation for optimisation, comparison with common BHE

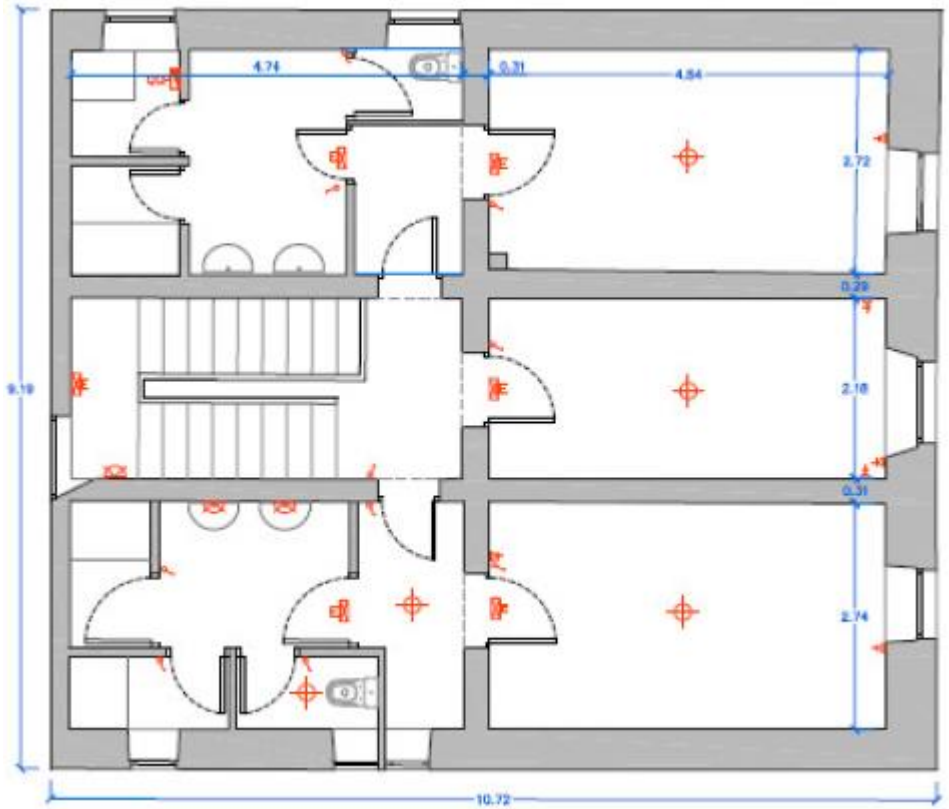
Demosite Location

- Location: Calonge de Segarra
- Population: 202
- Surface: 37 km^2
- Surface: 150 m^2
- Ownership: Municipality
- Tenants: 3 members





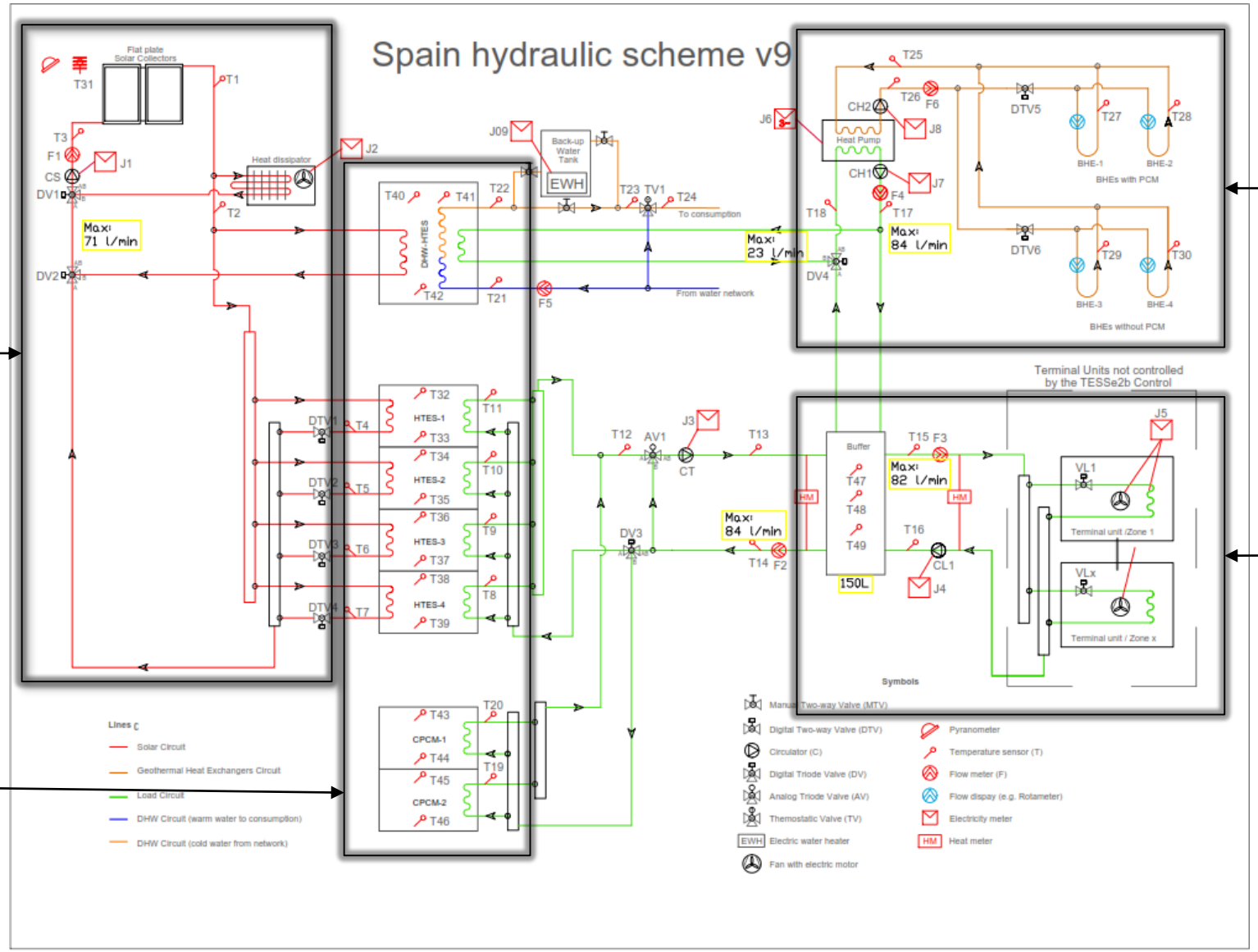
Ground Floor



First Floor

Solar System

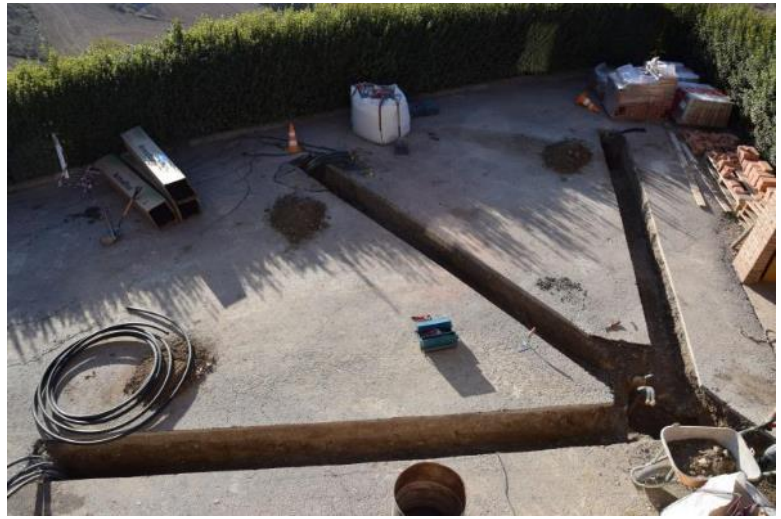
PCM Storage



Geothermal System

Terminal Units
Heating Cooling

Radiators – Heating Cooling



Geothermal: 4 BHE – 360m – 40mm

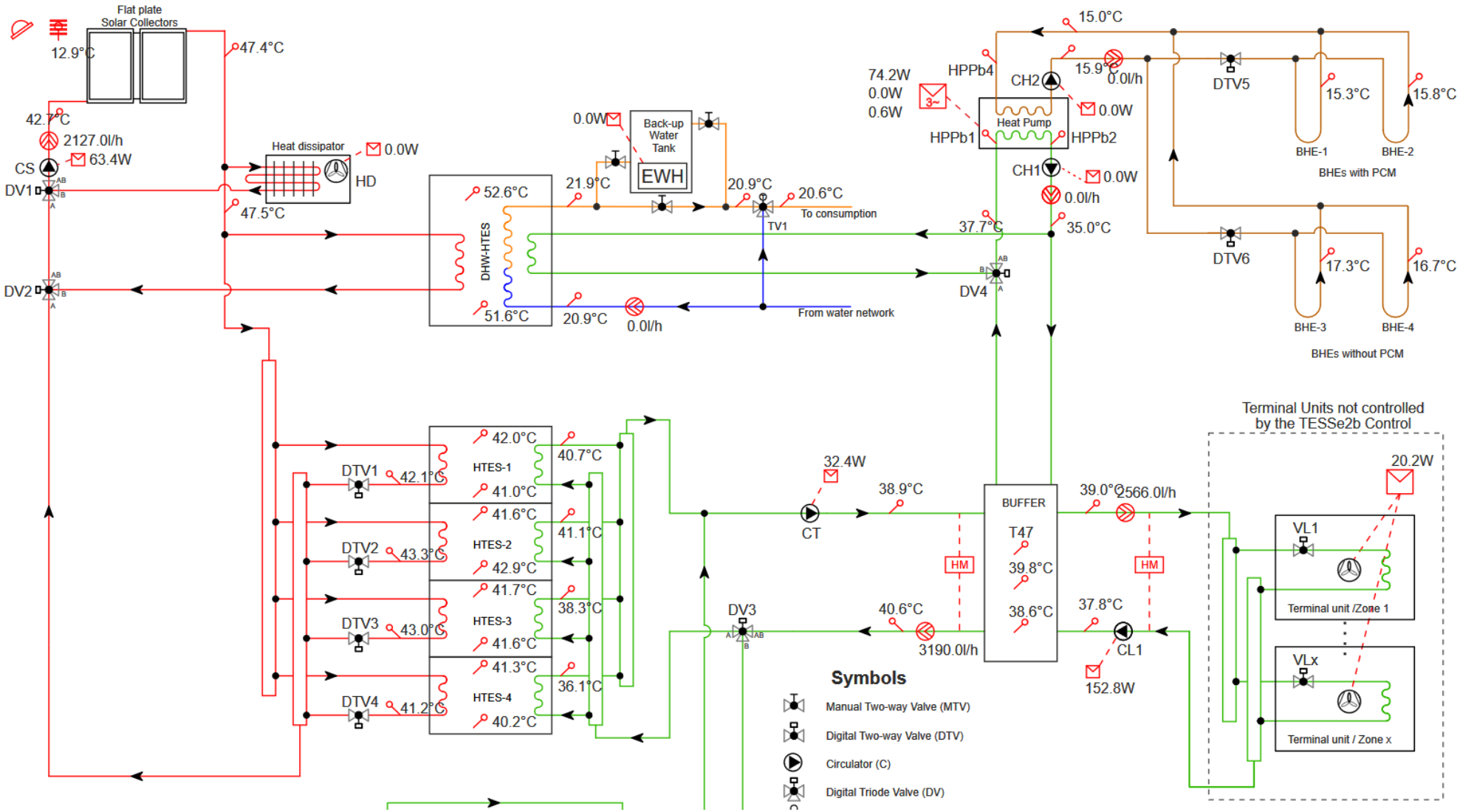
GSHP: 14KW – Heating-Cooling - DHW

Solar: 10 collectors – 23m^2 - South West

PCM Tanks – 1 DHW – 2 Cooling – 4 Heating

Control

Monitoring


Flat plate Solar Collectors
12.9°C
47.4°C
42.7°C
2127.0l/h
63.4W
CS
DV1
DV2
Heat dissipator
0.0W
HD
47.5°C
52.6°C
DHW-HTES
51.6°C
0.0W
Back-up Water Tank
EWH
21.9°C
20.9°C
20.6°C
To consumption
TV1
20.9°C
0.0l/h
From water network
74.2W
0.0W
0.6W
HPPb4
HPPb1
HPPb2
Heat Pump
CH2
CH1
15.0°C
15.9°C
0.0l/h
0.0W
0.0W
0.0l/h
37.7°C
35.0°C
DV4
DTV5
DTV6
15.3°C
15.8°C
BHE-1
BHE-2
BHEs with PCM
17.3°C
16.7°C
BHE-3
BHE-4
BHEs without PCM
Terminal Units not controlled by the TESSe2b Control
DTV1
42.1°C
DTV2
43.3°C
DTV3
43.0°C
DTV4
41.2°C
HTES-1
42.0°C
41.0°C
HTES-2
41.6°C
42.9°C
HTES-3
41.7°C
41.6°C
HTES-4
41.3°C
40.2°C
40.7°C
41.1°C
38.3°C
36.1°C
32.4W
CT
38.9°C
DV3
40.6°C
3190.0l/h
HM
HM
BUFFER
T47
39.8°C
38.6°C
39.0°C
566.0l/h
37.8°C
CL1
152.8W
20.2W
VL1
Terminal unit /Zone 1
VLx
Terminal unit / Zone x
Symbols
Manual Two-way Valve (MTV)
Digital Two-way Valve (DTV)
Circulator (C)
Digital Triode Valve (DV)

Dissemination


TESSe2b
the smart energy storage


TESSe2b
the smart energy storage

Resultats:

Annual savings	
Annual primary energy saving (kWh)	30065.6
Annual primary energy saving (%)	91.85
Annual emissions reduction (Kg CO_2)	6.85
Maintenance cost of TESSe2b (€)	160
Annual operational & maintenance cost of TESSe2b (€)	326.5
Maintenance cost of Conventional System (€)	220
Annual operational & maintenance cost of Conventional System (€)	2659.3
Annual savings from operational & maintenance cost (€)	2332.7
Annual savings from operational & maintenance cost (%)	87.72

	SPF1	SPF2	SPF3	SPF4
April	7.07	6.16	4.77	4.57
May	26.47	16.69	11.17	10.15
June	11.72	9.96	8.01	7.18
July	2.95	2.49	2.13	1.93
August	3.70	2.75	2.16	2.04

Simple pay-back period	
Capital cost of Conventional System	10688
Capital cost of TESSe2b System	33650
Simple pay-back period (years)	**9.84**

Assumptions	
Inlet temperature of radiators	80°C
Outlet temperature of boiler	80°C
Volume of DHW tank	160 lt
Outlet temperature of DHW	50°C
Min temperature of fresh water	10°C
Max temperature of fresh water	17.5°C

TESSe2b
the smart energy storage

Thank for your attention

European Commission

Thermal Energy Storage Systems

for energy efficient building an integrated solution for residential building energy storage by solar and geothermal resources