TESSe2b

the smart energy storage

Thermal Energy Storage Systems

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

TESSe2b Project

Project Presentation

Aniol Esquerra Alsius – Associació Ecoserveis

INNOVATIVE ENERGY STORAGE SYSTEMS FOR GREEN ENERGY SUPPLY 08/05/18

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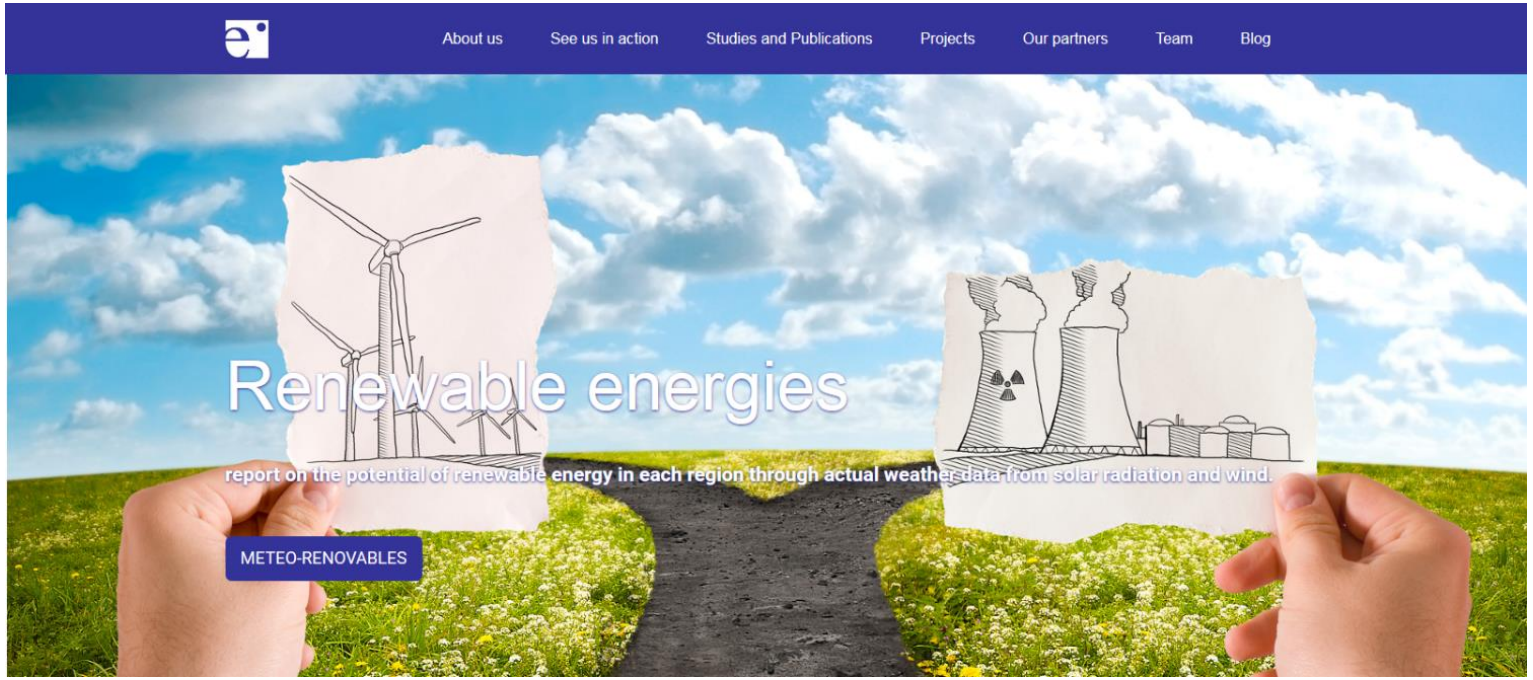


ecoserveis

Renewable Energies – Energy Efficiency – Energy Poverty – Mobility – Smart Grids – Energy Finances

Project Title

Thermal Energy Storage Systems for Energy Efficient Buildings. An integrated solution for residential building energy storage by solar and geothermal resources

- TESSe2b Project –

Project number: 680555

Call identifier: H2020-EeB-2015 **Call for EeB – Energy-efficient Buildings**

EeB 6 – 2015: Integrated solutions of thermal energy storage for building applications

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)

General Objectives

- Increasing **energy efficiency** in buildings, enhance **green technologies** and promote advance **thermal energy storage** solutions.

- The target of TESSe2b is to **design**, **develop**, **validate** and **demonstrate** a **modular** and **low cost thermal storage** technology based on **solar collectors** and highly efficient **heat pumps** for **heating**, **cooling** and domestic hot water (**DHW**) production.

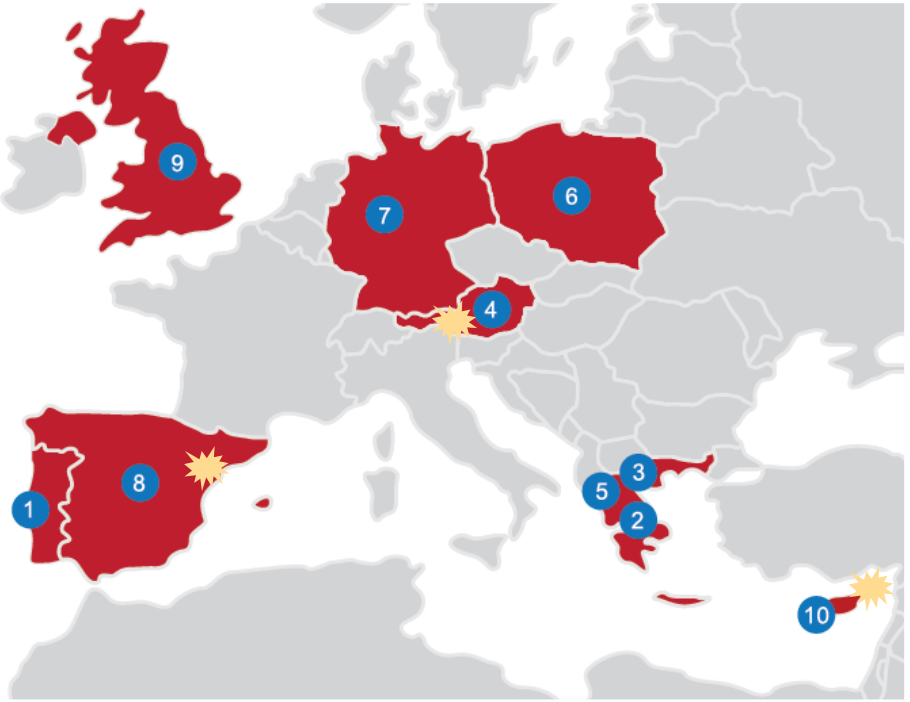
Expected results

- The TESSe2b solution will **reduce the building energy consumption at least 15%,** but it might be possible to reach **25-30%,** with a corresponding reduction in operating costs.

- The estimated **payback** period is expected to reach **8-9 years**.

- TESSe2b project and its exploitable products have the **potential** not only to be included as a **market opportunity** but also to **enhance the development of TES systems** in the EU market.

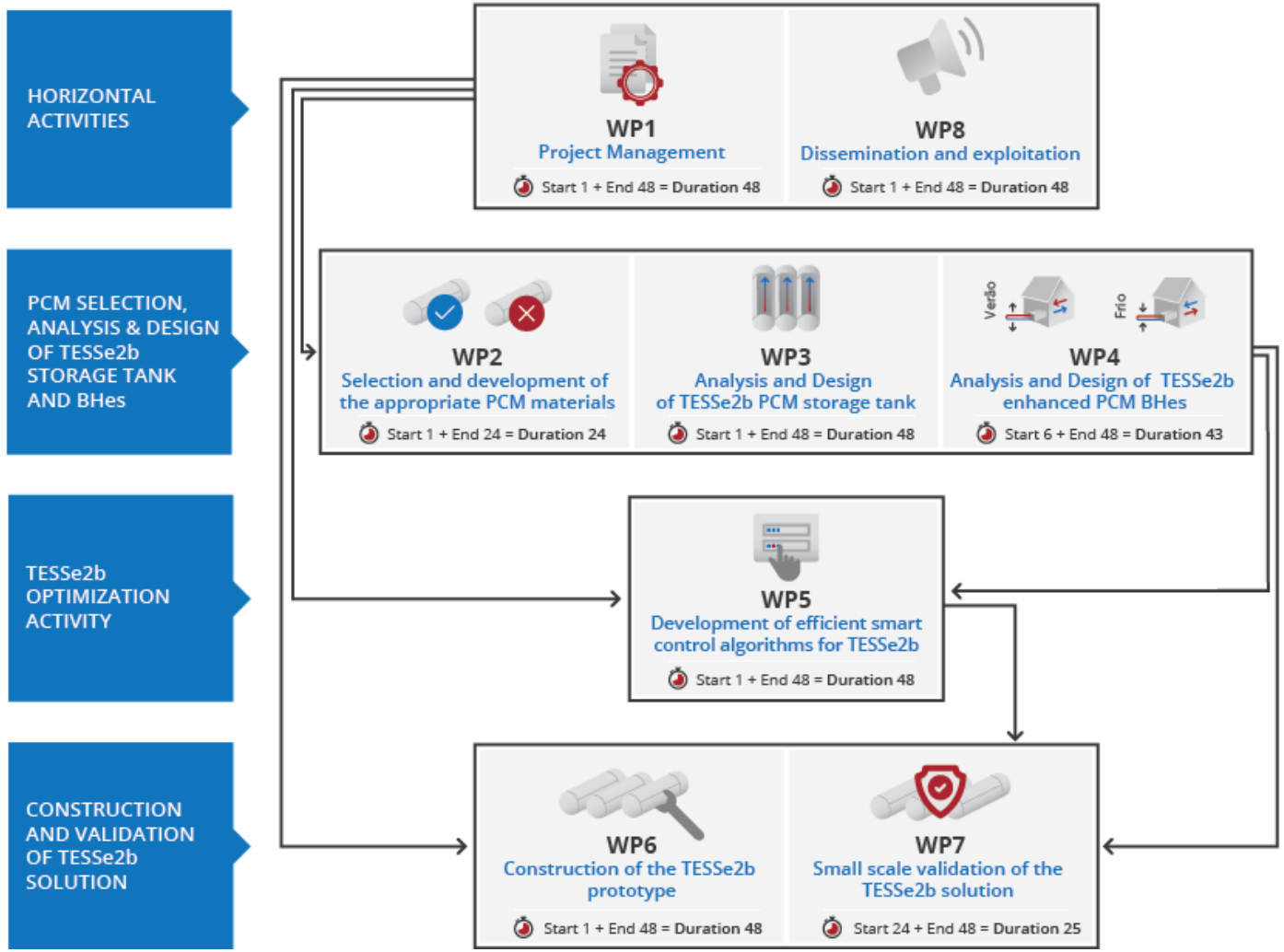
Consortium overview and organisation



Demo Sites

Name	R&D legal statuses	Country
Instituto Politécnico de Setúbal - IPS	Higher education	Portugal
Centre For Renewable Energy Sources and Saving Fondation - CRES	Research organisation	Greece
Technologiko Ekpedeftiko Idrima Stereas Elladas - TEISTE	Higher education	Greece
Geoteam Technisches Buro Fur Hydrogeologie, Geothermie Und Umwelt Gmbh - GEOTEAM	SME	Austria
Panepistimio Ioanninon - UOI	Higher education	Greece
Szkola Glowna Gospodarstwa Wiejskiego - SGGW	Higher education	Poland
Ruhr-Universitat Bochum - RUB	Higher education	Germany
Asociacion Ecoserveis - ECOSERVEIS	Non-profit org.	Spain
Phase Change Material Products Ltd – PCM Produc	SME	U.K.
Z & X Mechanical Installations Limited – Z&X	SME	Cyprus

Work Plan



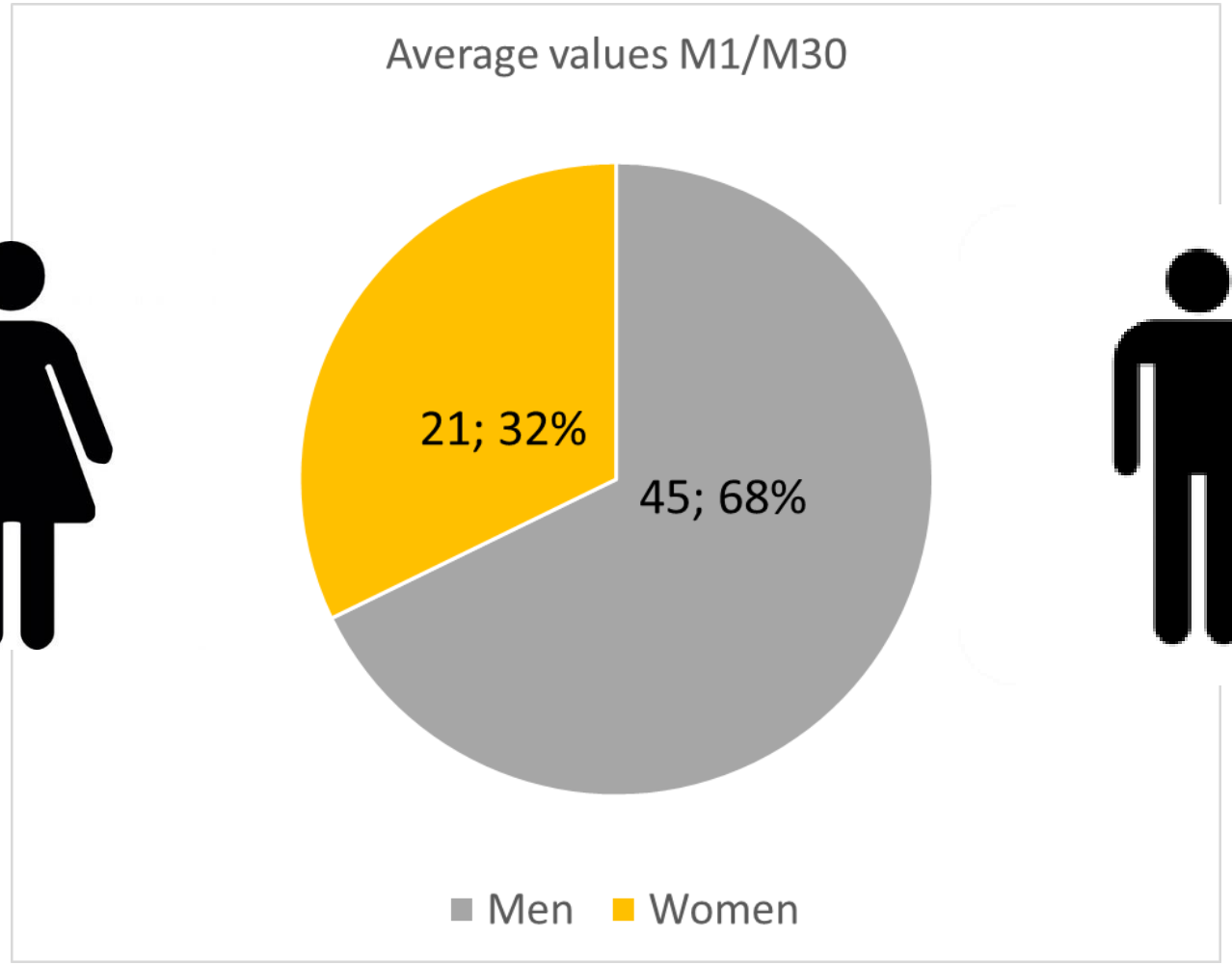
Total: 8 Workpackages

Management: One

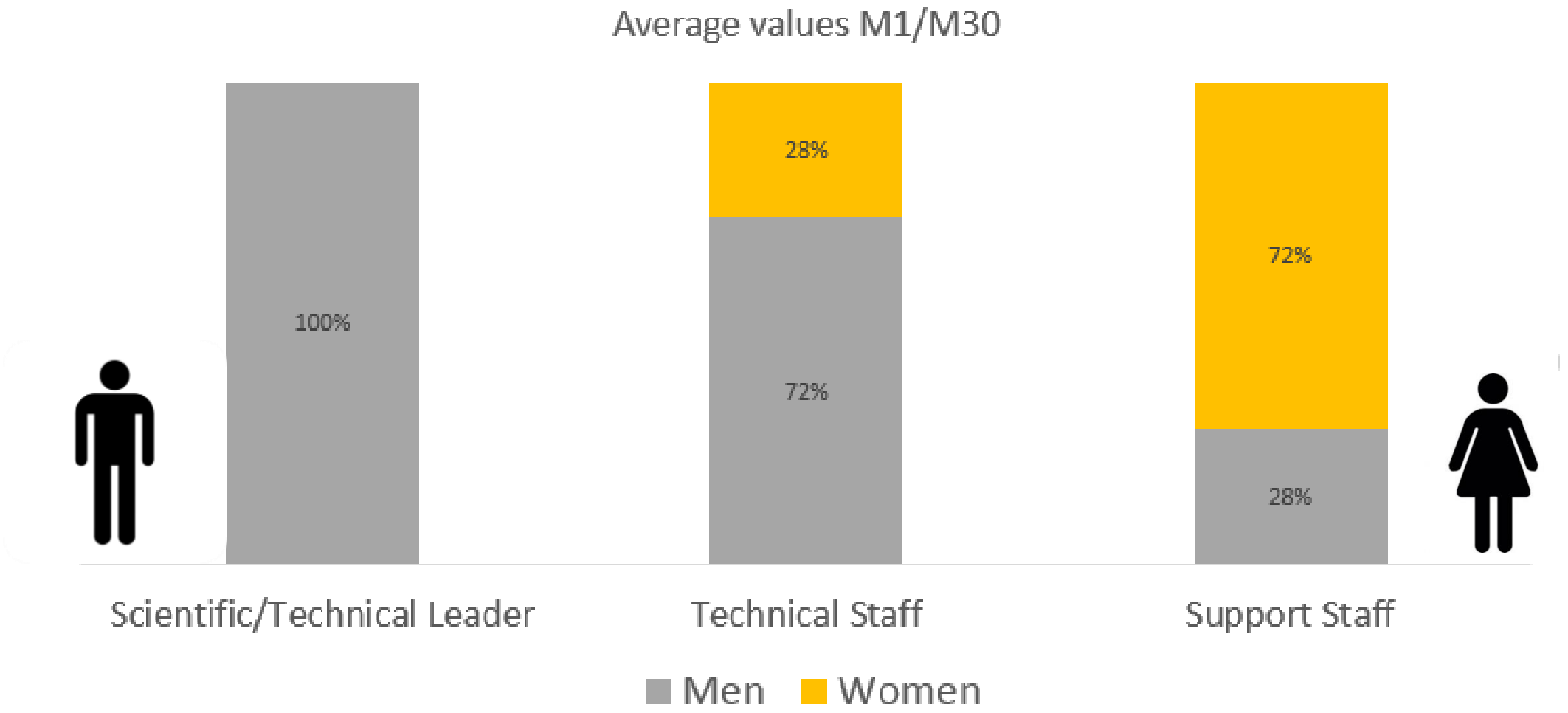
Dissemination and exploitation: One

Technical: Seven

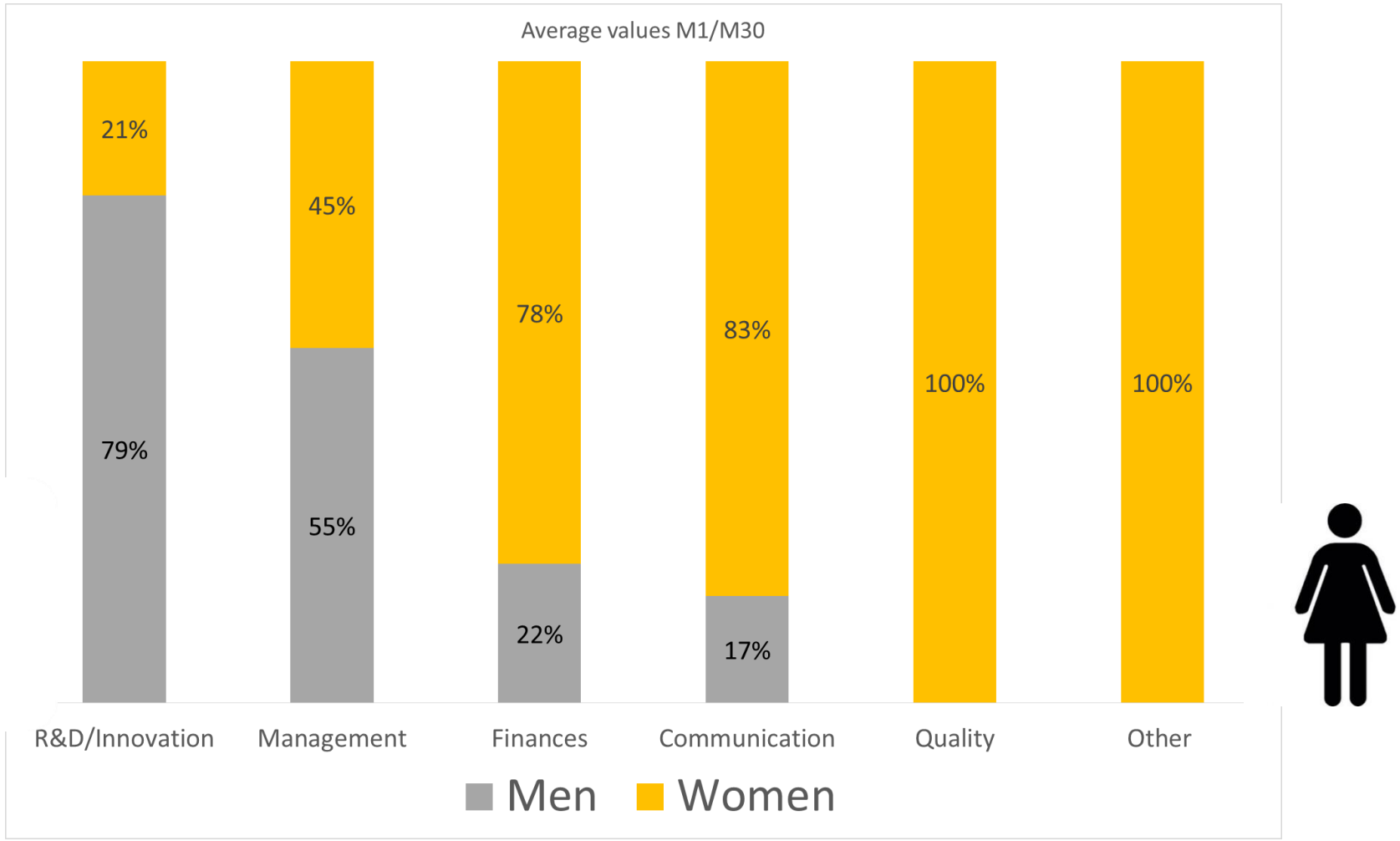
GENDER DISTRIBUTION M1/M30: GLOBAL

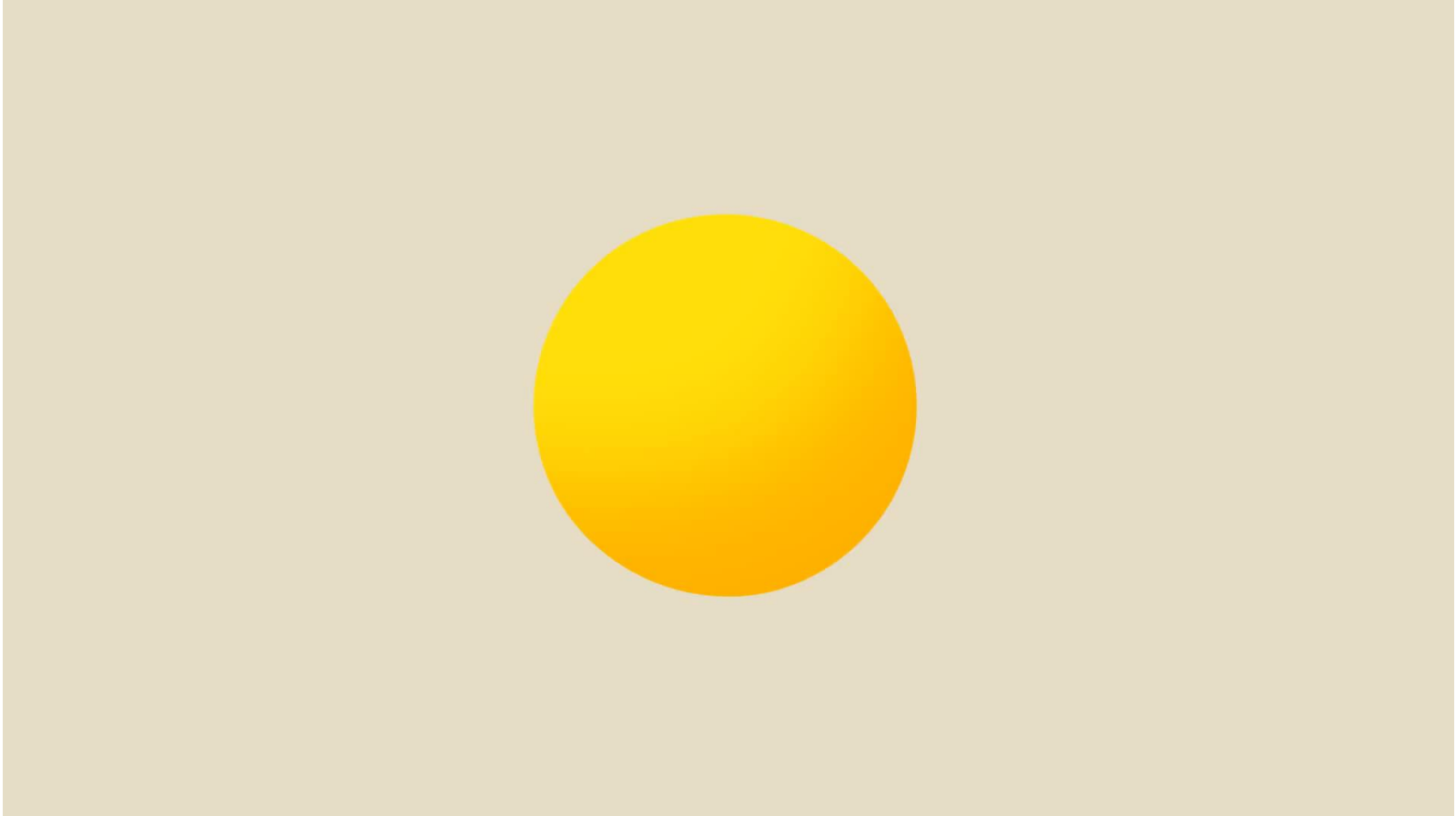


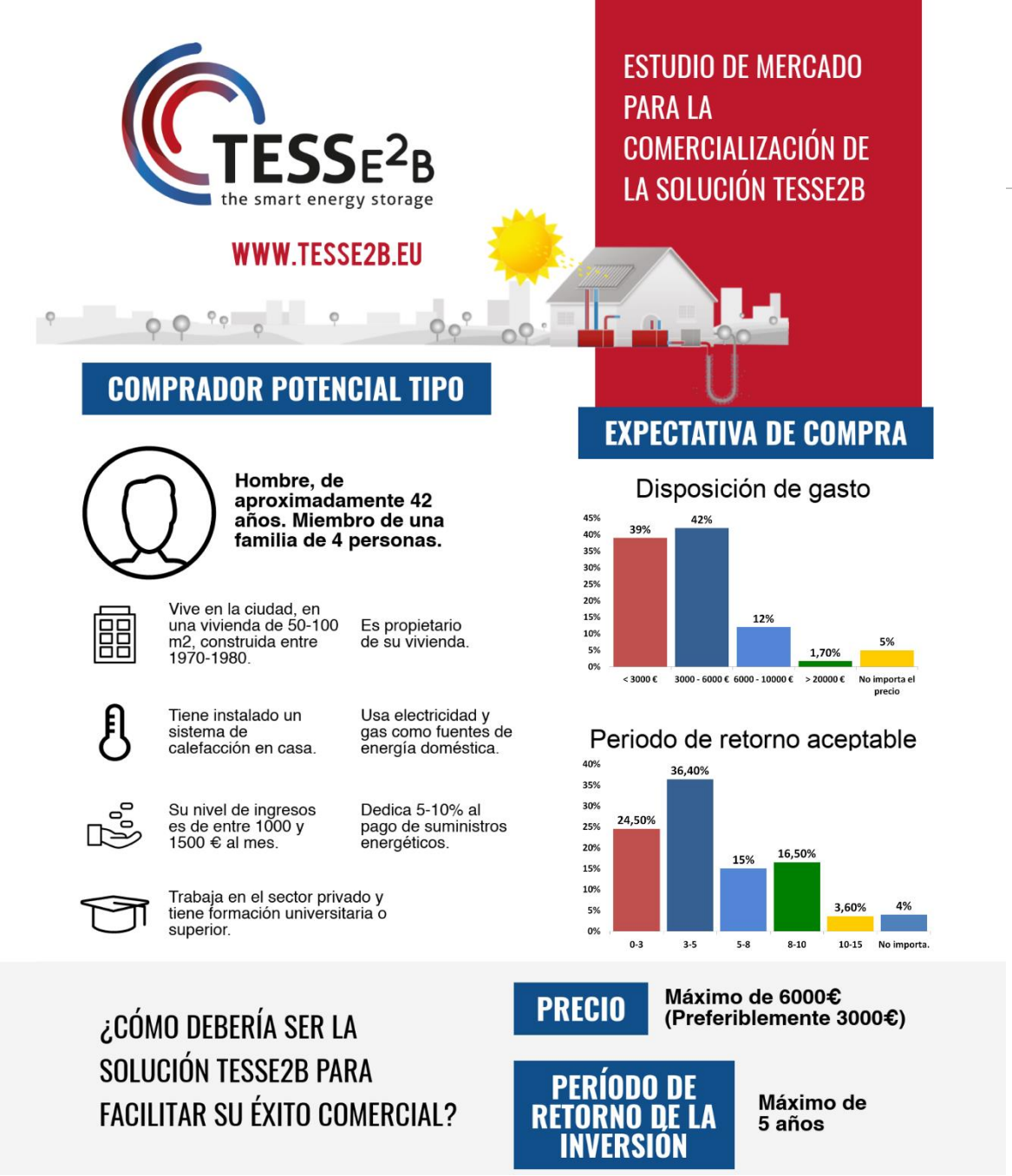
GENDER DISTRIBUTION M1/M30 by CATEGORY **STAFF CATEGORY**



GENDER DISTRIBUTION M1/M30 by AREA







Market Survey

+500 answers

Germany
Spain
Cyprus
Portugal
Greece

What is a PCM?
Phase Change Material

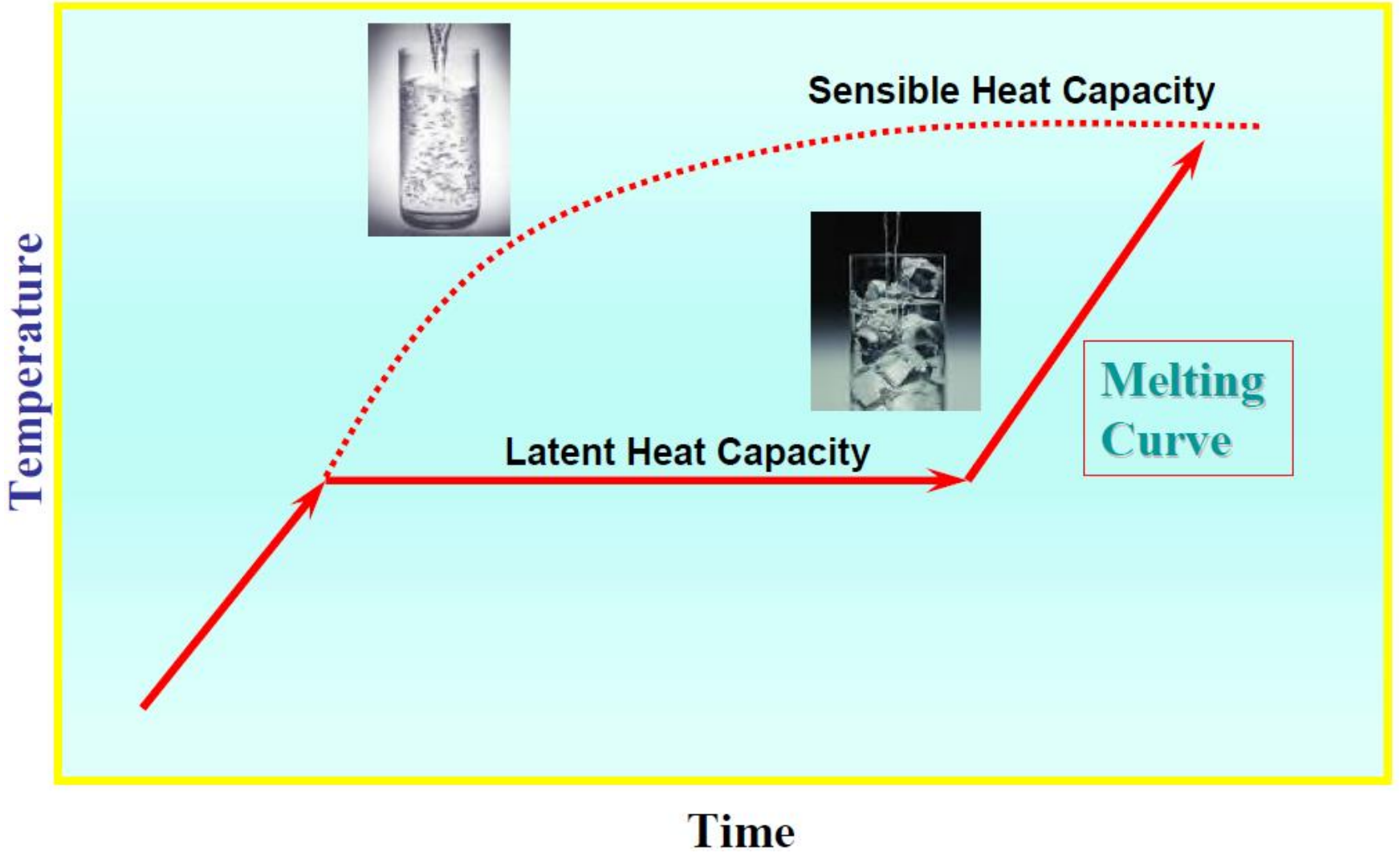
THERMAL ENERGY STORAGE TECHNIQUES

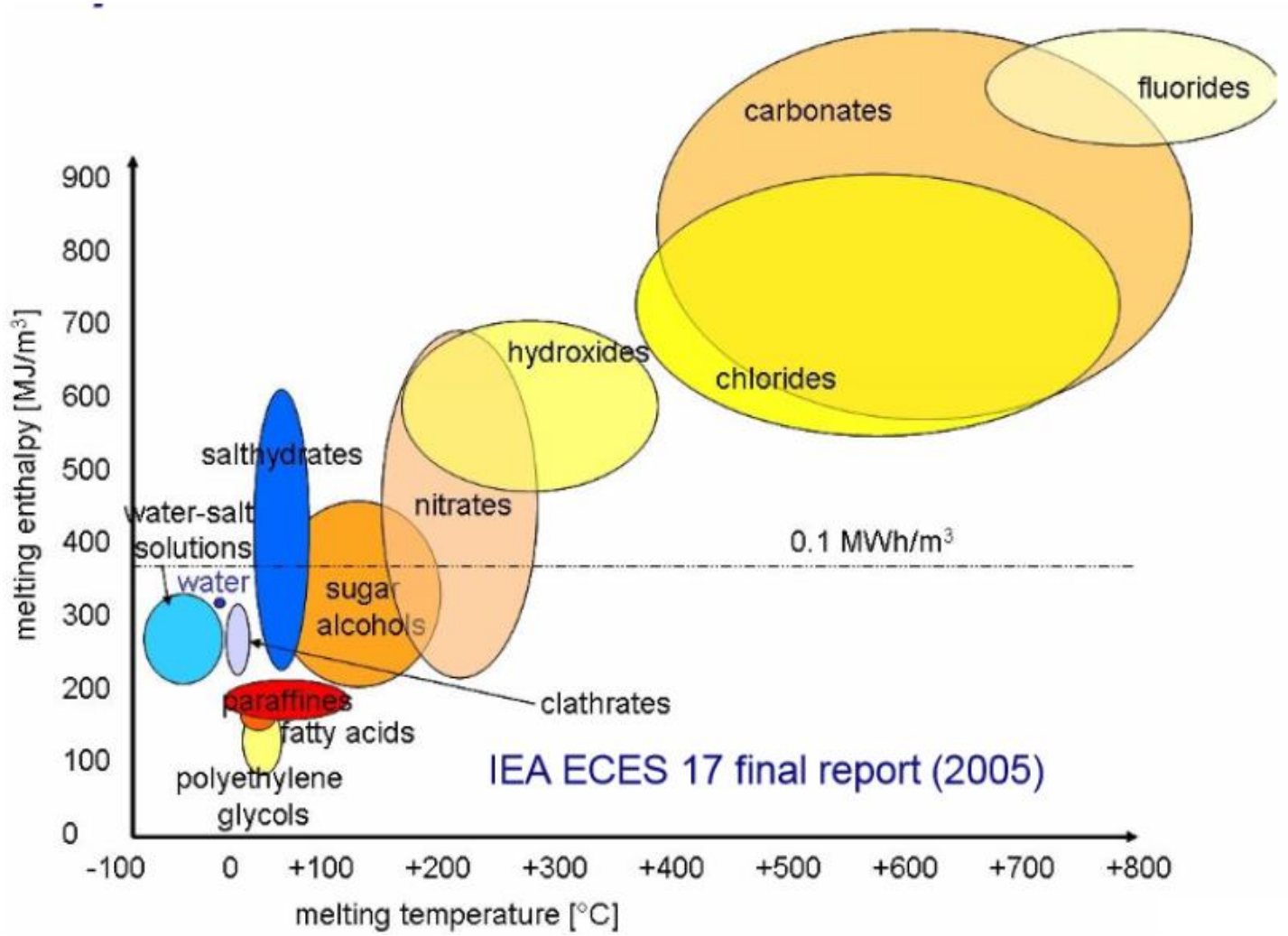
SENSIBLE TES

- Chilled / Hot Water
- Fabric TES

LATENT TES

- Ice TES
- Eutectic TES


Sensible Heat Capacity
Latent Heat Capacity
Melting Curve
Temperature
Time


carbonates
fluorides
hydroxides
chlorides
salthydrates
water-salt solutions
water
nitrates
sugar alcohols
0.1 MWh/m3
clathrates
paraffines
fatty acids
polyethylene glycols
IEA ECES 17 final report (2005)
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

H_20 vs PCM

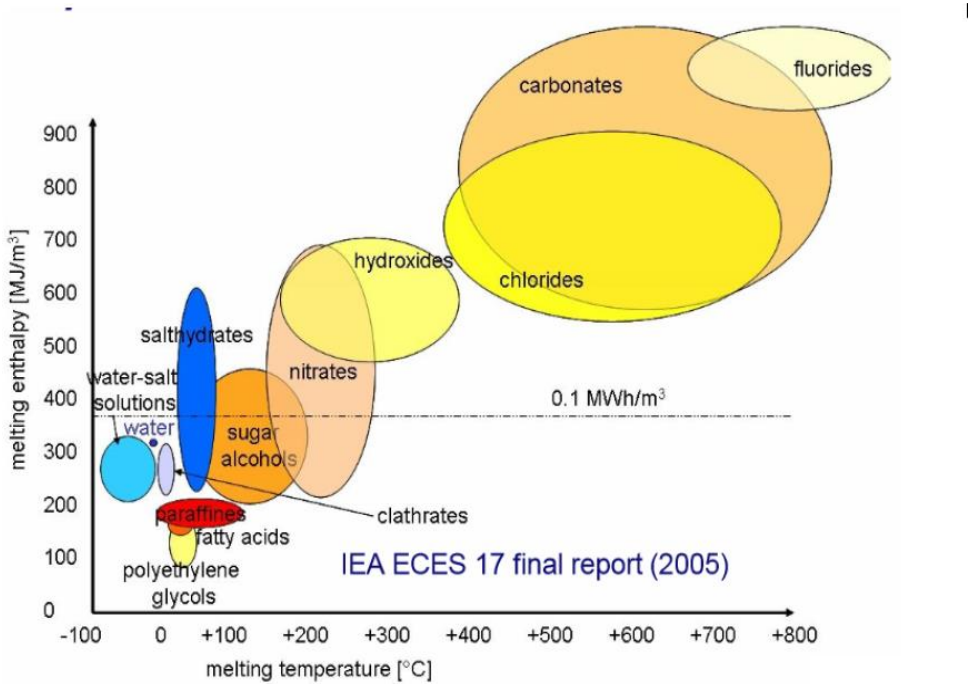
- Tanks: 60 times bigger than a PCM tank
- Heat: Same space with 3 times more heat losses
- T not constant

PCM Issues:

- High Corrosion for Salt Hydrates
- Low conductivity
- Segregation

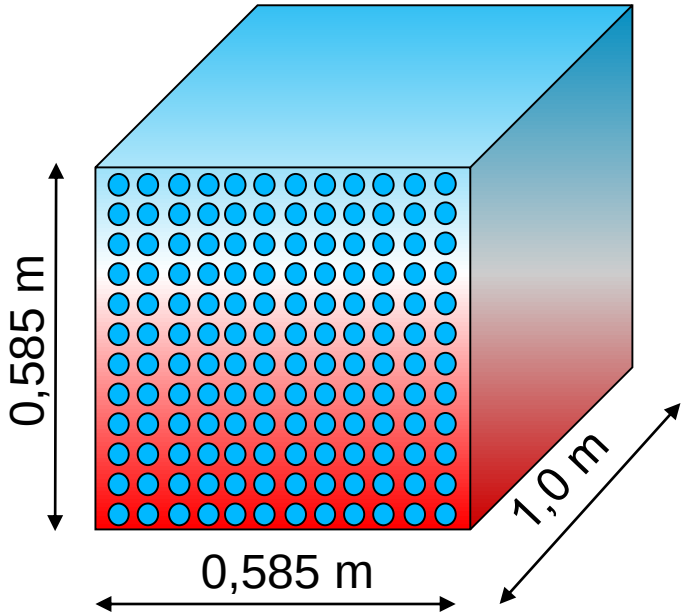
Ongoing research concerning nanoparticles

- Coating for Heat Exchangers
- Conductivity improvement



CFD studies for optimization of the Heat Exchanger in the Tank

HE design (under optimization).



Height of the fins: 45 mm
% of tubes in volume: 5%;
% of fins in volume: 6%

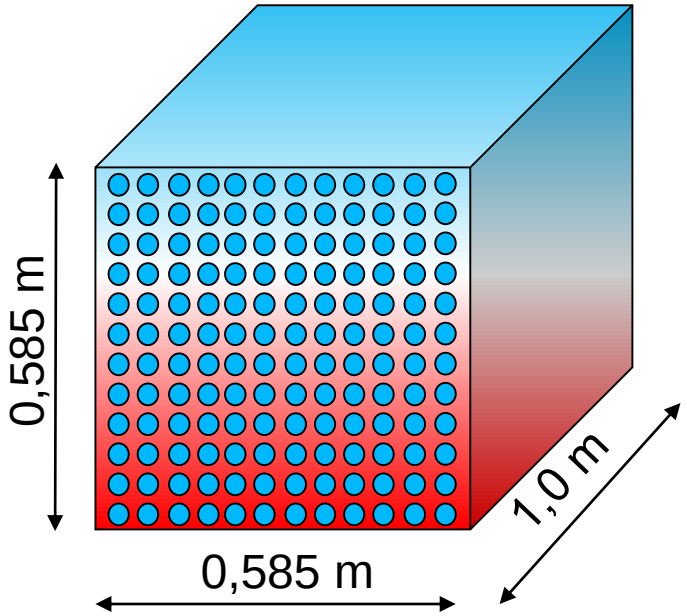
Total volume: 0,3422 m^3; 342,2 liters

Net PCM volume: 0,3422 x 0,95 x 0,94 = 0,306 m3 = 306 liters.

Heat Energy Storage: 0,306 x 805 x 260 x 0,9 = 57641 kJ = **16,0 kWh**

CFD studies for optimization of the Heat Exchanger in the Tank

HE design (under optimization).



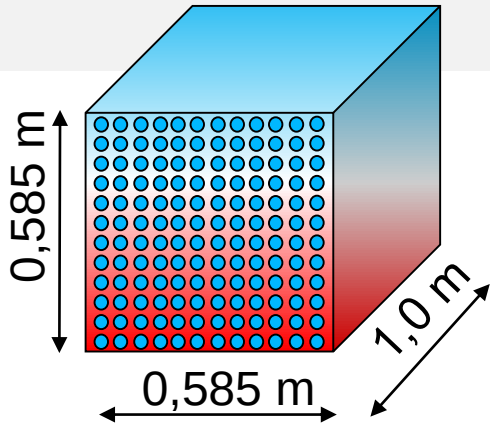
Number of tubes: 24 tubes (6 passes)
Length per tube: 6 m
Number of passes per tube: 6
Total length: 144 m

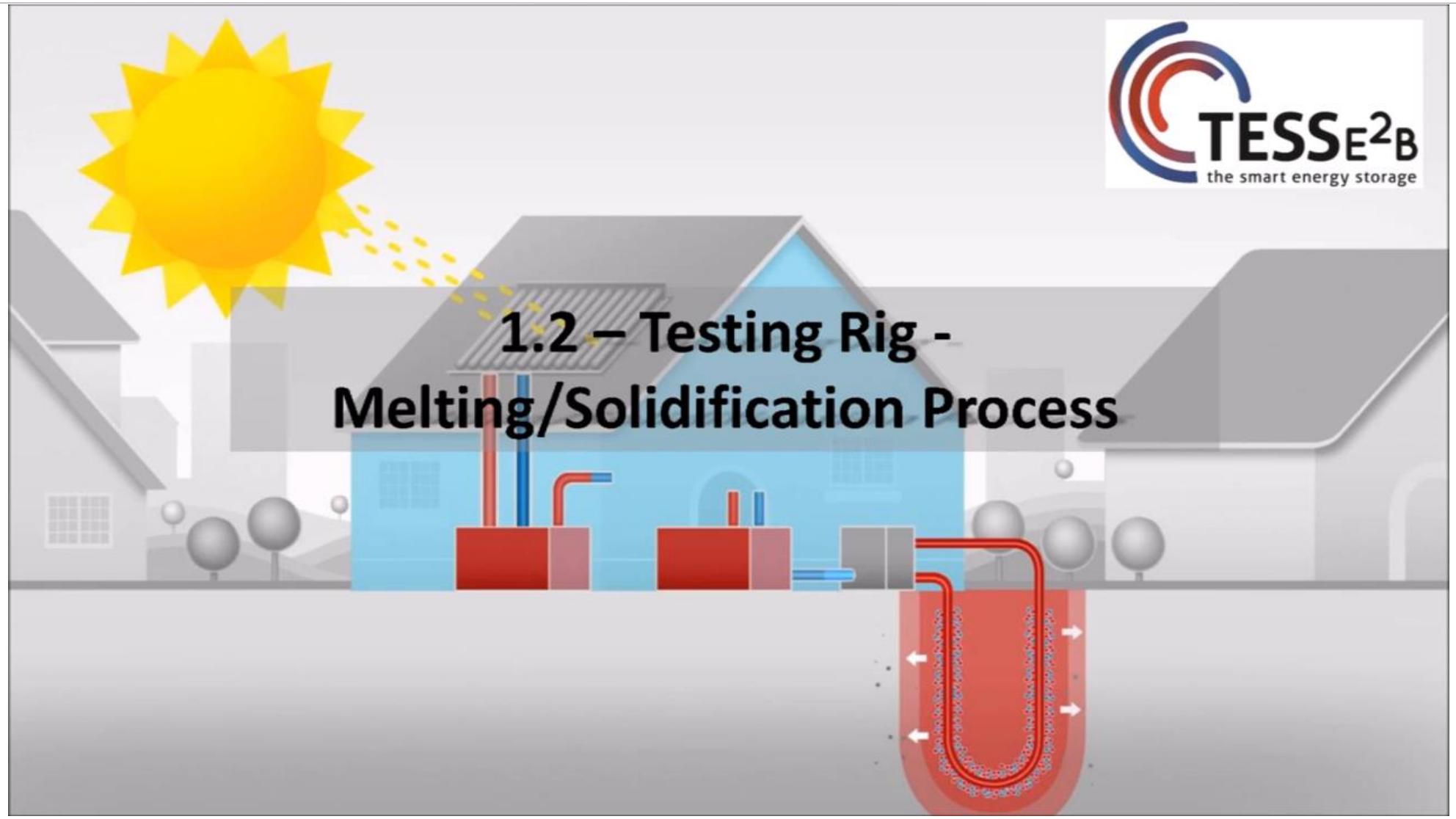
Heating capacity: 10 x 144 = 1440 W = **1,44 kW**

Height of the fins: 45 mm
% of tubes in volume: 5%;
% of fins in volume: 6%

Hot Tanks for Demo Site in Austria

- **Number of Tanks: 3**
- **<u>Heat Energy Storage</u>**: 3 x 16,0 kWh = **48 kWh** (maximum predicted: 55,5 kWh)
- **<u>Heating capacity:</u>** 3 x 1,44 = **4,32 kW** (max. predicted, 6,3 kW, few hours, HP in series with hot tanks)

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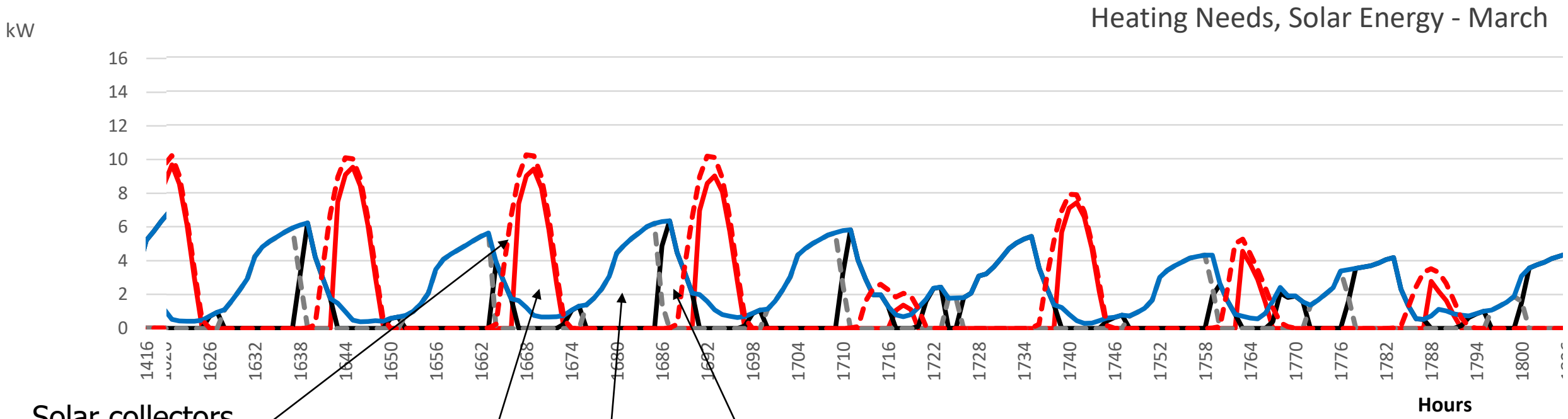
1.2 – Testing Rig -
Melting/Solidification Process
125x60x201 cm

PCM Tank

- Compact: 4 tanks in a IKEA closet

- 64 kWh thermal energy

PAX
Armari, blanc, Ballstad Vikedal
€ 257 / u.
125x60x201 cm



Solar collectors

1. Charging DHW tank;
2. Satisfying heating needs;
3. Charging HPCM.

Charging HPCM

HPCM

HP

Workpackage WP7 - Small scale validation of the TESSe2b solution [Months: 24-48]

WP leader: CRES

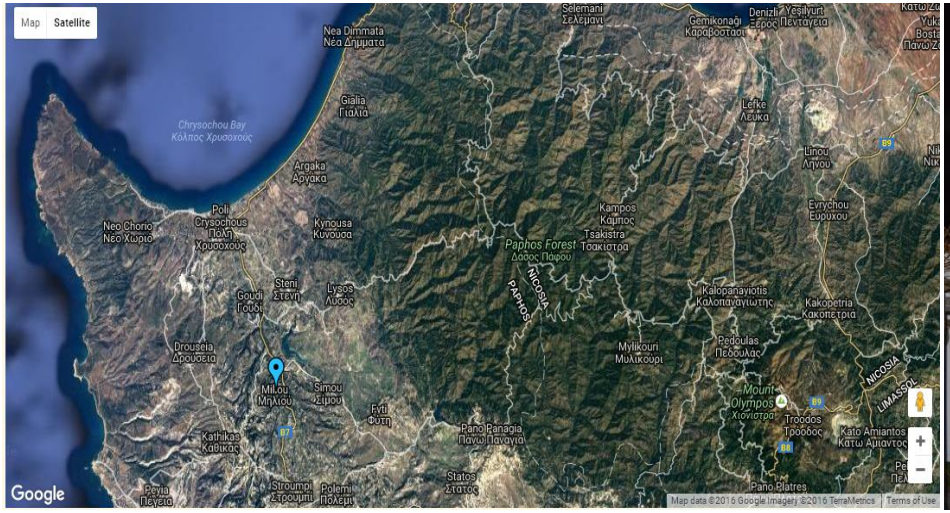
Demo Site - Austria

Location: Kapfenberg, Graz

Workpackage WP7 - Small scale validation of the TESSe2b solution [Months: 24-48]

WP leader: CRES

Demo Site - Cyprus

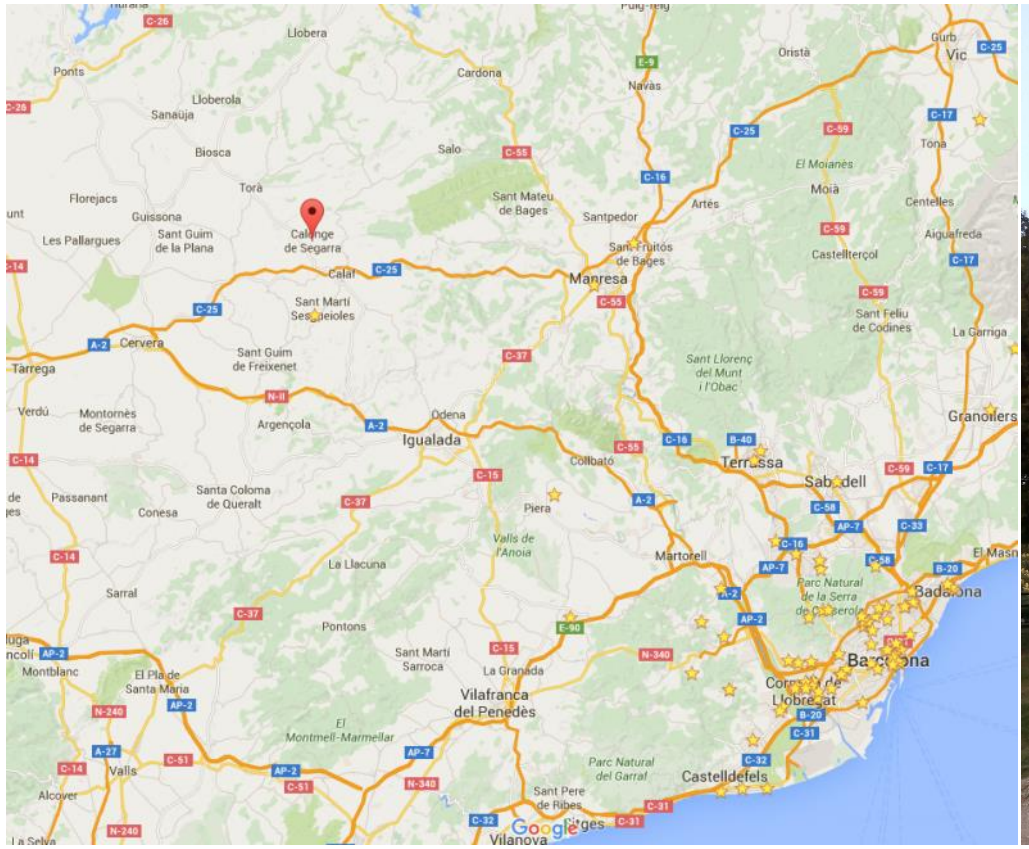


THE LOCATION OF THE VILLAGE MILIOU

Workpackage WP7 - Small scale validation of the TESSe2b solution [Months: 24-48]

WP leader: CRES

Demo Site - Spain



Location: Calonge de Segarra, Barcelona

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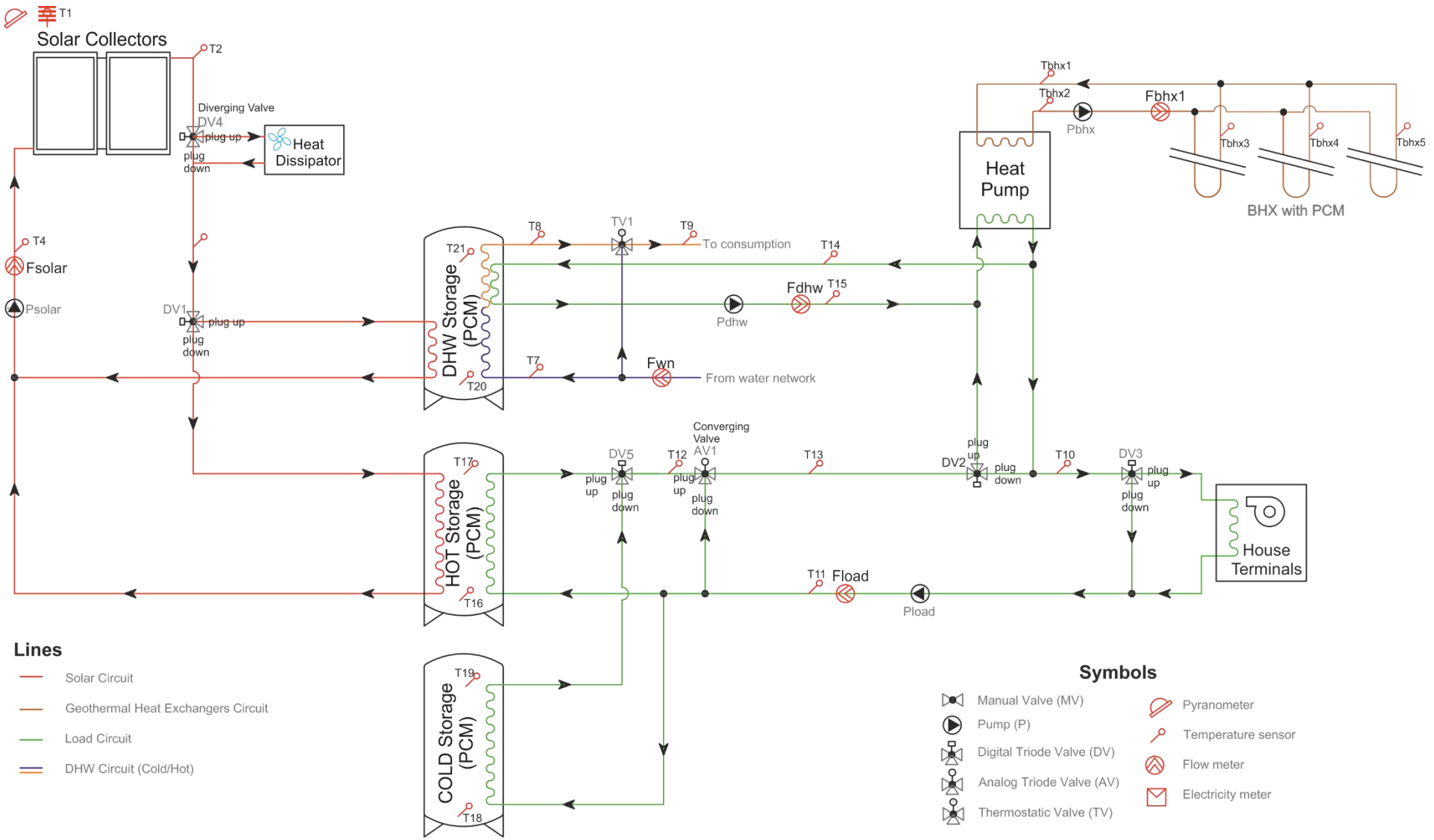
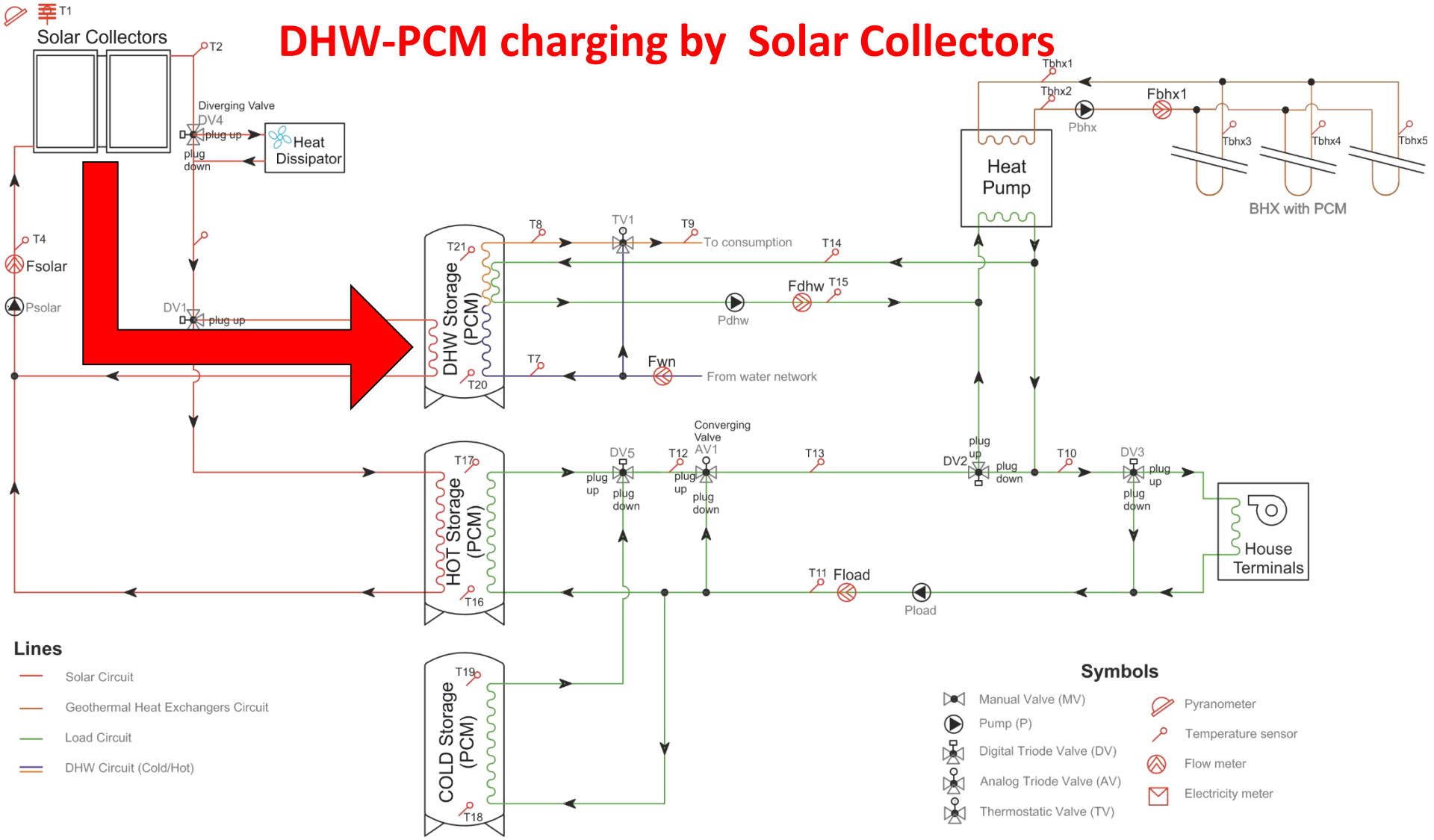
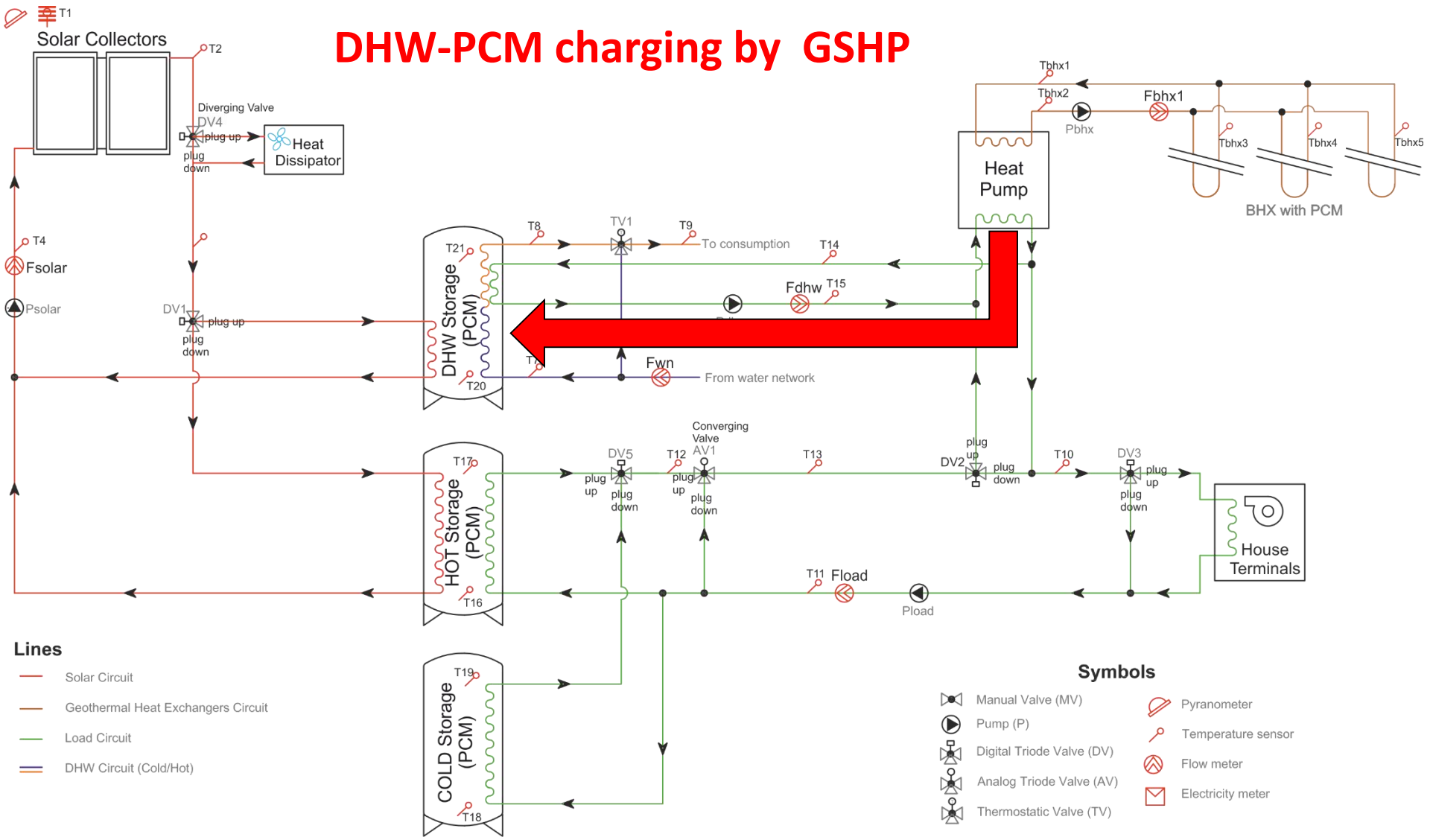


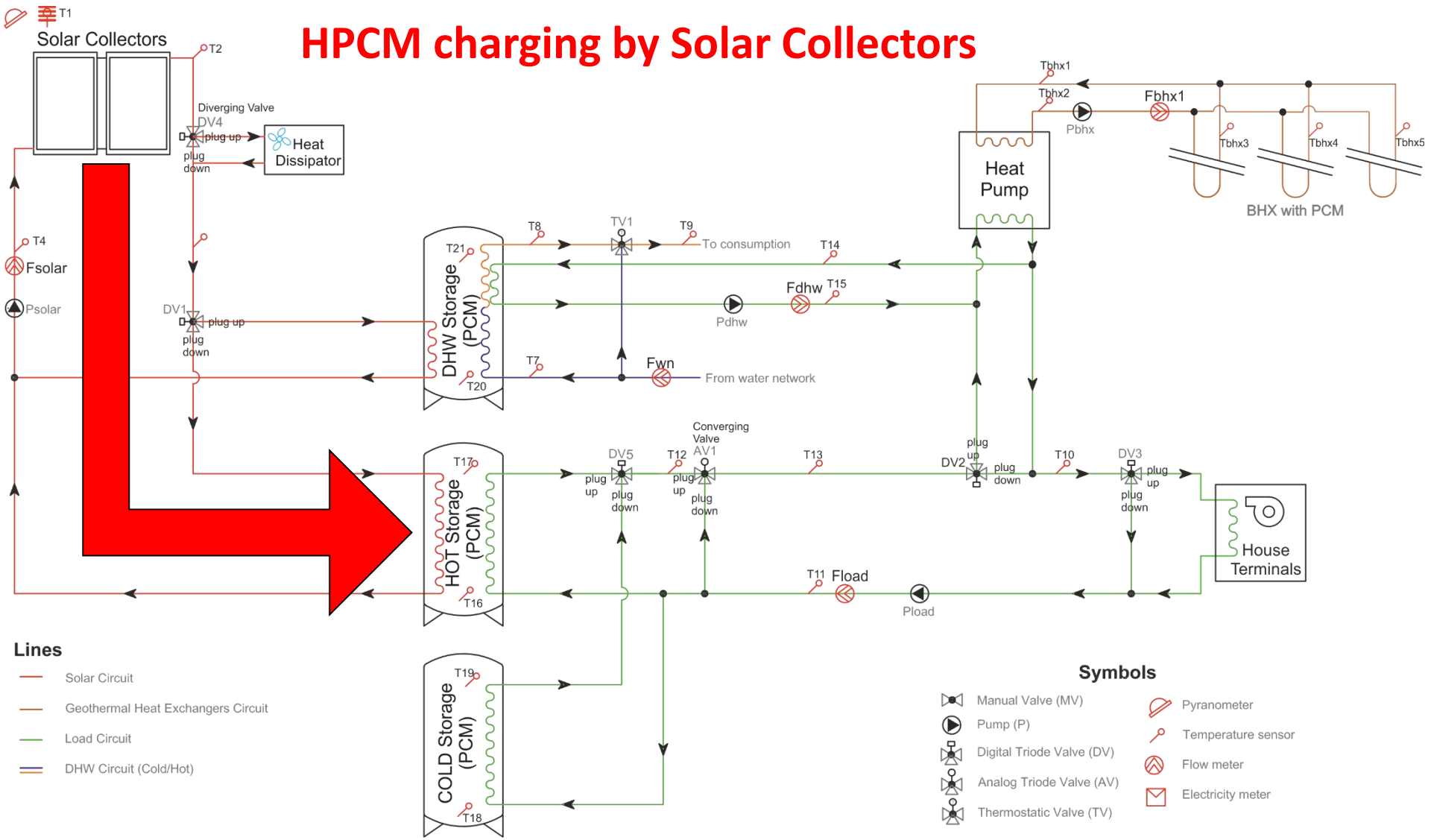
DHW-PCM charging by Solar Collectors



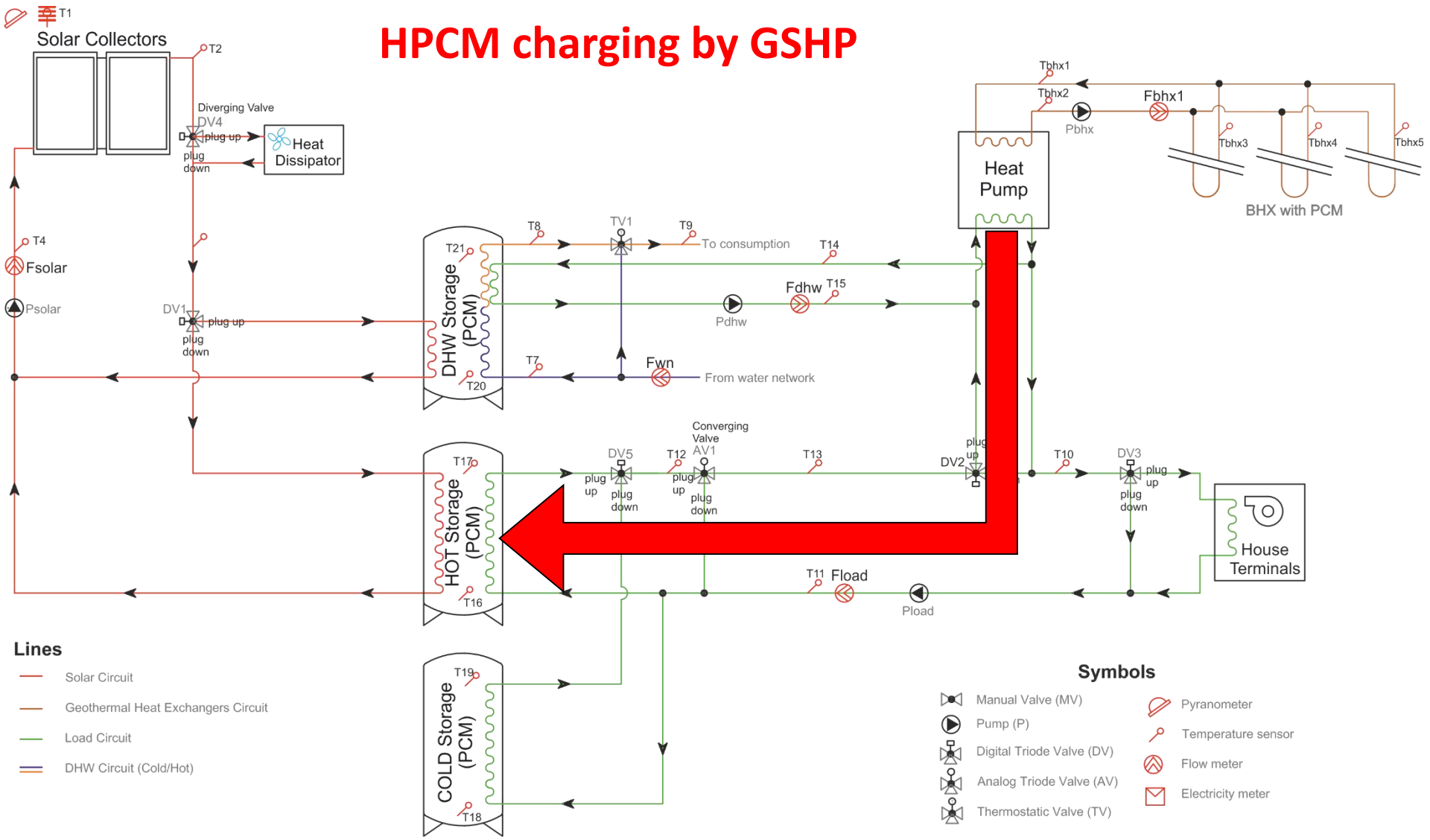
DHW-PCM charging by GSHP



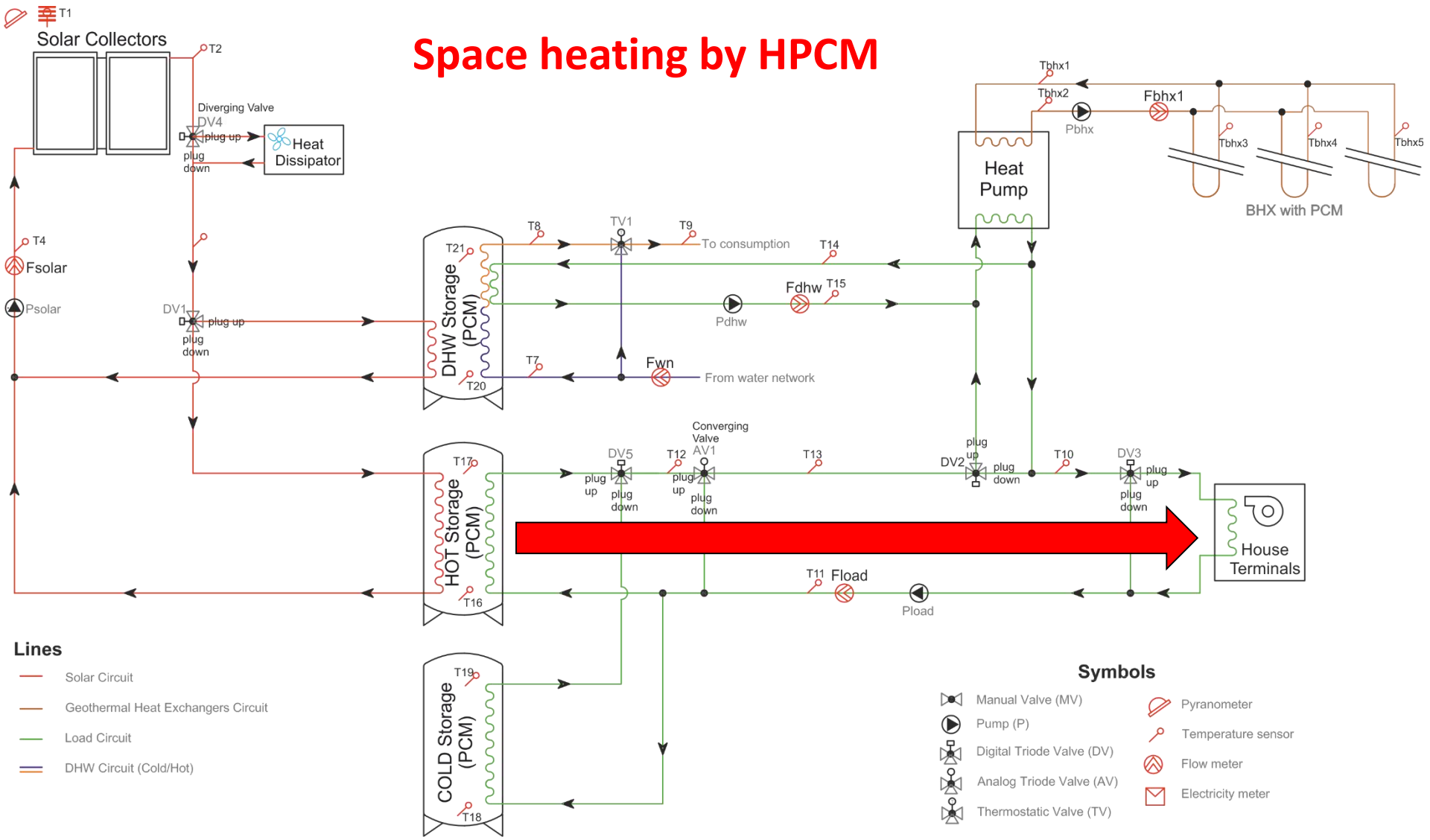
HPCM charging by Solar Collectors



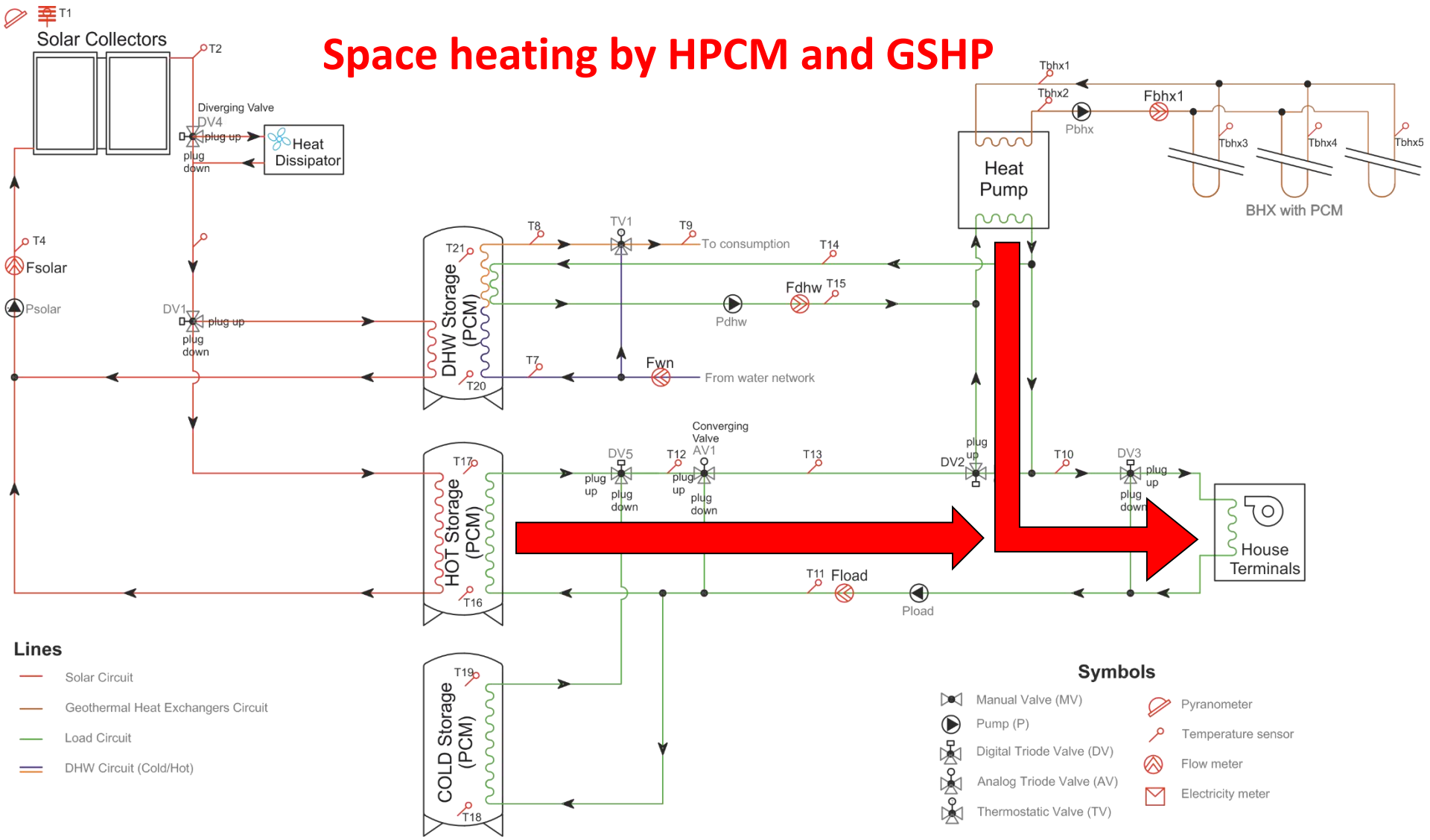
HPCM charging by GSHP



Space heating by HPCM



Space heating by HPCM and GSHP



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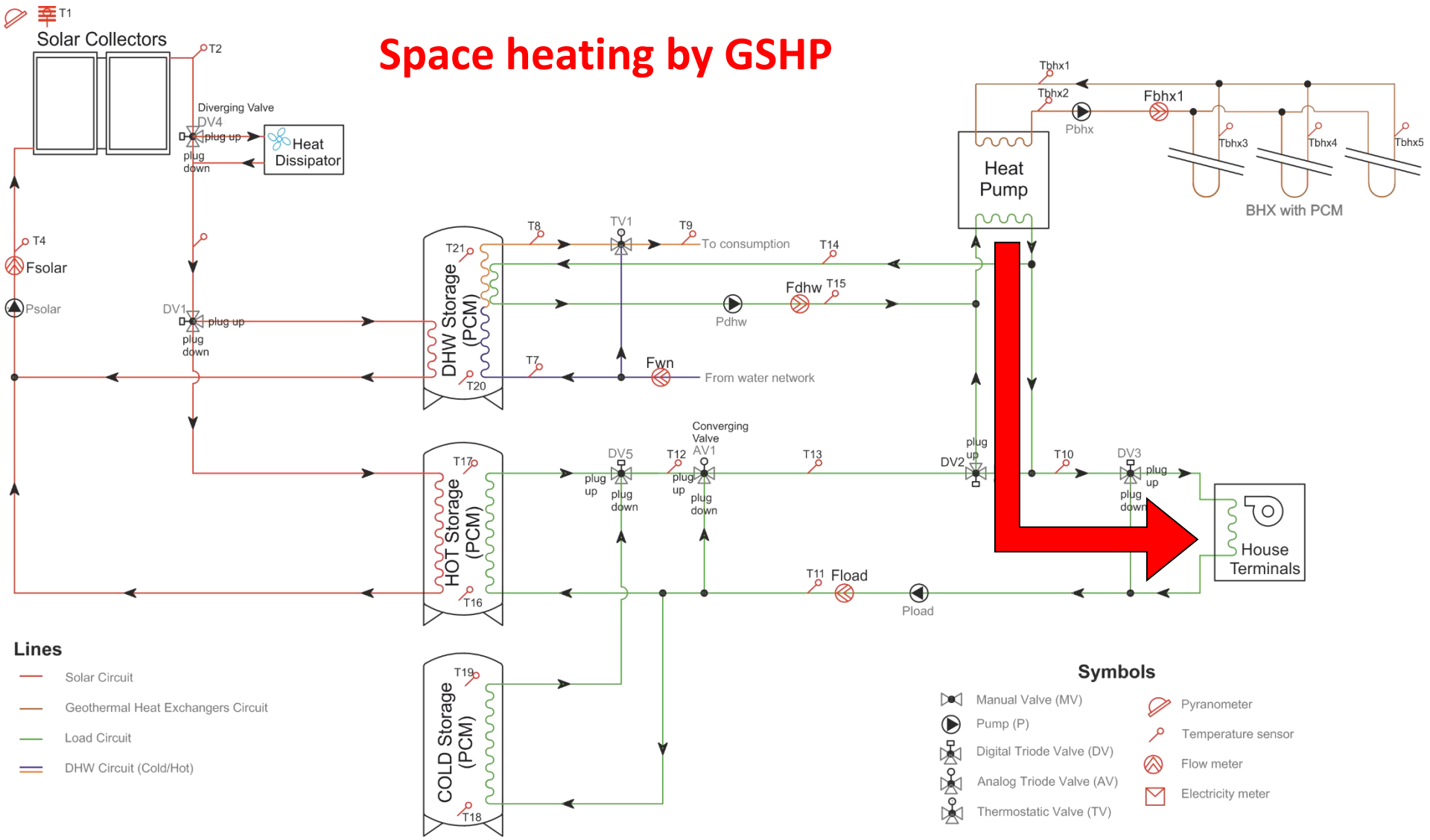
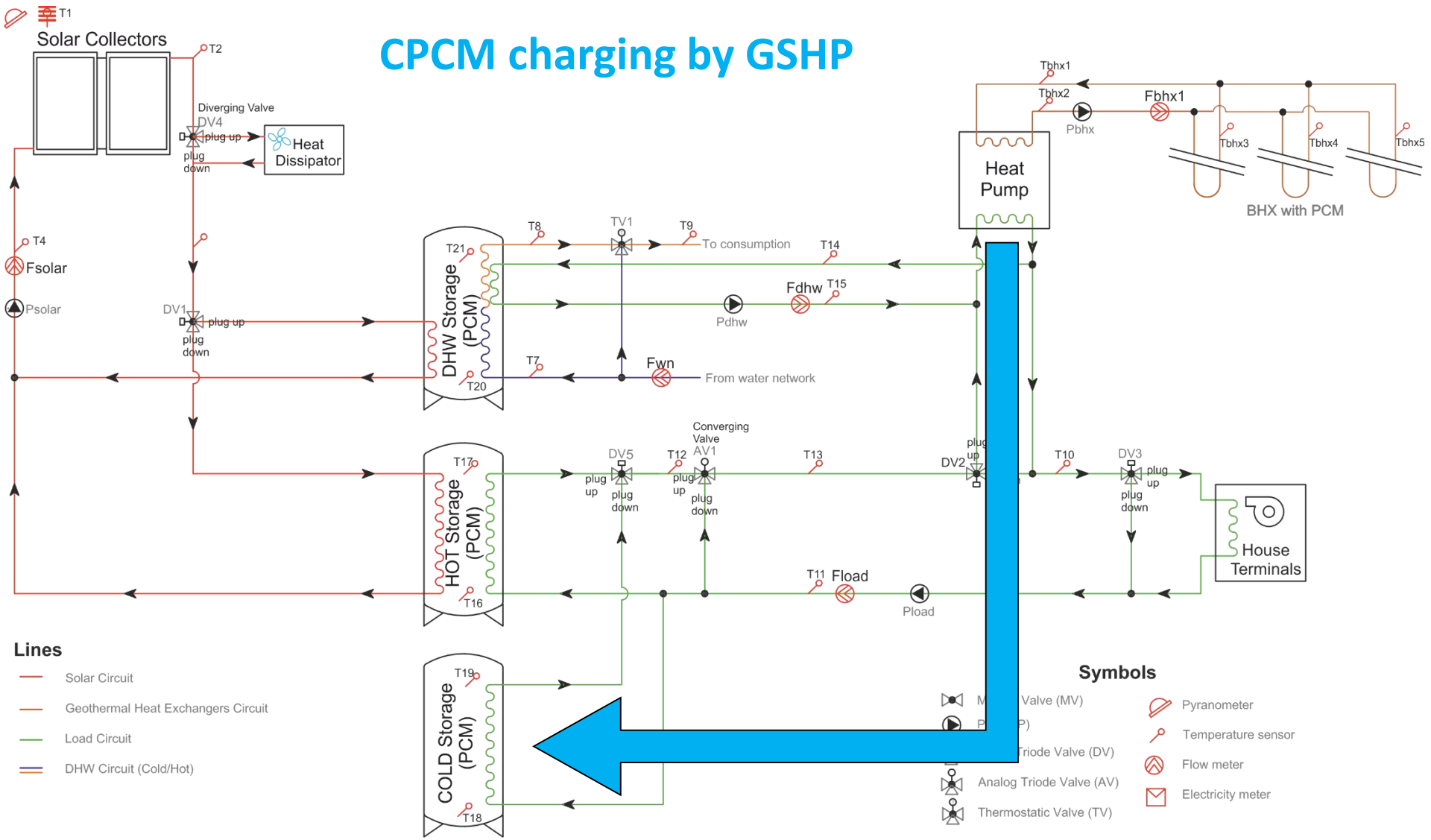
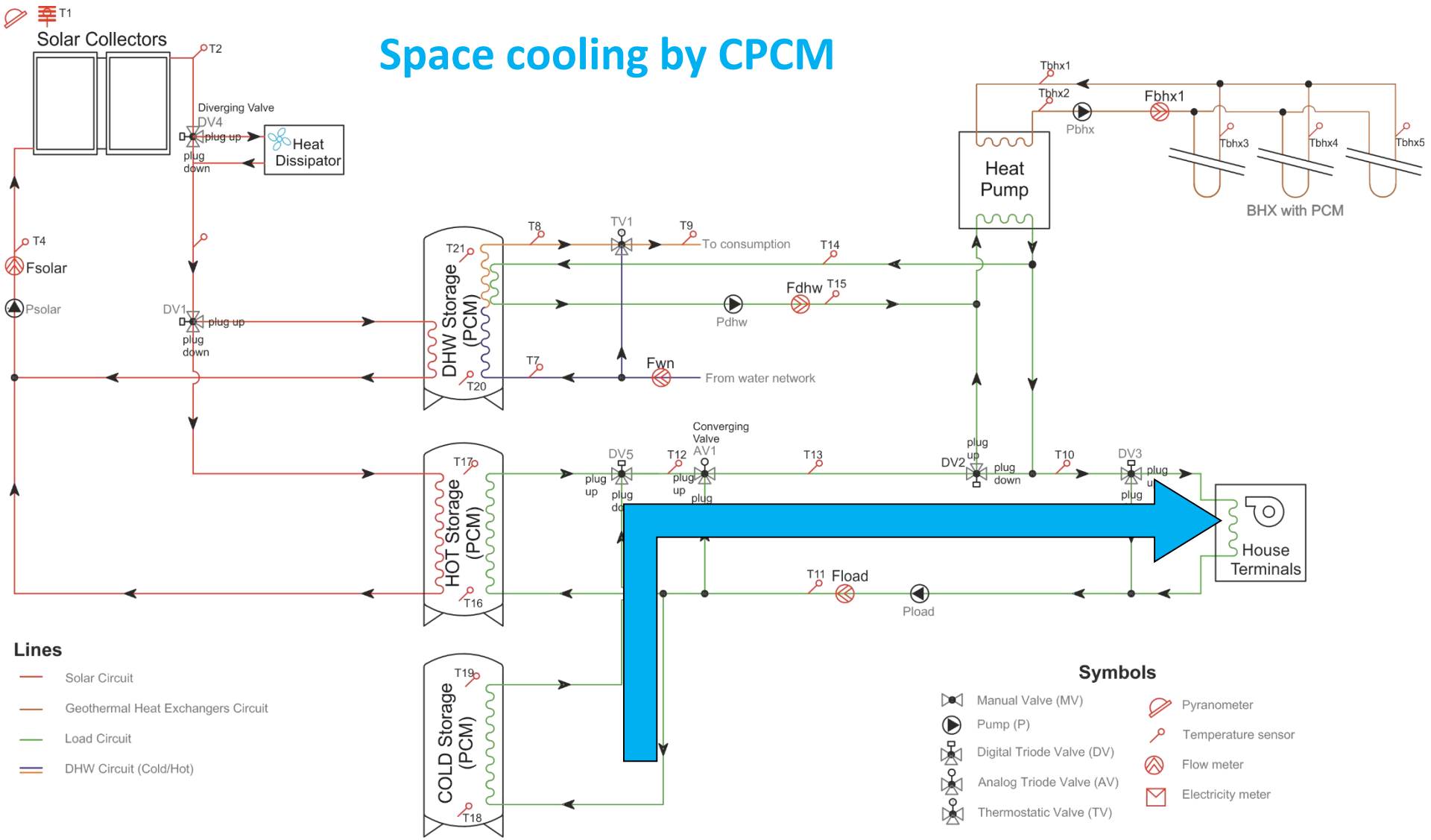
Space heating by GSHP



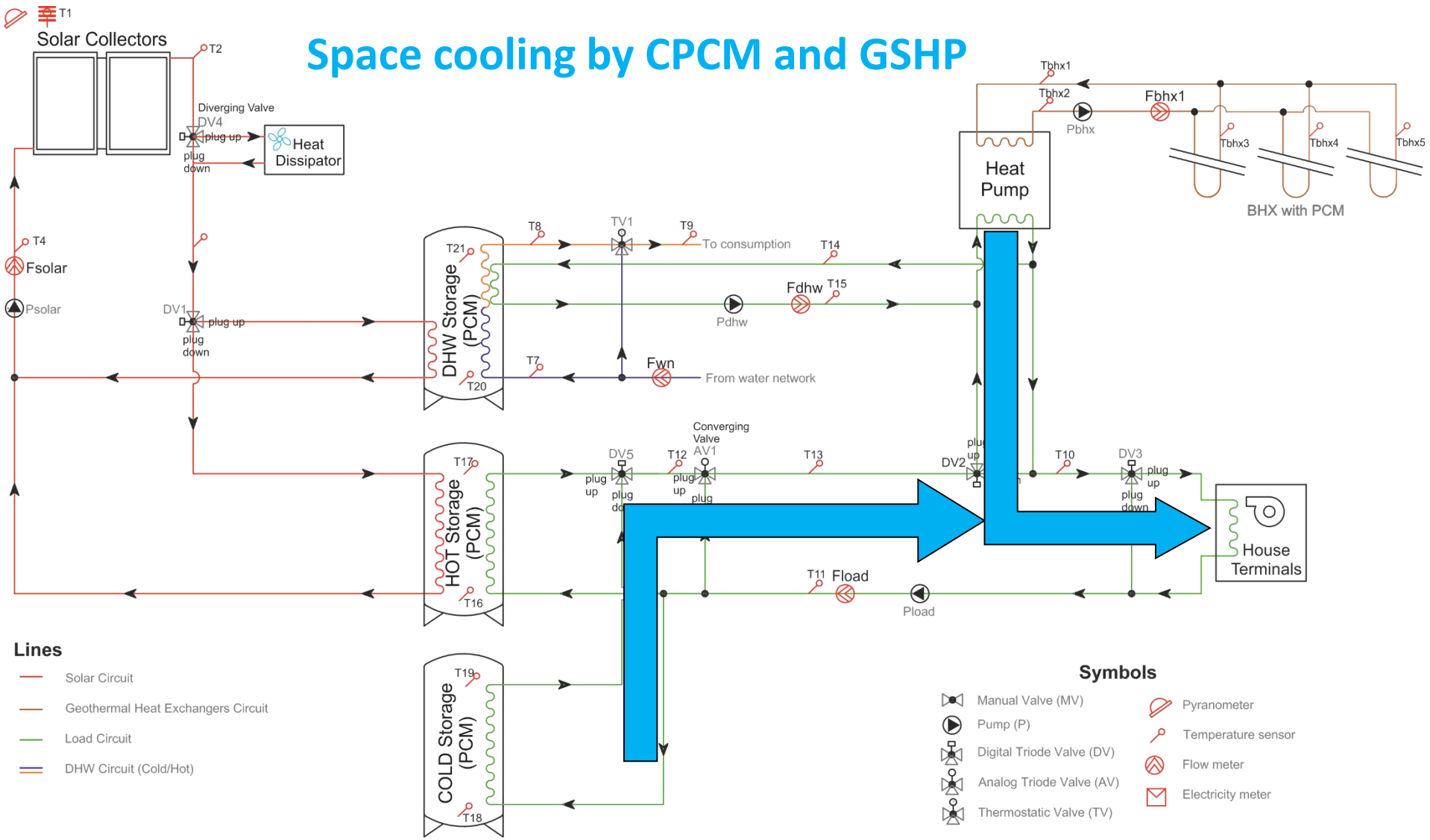
CPCM charging by GSHP



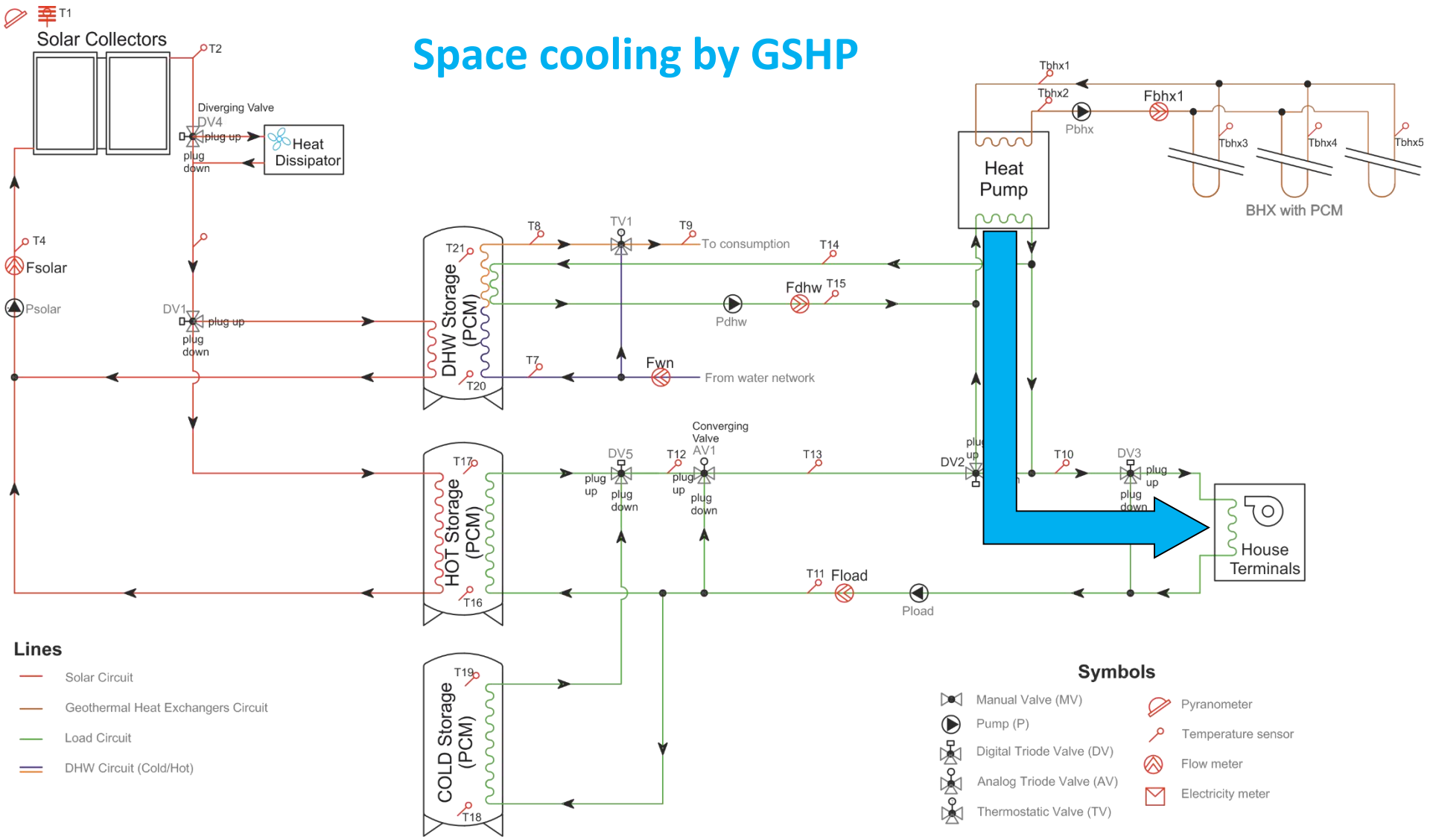
Space cooling by CPCM



Space cooling by CPCM and GSHP



Space cooling by GSHP



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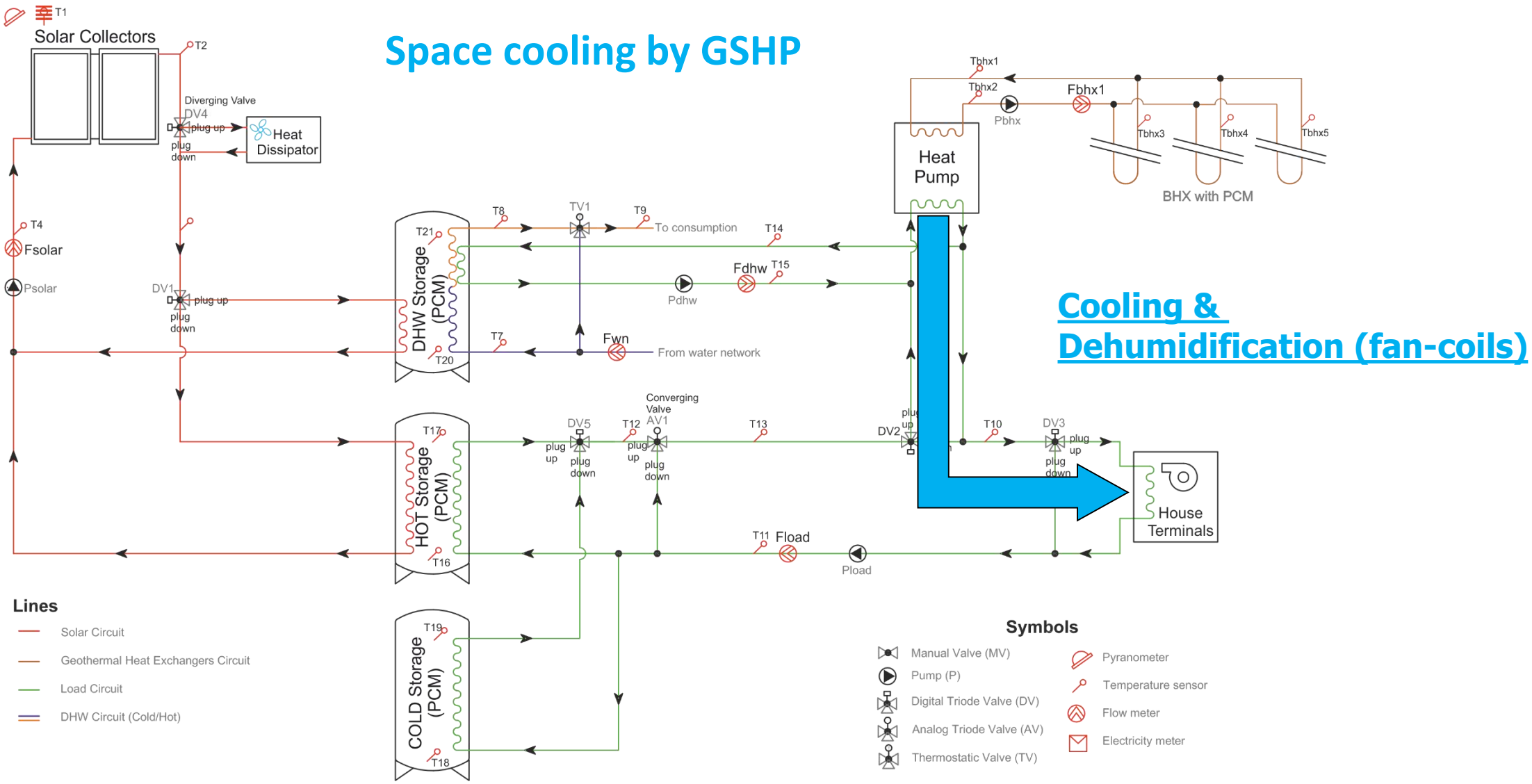
Space cooling by GSHP



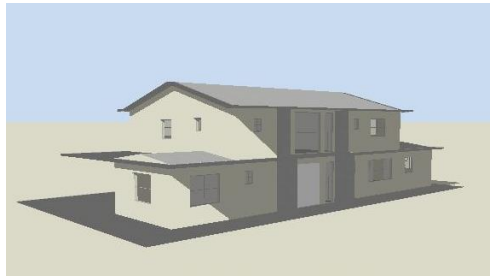
Cooling & Dehumidification (fan-coils)

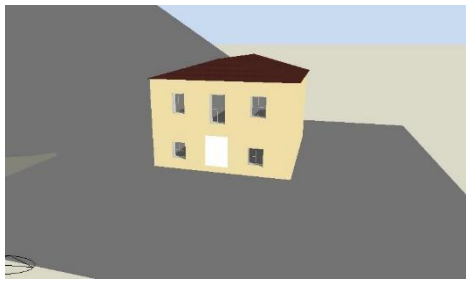
Main results from Energy Building Simulation for each demo site

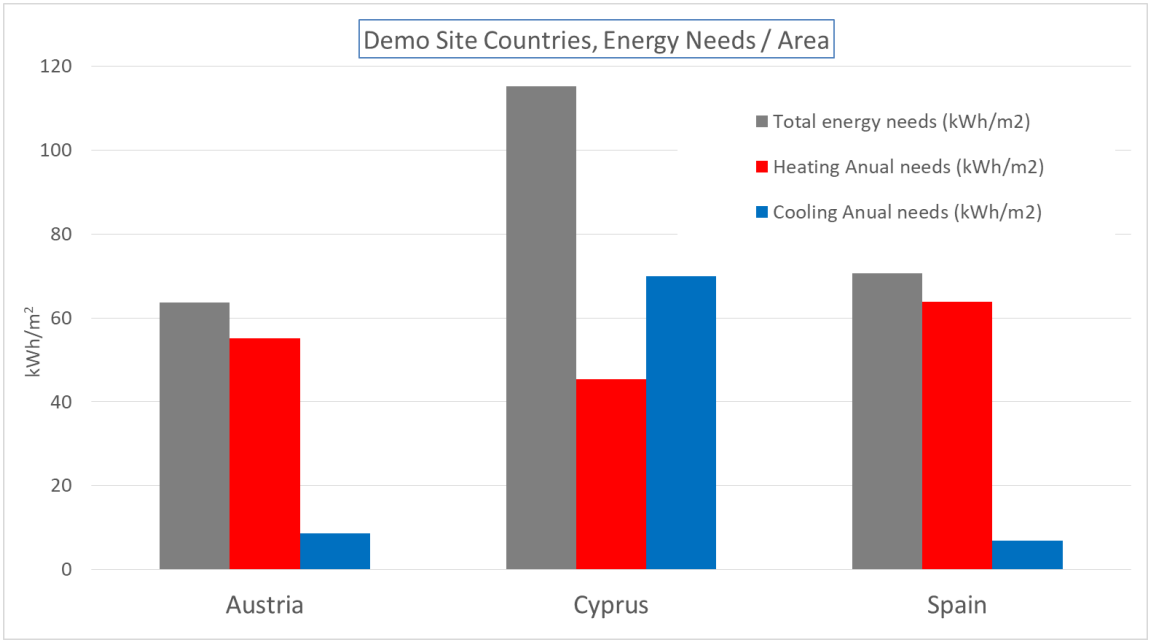
Demo Site	Area (m^2)	Heating Capacity (kW)	Cooling Capacity (kW)	Heating Anual needs (kWh)	Cooling Anual needs (kWh)	Heating Anual needs (kWh/m^2)	Cooling Anual needs (kWh/m^2)	Solar collectores #	Hot PCM tanks	Cold PCM tanks	DHW PCM tanks	Solar Fraction Heating	Increase of solar fraction due the PCM	Solar Fraction Heating + DHW	Heating needs shifted day to night (total - solar)	Cooling needs shifted day to night
Austria	321,1	14,39	4,67	17685,8	2784,0	55,08	8,67	**10,00**[a)]	**4**	*	**1**	11,8%	8,2%	20,9%	43,7%	*
Cyprus	220,7	17,03	18,56	10006,4	15431,0	45,34	69,92	**10,00**[b)]	**3**	**3**	**1**	30,5%	27,2%	42,3%	44,8%	30,3%
Spain	137,8	12,18	4,92	8802,0	944,0	63,88	6,85	**9,00**[b)]	**4**	**2**	**1**	33,5%	31%	47,0%	0,0%	95,3%

* free-cooling

[a)] Vacuum; [b)] Flat plate;





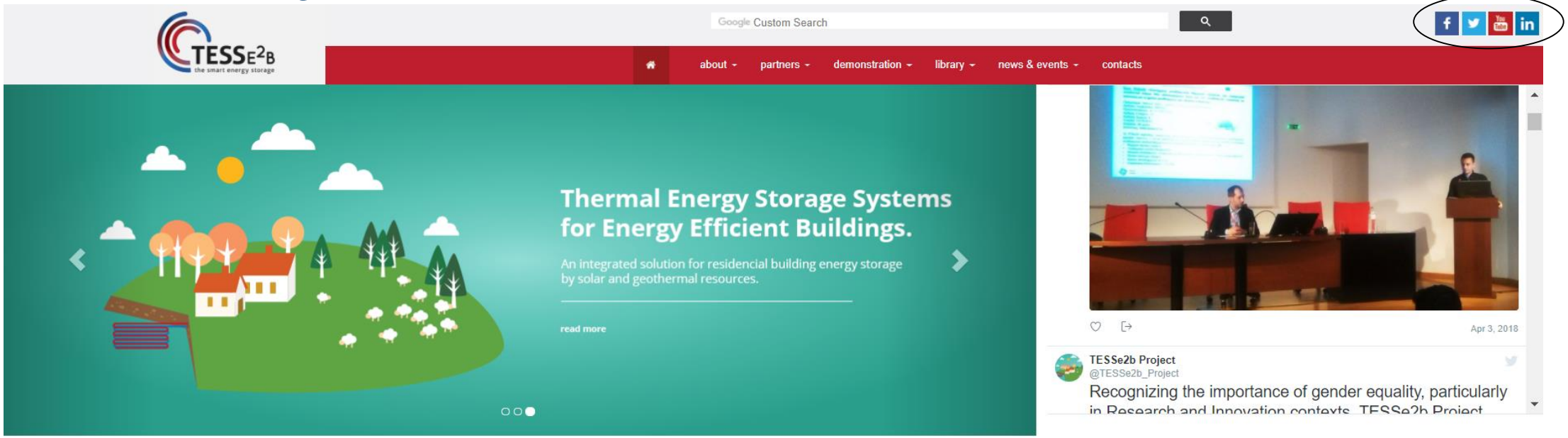


Conclusions

- Low temperature PCM TES are a performing solution for HVAC
- TESSe2b is achieving the expected impacts so far.
- New project results will be shown in EFINTEC - B2B meeting.
  - Save the date!
  - 3th and 4th October – Fira de Barcelona
  - www.efintec.es www.tesse2b.eu

EFINTEC
Exposición y Fórum
de las Empresas Instaladoras
y Nuevas Tecnologías

Website, Project Video and Social Media



www.tesse2b.eu

Presentation

TESSe2b Project - Thermal Energy Storage Systems for Energy Efficient Buildings is a EC financed H2020 four years project, that develops an integrated solution for residential building energy storage using **solar and geothermal energy**, with the purpose of correcting the mismatch that often occurs between the supply and the demand of energy in residential buildings.

That is achieved by integrating compact Thermal Energy Storage Tanks with **Phase Change Materials (PCM TES)** coupled with enhanced Phase Change Materials inside the borehole heat exchangers (BHEs), and using an **advanced energy management** smart self-learning control system.

A demonstration and on-site monitoring evaluation of small scale TESSe2b solution in buildings in three pilot sites (Austria, Spain, Cyprus) are being conducted in order to evaluate the system's integration into buildings space, to assess the impact of TESSe2b solution in different climates and to provide evidence about its overall technical and economic feasibility.

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Thank for your attention

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