EnTReC
ENERGY DAYS
2022

25 - 27 MAY 2022

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

Renewable Energy Solutions from SunHorizon H2020 project

SunHorizon

sunhorizon-project.eu

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Project Title: Sun coupled innovative Heat pumps

Project duration: 60 months (1st October 2018 – 30th September 2023)

Project value: 11.604.927 euro

Coordinator: RINA Consulting Spa

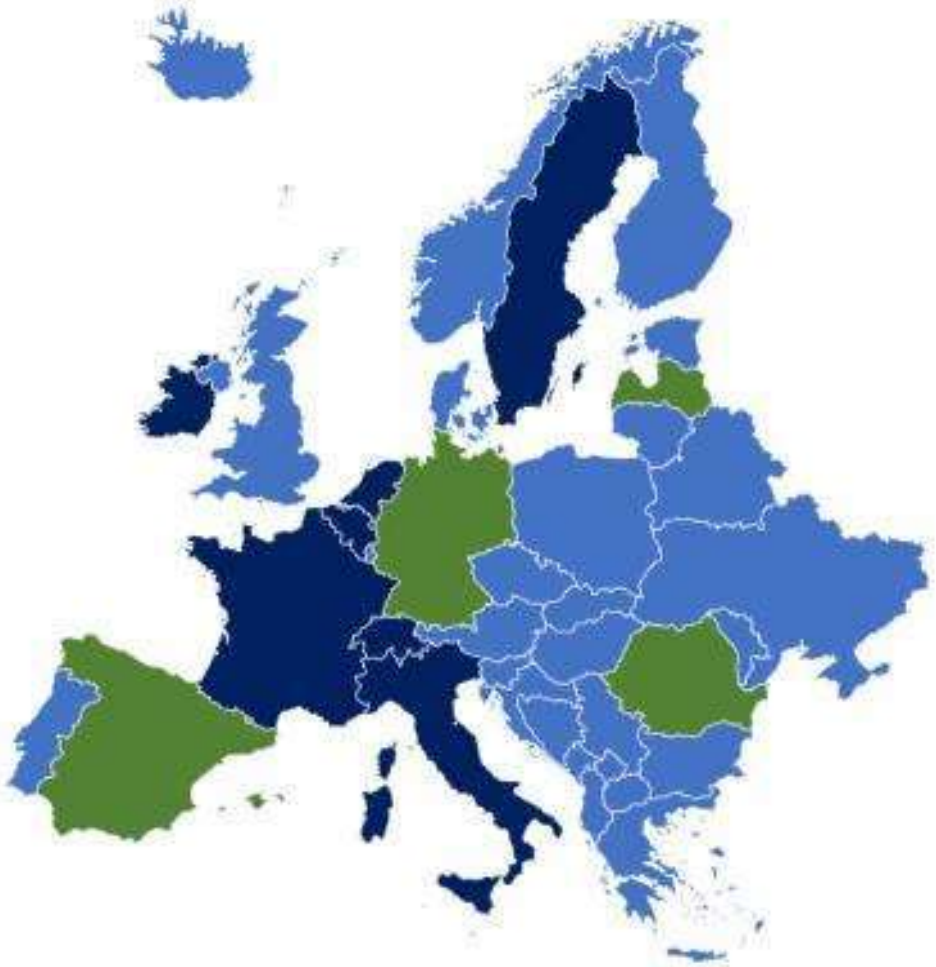
TUCN Role: Technology Demonstrator and Testing Pilot Site

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Project Consortium

- RINA Consulting Spa, Italy
- Commissariat a l'Energie Atomique et aux Energies Alternatives, France
- Schneider Electric Spa, Italy
- Boostheat, France
- Consiglio Nazionale delle Ricerche, Italy
- Fahrenheit Gmbh, Germany
- Fundacion Cartif, Spain
- IES R&D, Ireland
- IVL Svenska Miljoeinstitutet AB, Sweden
- European Heat Pump Association, Belgium
- TVP Solar SA, Switzerland
- Dualsun, France
- Checkwatt, Sweden
- Ajuntamiento de Sant Cugat del Valles, Spain
- BDR Thermea Group BV, Netherlands
- Ratiotherm Heizung + Solartechnik Gmbh & Co. KG, Germany
- Rigas Tehniska Universitate, Latvia
- Empresa Municipal de la Vivienda y Suelo de Madrid SA, Spain
- Veolia Serveis Catalunya Sociedad Anonima Unipersonal, Spain
- Universitatea Tehnica din Cluj-Napoca, Romania

20 partners from 11 countries



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Project Objectives

- To demonstrate innovative and reliable Heat Pump solutions (thermal compression, adsorption, reversible) that acting properly coupled and managed with advanced solar panels (PV, Hybrid, thermal) can provide heating and cooling to residential and tertiary building with lower emissions, energy bills and fossil fuel dependency.

Integrated Solar and Heat Pump technology packages

Scientific and Technical Objectives:

- *Increase SunHorizon H&C technologies performances.*
- *Promote cloud based functional monitoring for H&C purposes.*
- *Reduce SunHorizon H&C technologies CAPEX and OPEX*
- *Demonstration in different EU countries and type of buildings*

Non-Technical Objectives:

- *Promote the replication of SunHorizon Concept.*
- *Dissemination and Capacity Building.*

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SunHorizon Technologies

High Vacuum Flat Solar Panels (TVP)

Technology provider: TVP SOLAR

https://www.tvpsolar.com

Existing Technology:

The TVP solar panels were designed and manufactured to produce hot water/steam at 80°C – 180°C for industrial-scale solar thermal applications exhibiting energy conversion efficiencies up to 65% and 45% respectively.

SunHorizon Innovation:

- Define the LT-power technology, with target temperature below 100 °C, for residential and tertiary building applications.
- Selection of Balance of System components rated at 100 °C.
- Elaboration of a new, simplified layout of the solar system.
- Safety improvements, reduction of stagnation temperature.

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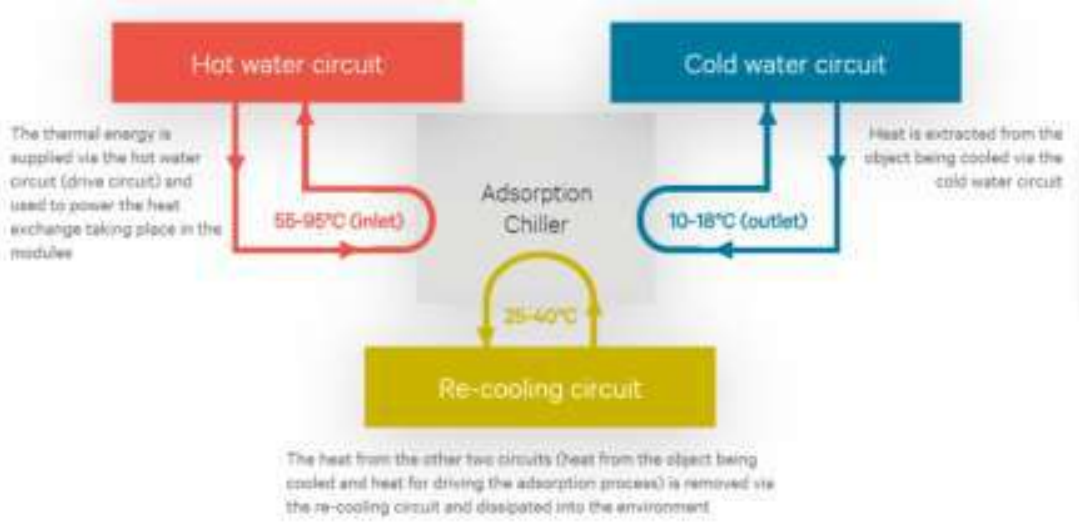
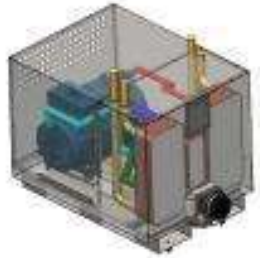
SunHorizon Technologies

Absorption Chiller (FAHR)



Technology provider: FAHRENHEIT



https://fahrenheit.cool/en/

Existing Technology:

The adsorption chillers from Fahrenheit utilize low-temperature heat (70-95 °C), for example from solar collectors, combined heat and power plants (CHP), district or process heat, in order to generate cold in an environmentally friendly and cost-effective way.

SunHorizon Innovation:

- New vacuum brazed heat exchangers are introduced with a considerably larger surface area and new coating technique.
- Process modules are arranged horizontally, such layout eliminates the “false condensation” completely, since the condensate flows always to the bottom of the module.
- The R134a has been replaced by the natural refrigerant R290 which has a global warming potential of 3 instead of 1430 for R134a.

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SunHorizon Technologies

Heat Booster Module (BH)

Technology provider: boostHEAT

https://www.boostheat-group.com/en/

Existing Technology:

The BOOSTHEAT.20 uses a new type of thermally-activated compressor. The thermally driven heat pump exploits a natural refrigerant, CO2, to "pump" low-grade heat from the outside air into the house, achieving extremely high efficiencies compared to other gas-driven heating technologies, like gas boilers.

SunHorizon Innovation:

- Integration of the Evohome (Honeywell) thermostat allows simpler regulation and lower energy costs.
- Redesigned user interface (HMI) to allow, among other things, easier management with solar integration.
- Full access to the heating control, user can configure customized heating profiles according to the needs.

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SunHorizon Technologies

Hybrid Solar Thermal & PV Panels (DS)

Technology provider: DUALSUN

https://dualsun.com/en/

Existing Technology:

A standard photovoltaic panel only generates 20% of electricity during operation; the remaining 80% is mostly heat. Hybrid DualSun PVT solar allows a real synergy between photovoltaic and thermal, producing up to 3 times more energy than a traditional photovoltaic panel.

SunHorizon Innovation:

- Simplified hydraulic connection to reduce cost and installation time and to make technology accessible to nonspecialist installers.
- Redesign the heat exchanger to be compatible with more PV modules and lighter the module: a thinner heat exchanger was developed.
- Improvement of the PV integration (15% more efficient in electricity) and efficiency increase in the heat exchange between the fluid and the panel.

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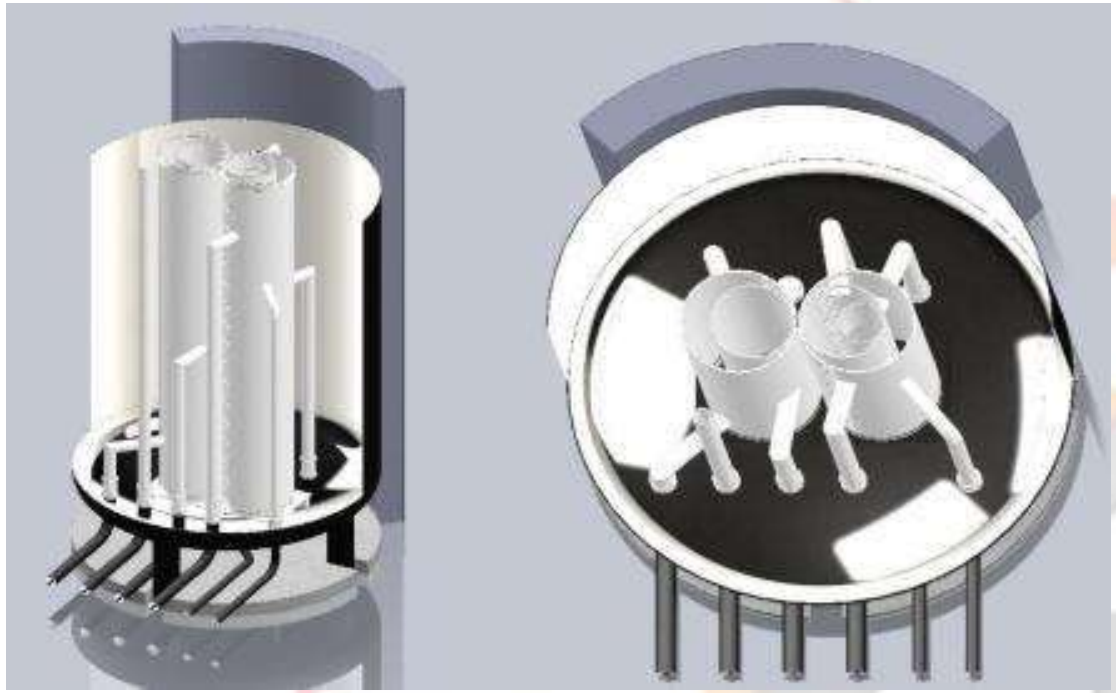
SunHorizon Technologies

Thermal Storage Units



Technology provider: ratiotherm

https://ratiotherm-systems.com

Existing Technology:

The main concept of the Ratiotherm thermal storage is to maintain a satisfactory stratification within the storage tank using preselected connections and physical stratification due to fluid density. This allows an enhanced charging and discharging while the heat carrier is ascending and descending within the distributor, prior entering the storage.

SunHorizon Innovation:

- Improve the internal distributor in order to manage the different source and sinks connected to the storage and their thermal requirement.
- Modified distributor from a one-chamber-system to two circular chambers and a larger pipe diameter (DN40), thus a higher flow rate does not destroy the thermal stratification.

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SunHorizon Technologies

Heat Pump Units (BRD)

Technology provider: BDR THERMEA GROUP

https://www.bdrthermeagroup.com

Existing Technology:

The BDR Thermea group produces a wide range of heat pumps for most of the residential and tertiary requirements:

- Monobloc Water to Water
- Monobloc Air to Water
- Monobloc Air to DHW
- Split Air to Water
- Split Air to Air
- Split Air to DHW

SunHorizon Innovation:

- Optimize the self-consumption of electricity produced at building scale, by optimizing the operation of the heat pump as power-to-heat converter.
- Integrated hybrid configuration, using heat pumps and gas boilers, if the COP is below the cost ratio between electricity and gas the heat pump.
- Optimized BDR control to use exceeding electricity produced by PVs to store it as thermal energy in water tanks for heating, DHW or cooling.

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Testing Scenarios

SunHorizon Technology Package		Solar – Heat Pump Integration Concept	Description
TP1	TVP+BH	Parallel integration	TVP for space heating + DHW; BH to cover non solar periods
TP2	DS+BH	Mixed solar-assisted/ parallel integration	BH for space heating + DHW support; DS PV-T thermal output to cover as much heat demand as possible + excess electricity production for appliances
TP3	TVP+FAHR	Solar-driven HP for cooling	TVP for space heating + DHW in winter + activation of the thermal compressor of the adsorption chiller (FAHR)
TP4	DS+BDR	Parallel integration	DS PV-T thermal output to cover part of SH and DHW heat demand + electricity production to cover reversible HP electricity consumption
TP5	TVP+BH+FAHR	Mixed solar-driven/ parallel integration	TVP for space heating + DHW; BH to cover non solar periods; FAHR adsorption chiller activated only by BH or also by TVP

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Pilot Sites

Small Residential (TP1)

Berlin Germany

Multifamily Residential (TP2)

Nurnberg Germany

Tertiary Civic Center (TP3)

Saint Cugat del Valles Spain

Large Social Housing (TP4)

Madrid Spain

Small Residential (TP4)

San Lorenzo de Hortons Spain

Small Residential (TP2)

Riga Latvia

Spor Cent (TP

Vervi Belgi

Marasti Campus (TP1)

Cluj-Napoca Romania

ming
ool
P2)

viers
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Romanian Pilot Site

Location: Mărăști Campus of the Technical University of Cluj-Napoca

Student's dormitories

Thermal plant – boiler house

Campus Restaurant

- Around 1850 students.
- Used all year long;
- BEMS to monitor electricity use;

Energy consumption:

- 3397 MWh/year natural gas (DHW and heating);
- 745 MWh/year electricity;

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Implemented Technology Package

Technology Package: TP1, Parallel integration:

New: Solar thermal system: 220 m^2; 150 kW; up to 175 MWh/ year (80 °C)

New: Thermal compression heat pump (Boostheat) 40 kW

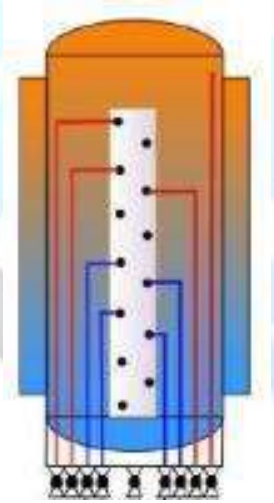
New: Storage tank (Ratiotherm Smart Energy Systems): 10,000 l

Type of building:

Residential building (1977; envelope insulation);

Available roof: 1150m^2 in the restaurant next to dormitory; close to boiler house)

Existing: Gas boilers and DHW tanks



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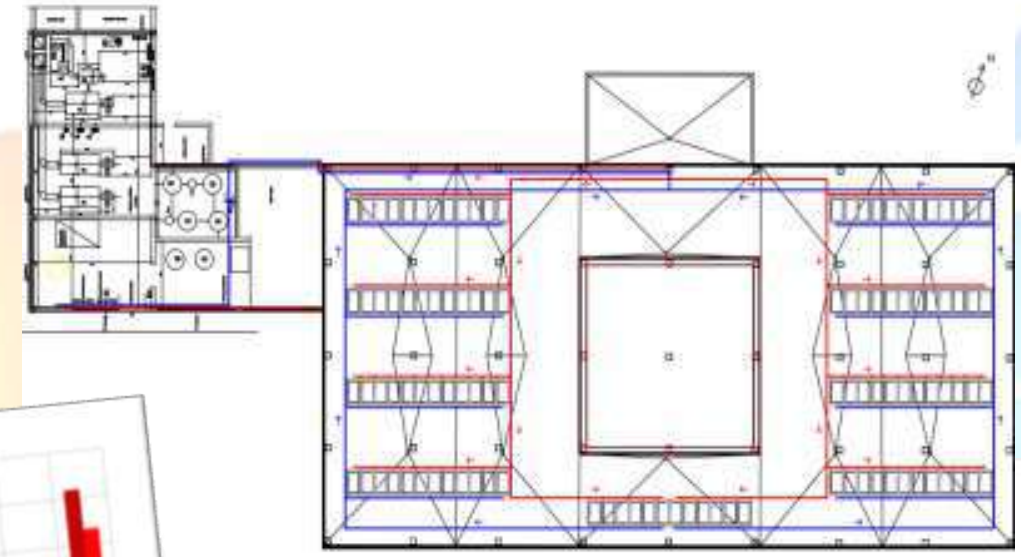
Technical Solution

- Installation of the solar system on the roof of the restaurant 48 x 24 m2
- Installation of the HP and of the storage tank inside the boiler house



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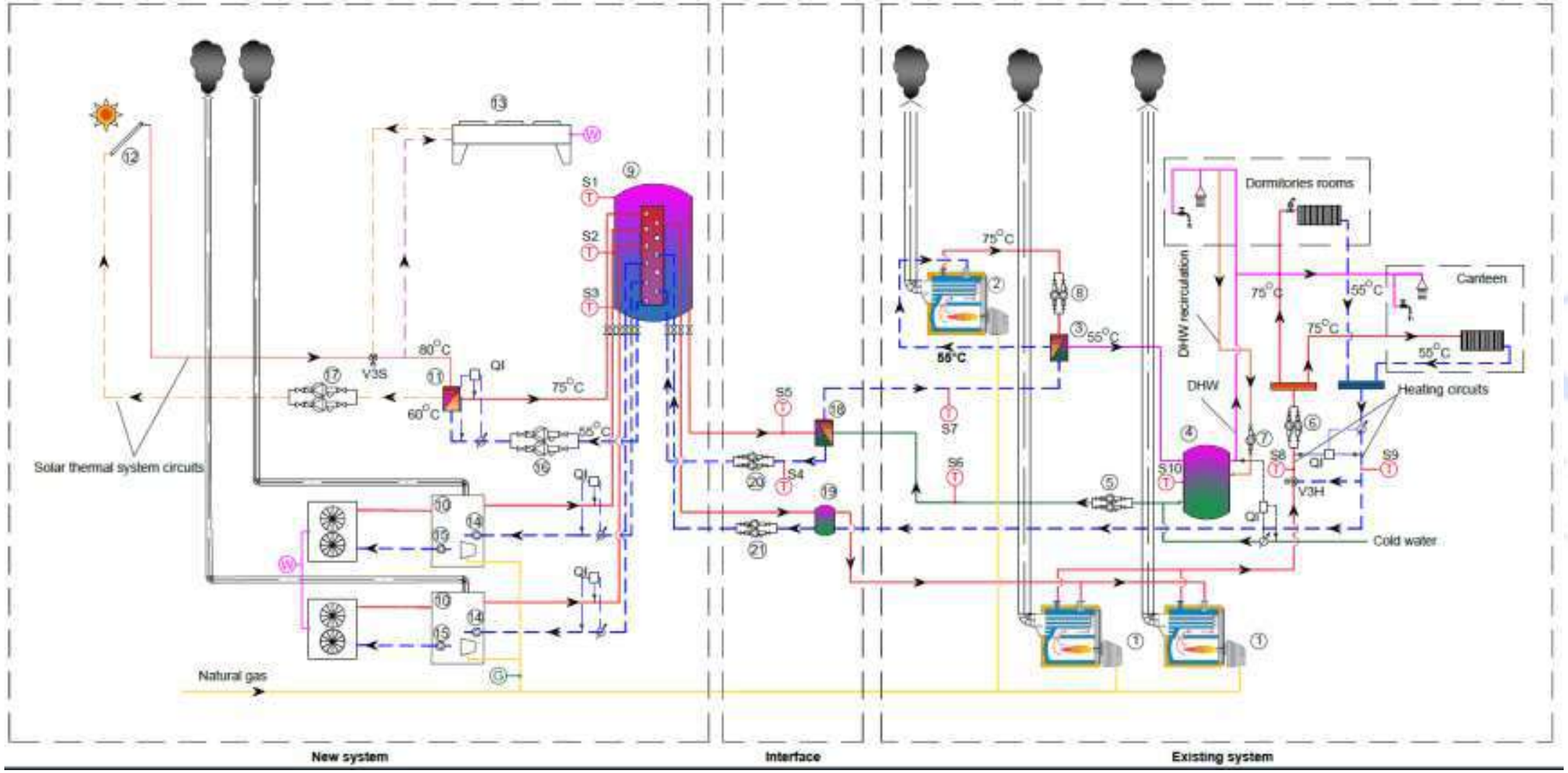
Concept of the Ingrated Heating System



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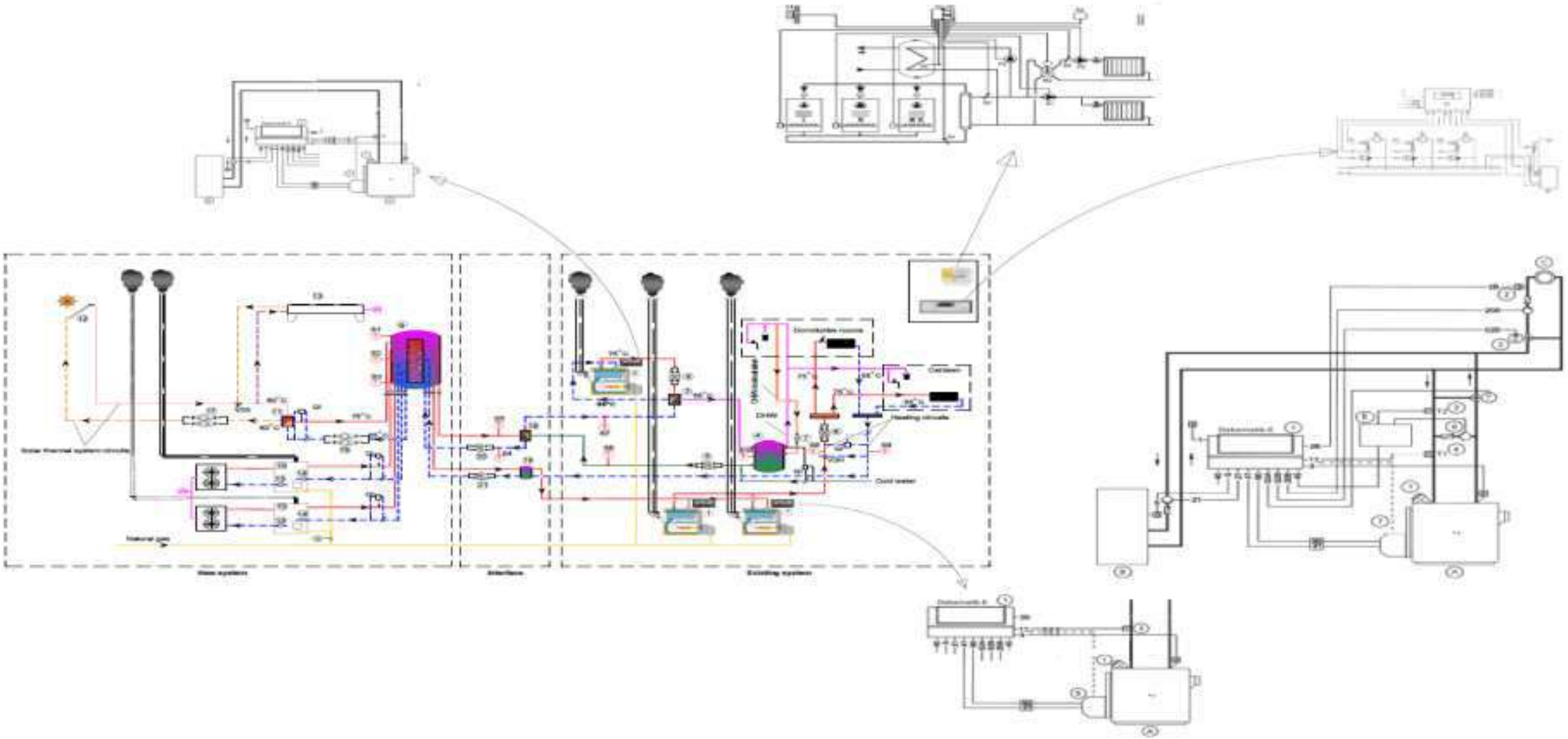
Control System Preliminary Concept



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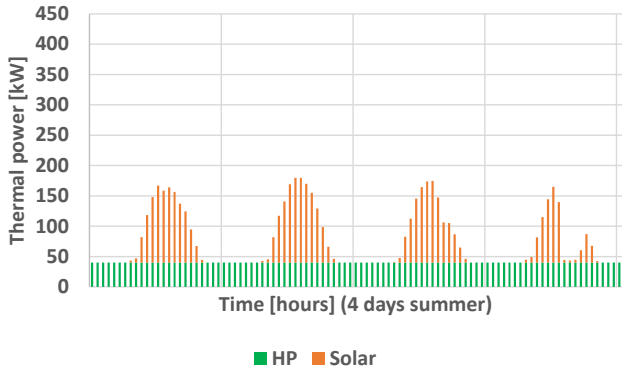
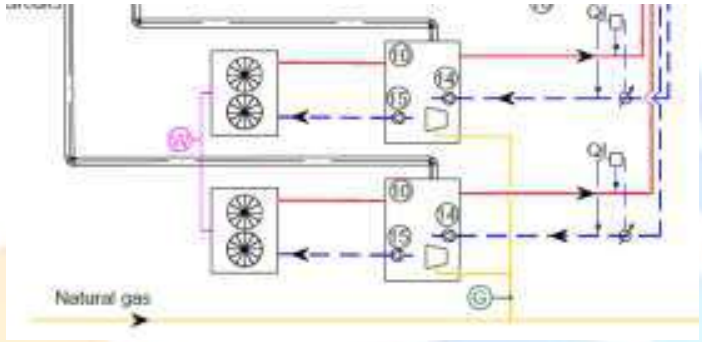
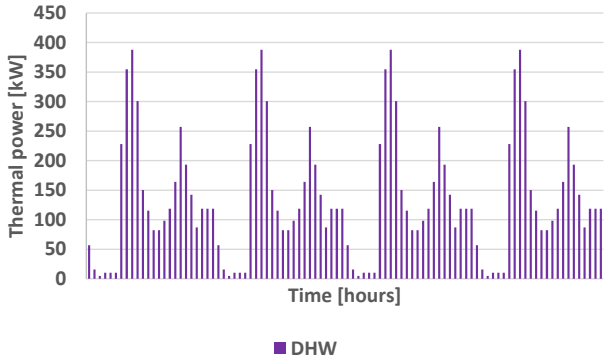
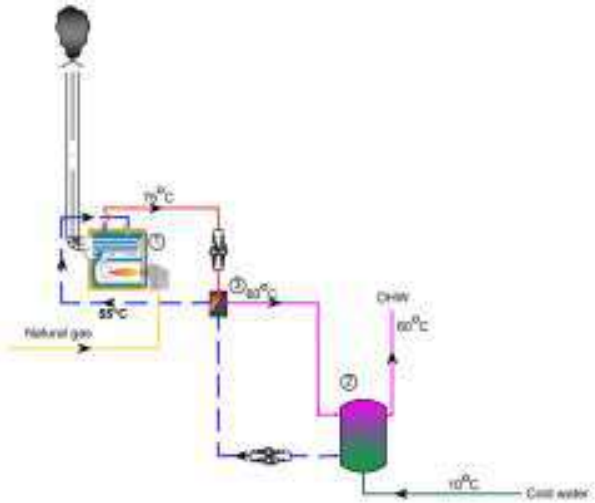
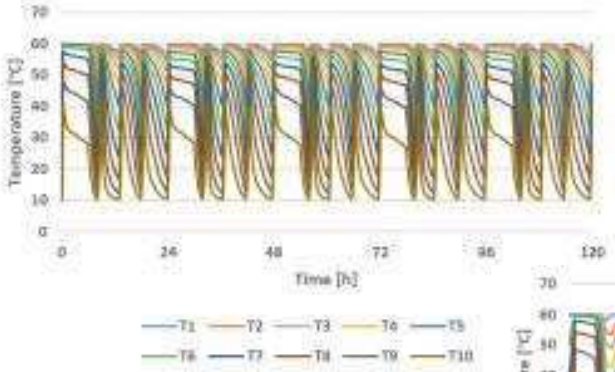
Simuations (Solar Potential + BHP + DHW)

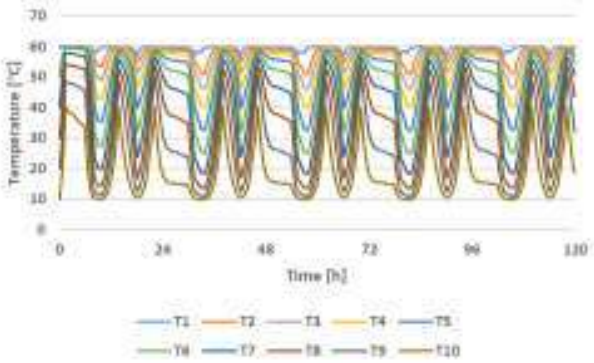


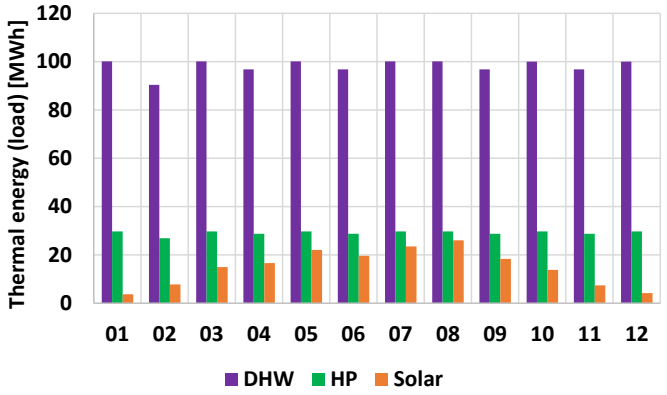












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!Thank you for your Attention!

Q & A

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