MISSION INNOVATION HEATING AND COOLING - SORPTION HEAT PUMP SYSTEMS

Kick-Off meeting (Microsoft Teams)

Tuesday 30th June 2020
3pm BST – 4pm BST

Dr. Eng. Salvatore Vasta, PhD.
Research Engineer
Head of Thermally Driven Heat Pumps and Thermal Storage Research Group

Consiglio **N**azionale delle **R**icerche (CNR)
Istituto di **T**ecnologie **A**vanzate per l'**E**nergia "Nicola Giordano" (ITAE)
Via Salita S. Lucia sopra Contesse n. 5
98126, Messina, ITALY

P: +39.090.624.404 – M: +39.338.212.4147 - F: +39.090.624.247
Skype: salvo-vasta
W: www.itae.cnr.it - E: salvatore.vasta@itae.cnr.it

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Salvatore VASTA – salvatore.vasta@itae.cnr.it

ITAE + IVECO TORINO

STRALIS 520

- ✓ Automotive competitions
- ✓ «Friction» reduction
- ✓ Possible different installation

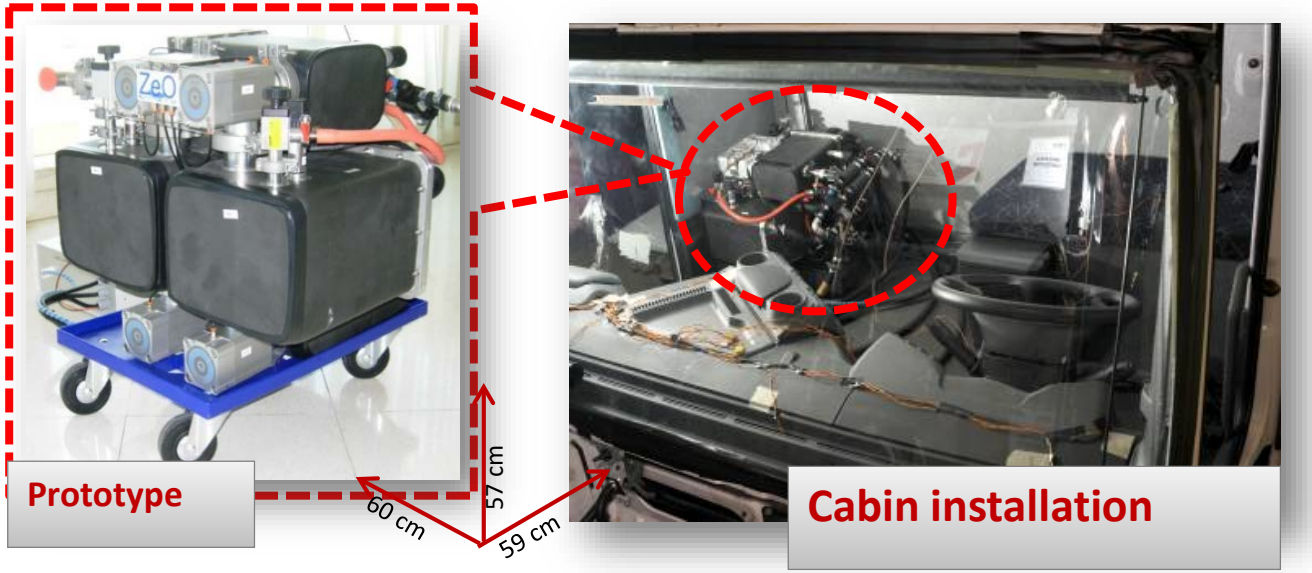
Overall volume	150 L
Overall weight	59 kg
Chilling capacity	2,3 kW
Min, air temperature	9 °C
COP	0,2
Regeneration temp.	80 °C
Adsorbent	Zeolite

SIXTH FRAMEWORK PROGRAMME

Thermally OPerated Mobile Air Conditioning Systems

Thermally OPerated Mobile Air Conditioning Systems

- SCP: up to 600 W/kg
- Very competitive weight considering commercial products!
- Volume density higher than 10kW/m³!



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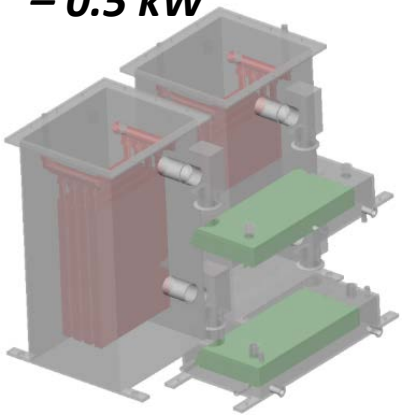
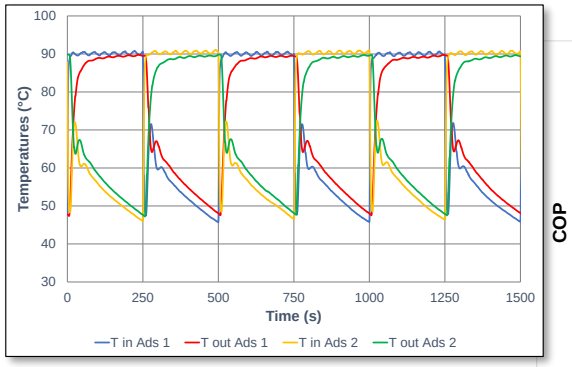
Activity

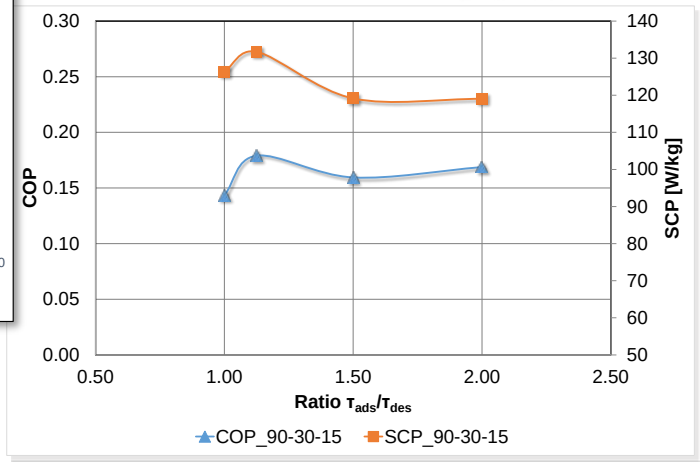
Development of sorption technologies for the waste heat exploitation on-board for cooling and refrigeration production.

Adsorption refrigerator activated carbon/EtOH – 0.5 kW

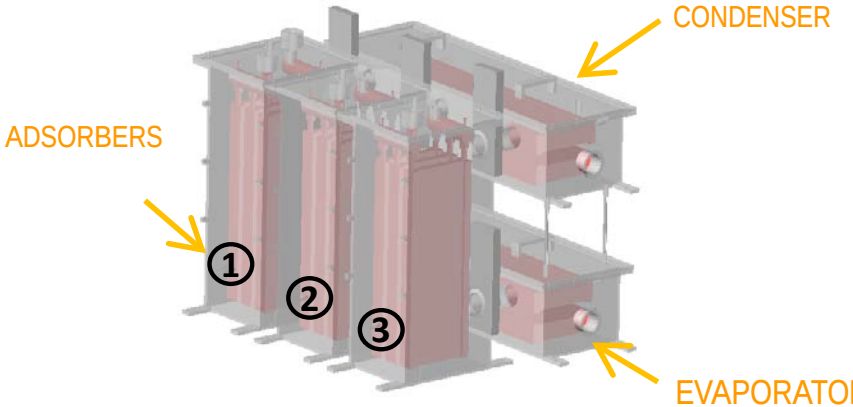


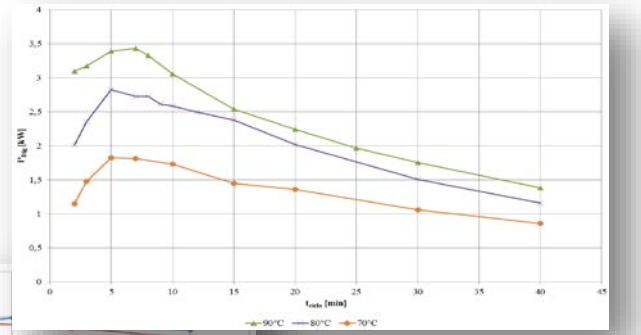
3D model

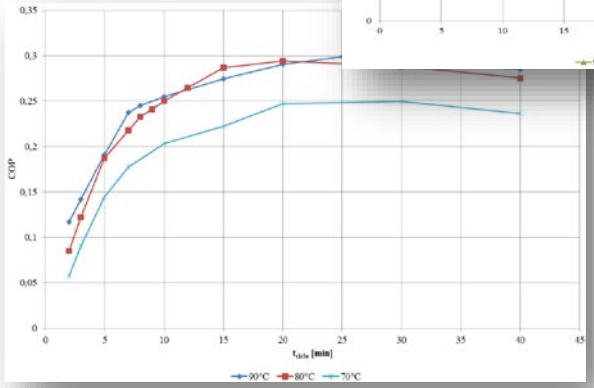




Adsorption Chiller water/AQSOA Z02-silica gel – 4 kW







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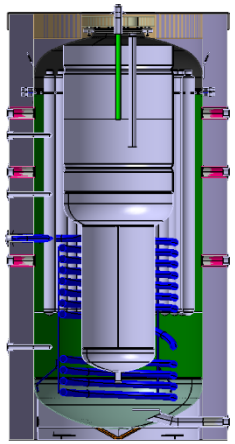
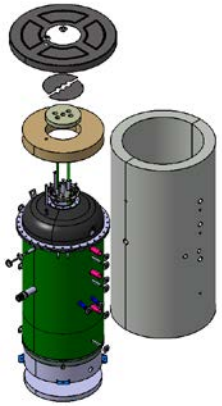
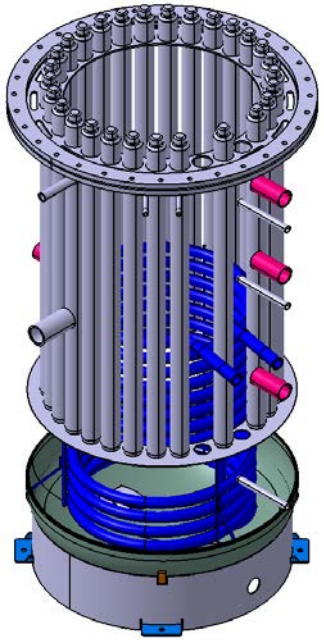
Latent Thermal Storage Tank-in-Tank

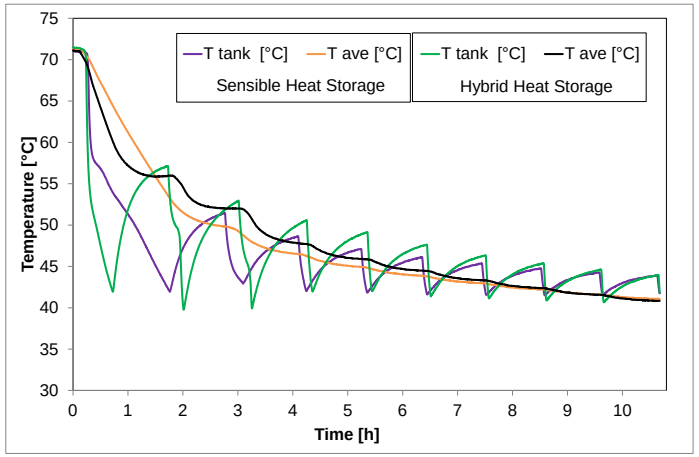
PLACE

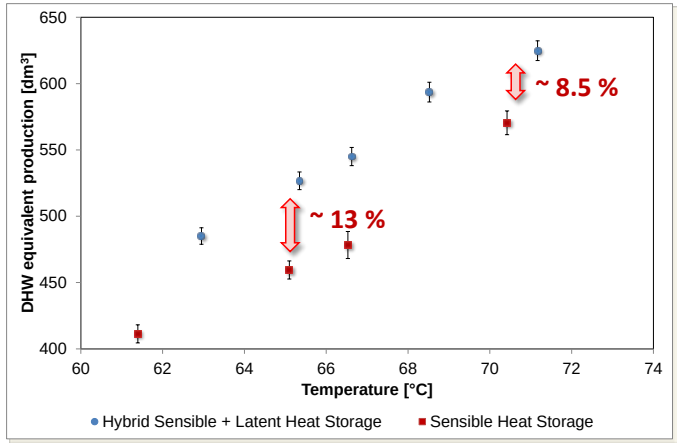
INDUSTRIA 2015











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Solar cooling from solar concentrating for industrial applications

Systema SYBCT23 (Broad BCT23)

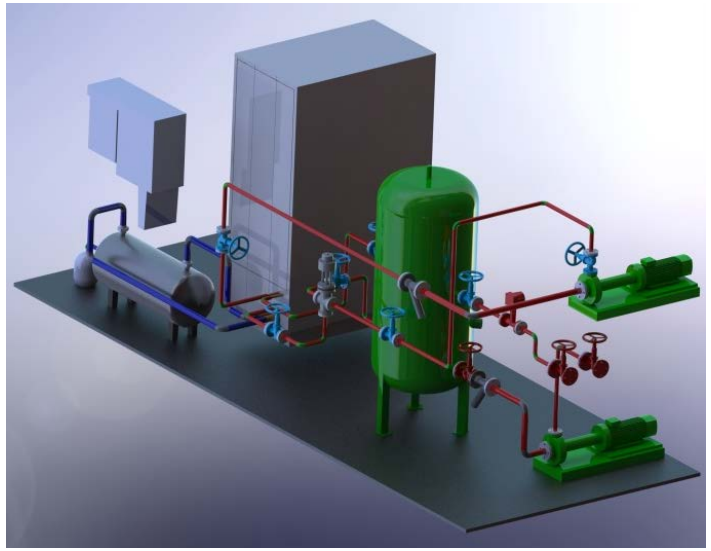
LiBr/H2O double stage

23 kW Nominal cooling power

180°C Heat Source

30 kW rated power

FRESNEL Solar Field



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Solar cooling for domestic applications

Overall dimensions:
3.5 m (W) x 2.5 m (L) x 2.5 m (H),

Estimated avg. Cooling load:
2.5 kW.

Technology of solar thermal collectors	Evacuated tubes
Number of evacuated tubes	90
Lay-out	2 x parallel of 45 tubes in series
Total thermal collectors area [m^2]	9.6
Azimuth	0° (South)
Tilt angle [°]	20
Heat storage volume [m^3]	0.5
Gas Boiler nominal Power [kW]	20
AHP cooling Power [kW]	8
Required Cooling Load [kW]	~ 2.5
Cold delivering system	Precast radiant panel
Overall radiant surface [m^2]	28

- Automatic management
- High accuracy sensors
- Heating/cooling operational mode

- **Chilled water temp: 18/22 °C**
- **Outstanding comfort level**
- **Noiseless**
- **0 m/s inside air speed**

RICERCA DI SISTEMA ELETTRICO

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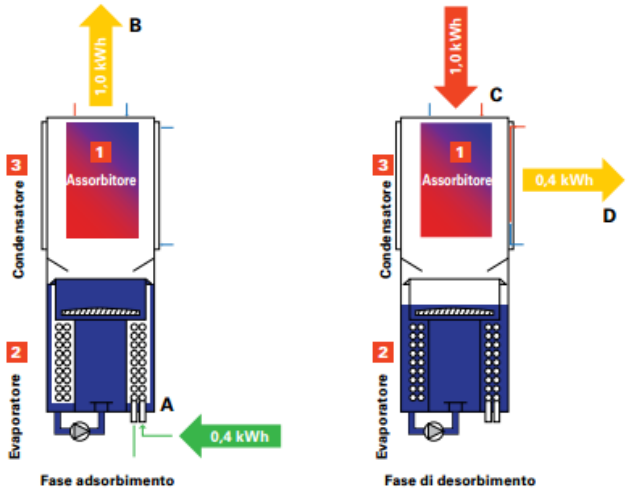
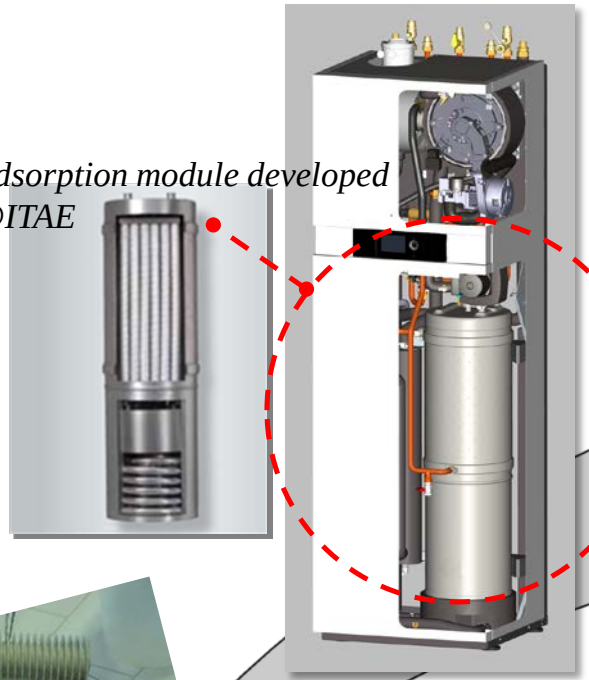
Adsorption heat pump 10 kW

- ITAE activity:
  collaboration in the development and characterization of the adsorber reactor

- Efficiency: 140% respect to the methane boilers





2007- first study on coatings

2010-first design of adsorber

2013- machine commercially available

New coating technique under development

Milano Comfortexpo- 18/21 March 2014

"VITOSORP 200 F"

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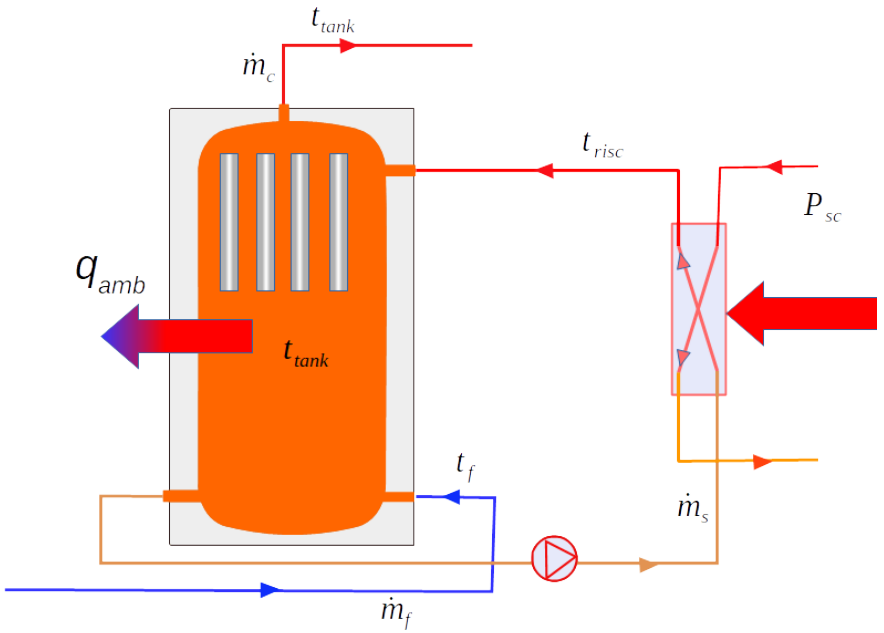
Activity

Development of a lab-scale latent storage for cruises applications



FINCANTIERI

Start 01/2017
End 12/2018

Activity

- Testing of the lab-scale storage @ ITAE lab
- Installation in a complete system @ CNR IM (Naples)

In collaboration with University of Trieste

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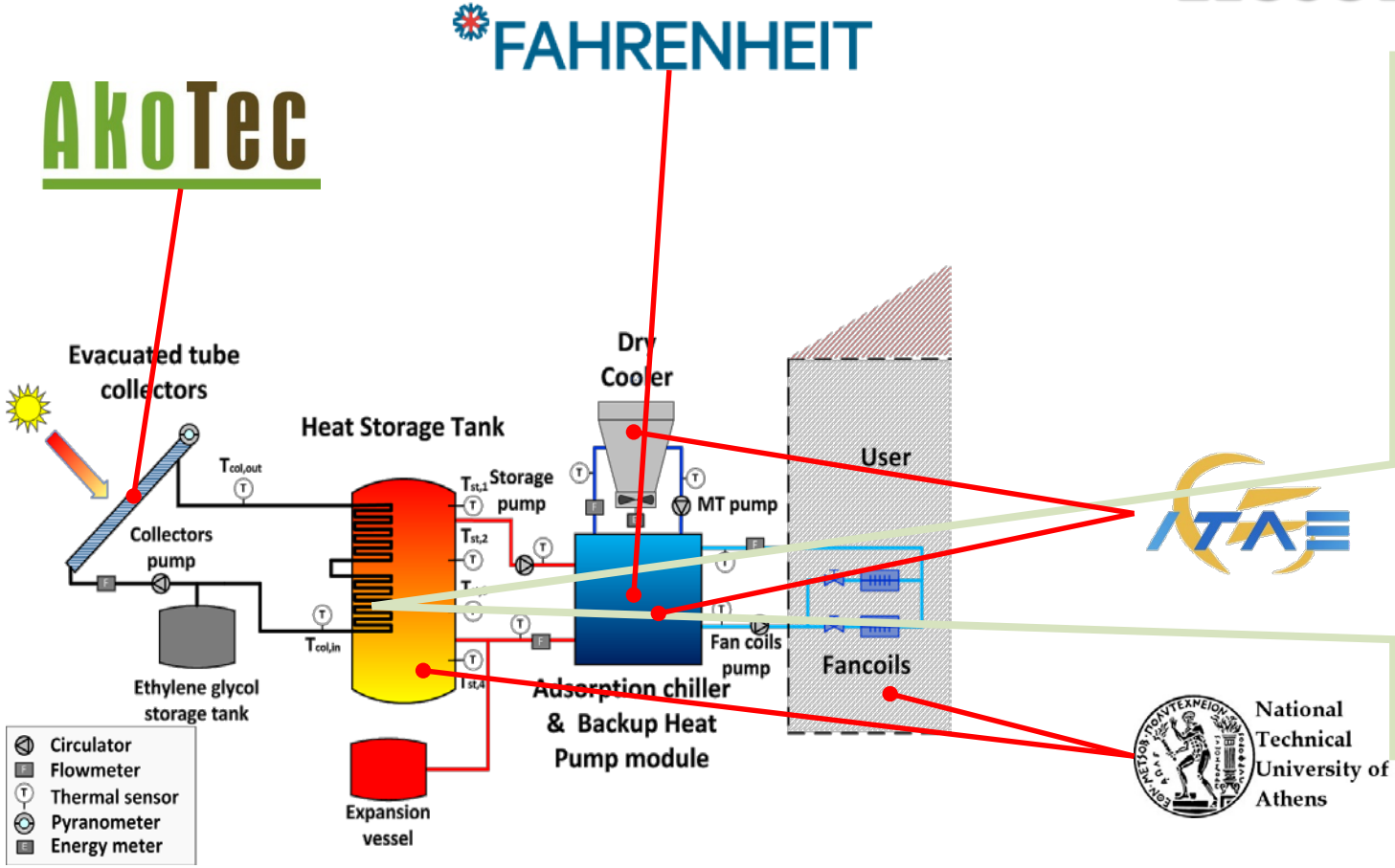
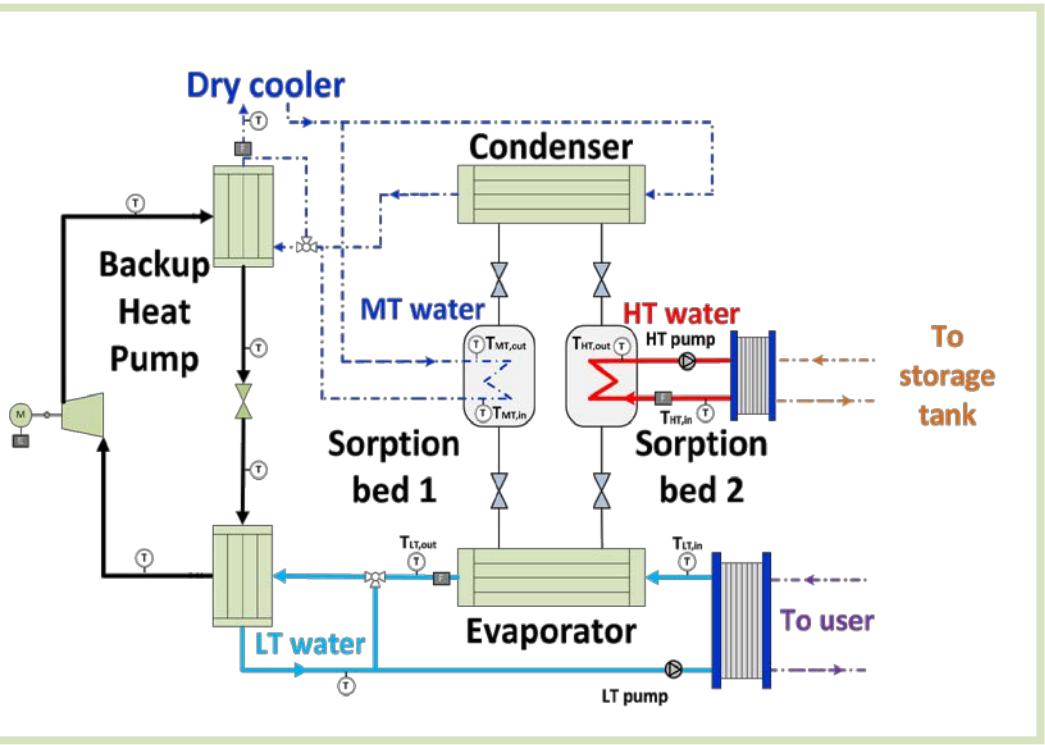
ZEOSOL 2017 - 2020

National Technical University of Athens · FAHRENHEIT · AkoTec · ITAE · DIADIKASIA S.A. Business Consultants

GOAL: To develop a new advanced **solar cooling** and **heating product**, using advanced heat exchanger technology and integrating a heat pump for covering peak demand.

ZEOSOL prototype description/1 - layout





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ZEOSOL prototype description/2 - features

The core of the ZeoSol system is the hybrid chiller, based on a commercial unit already commercialised by Fahrenheit.

1. **It consists of a "parallel" connection of a thermally-driven unit and a traditional vapor compression unit**

2. **It allows to exploit the benefits and main peculiarities of both components:**

- **sorption systems have LOW electricity consumption, need limited maintenance and use a natural refrigerant (R718)**

- **electric chillers offer high precision in temperature regulation, fast response to temperature fluctuations and can use natural refrigerants (R600a, R290)**

By combining the two technologies, it is possible to cover the peak loads, reducing the number of collectors and chiller capacity, providing at the same time an excellent part-load operation.

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ZEOSOL prototype description/3 - system

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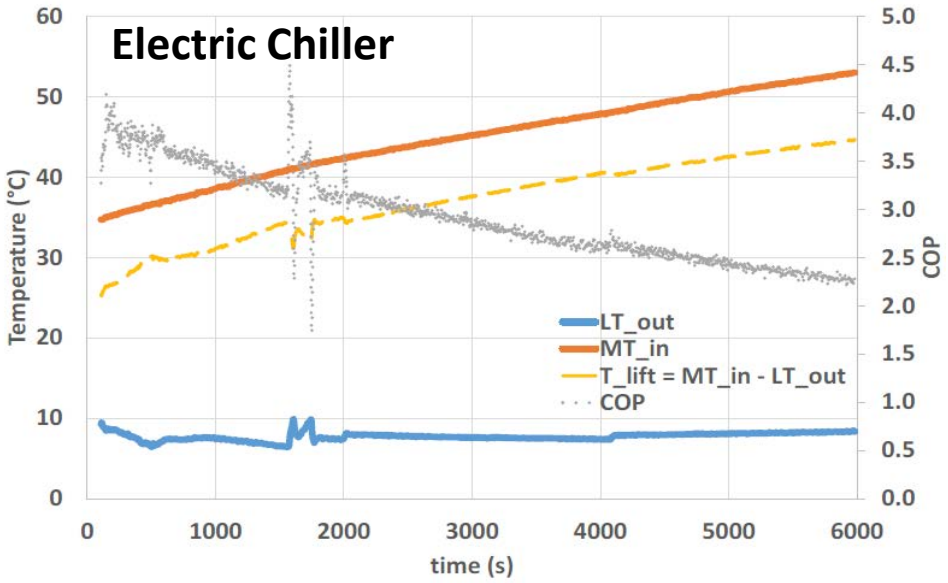
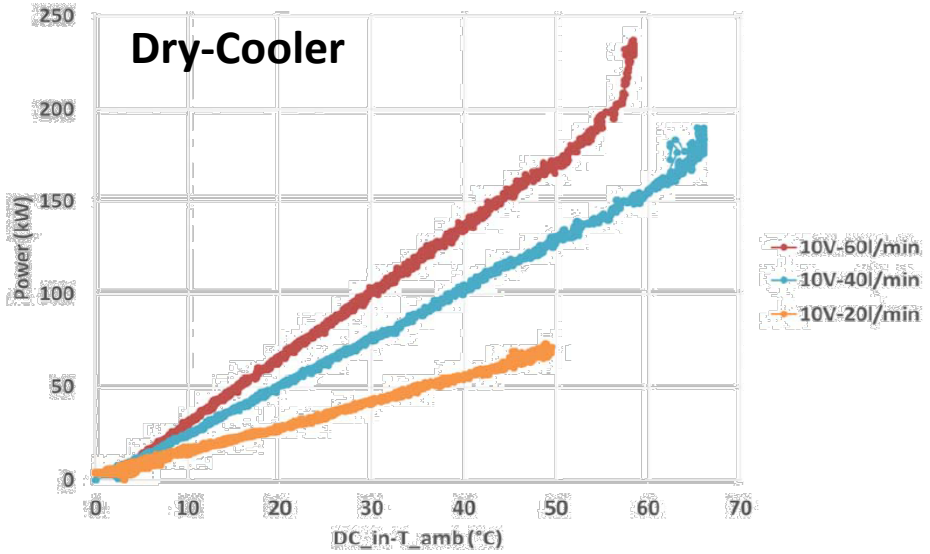
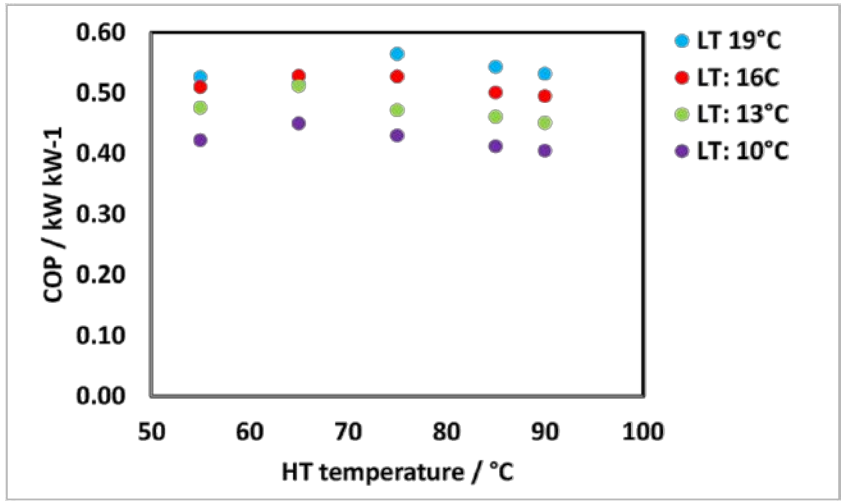
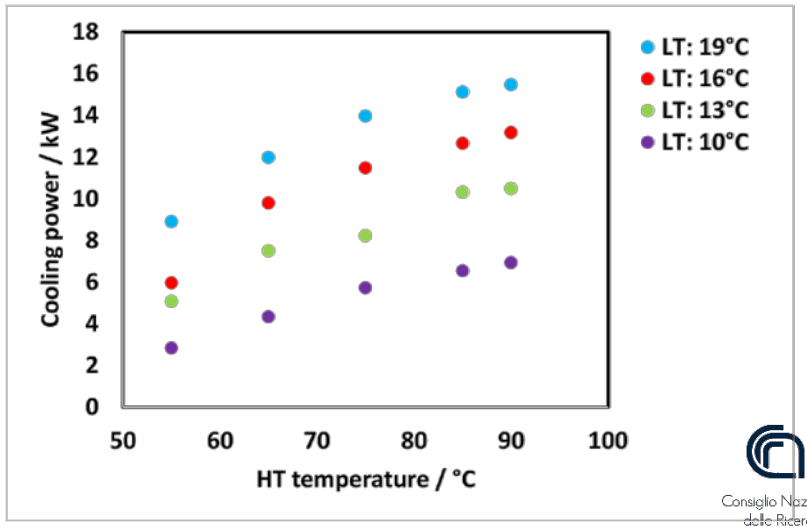
Experimental measuring of separate components – ADS Ch + EL Ch + DC







Adsorption Chiller (MT = 32 °C)



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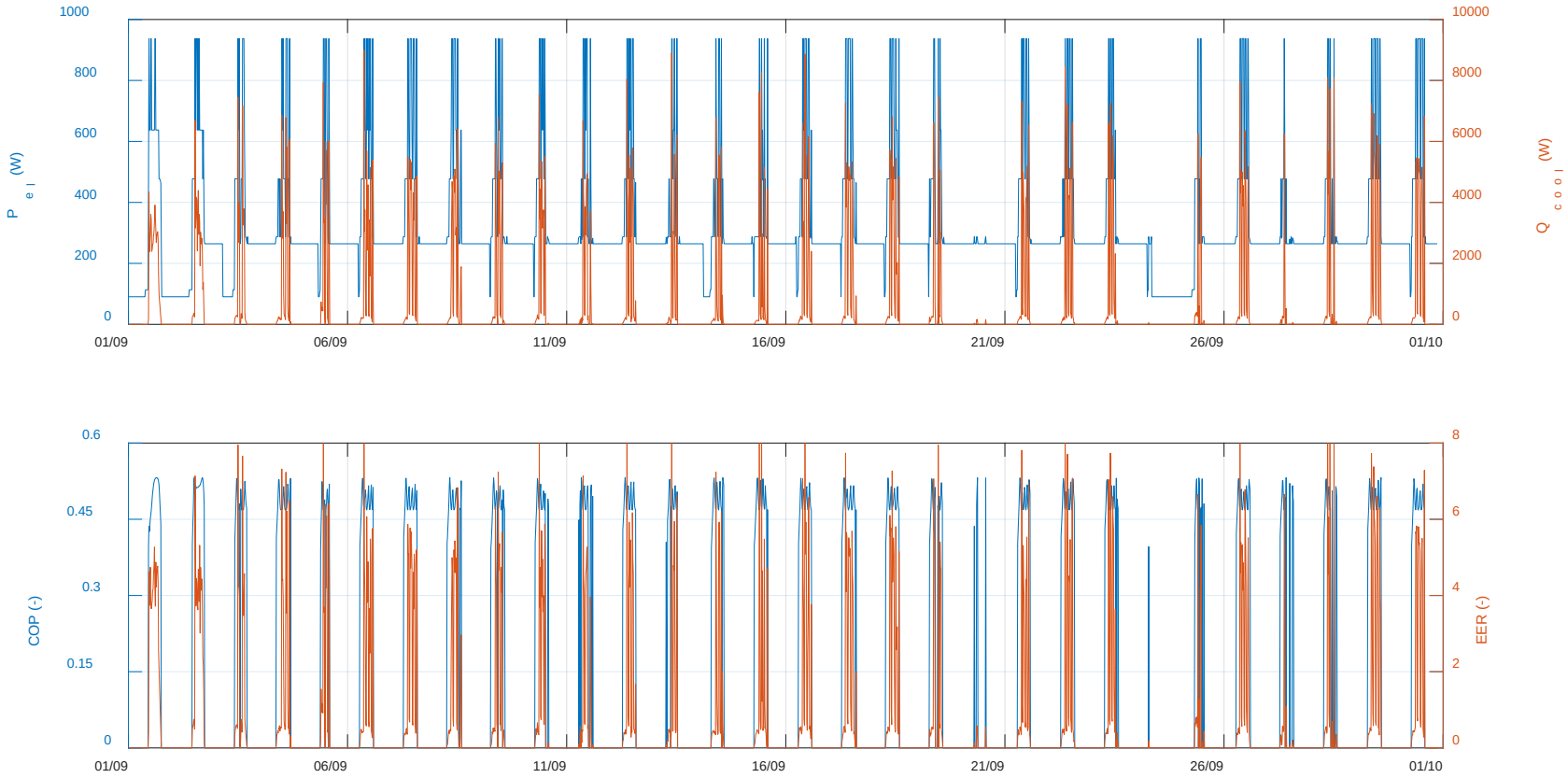
ZEOSOL system performance – September 2019



REMARKS

- Elecricity consumption is extremily low (can be optimized)
- Cooling power reached 8 kW
- EER exceeded 8 in some days (higher was expected)
- Thermal COP is 0.5

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HYBUILD 2017 - 2021

Hybrid Energy Storage for Buildings

GOAL: To develop cost-effective and environmental-friendly solutions, while ensuring comfort conditions in residential buildings located in Mediterranean and Continental climate

GEOFIT 2018 - 2022

SMART GEOTHERMAL

GOAL: To develop an innovative EGS, systems, specifically developed for geothermal based retrofitting, including the optimization and integration of novel heat exchangers concepts, cost effective heat pump, heating and cooling components and advanced IT control and monitoring technologies.

hycool 2018 - 2021

Solar Cooling Systems

GOAL: To develop two innovative Hybrid Solar System concepts based on solar steam for cooling generation: one for chemical industrial processes, and one for small food industry.

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SWS heating

2018 - 2022

GOAL: To develop an innovative seasonal thermal energy storage (STES) unit with a novel storage material and creative configuration.

SunHorizon

2018 - 2022

GOAL: 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

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SoBRio Rev

2019 - 2023

GOAL: To develop a configuration based on renewables that allows covering all **heating and cooling demand** and a **variable electricity demand** in the residential sector.