STORAGE RESEARCH INFRASTRUCTURE ECO-SYSTEM

RI Information sheet 2022

Organisation, RI name

Technology(ies) of Energy Storage (that can be assign to the facility, e.g. electrochemical, chemical, thermal, cross-cutting, ….)

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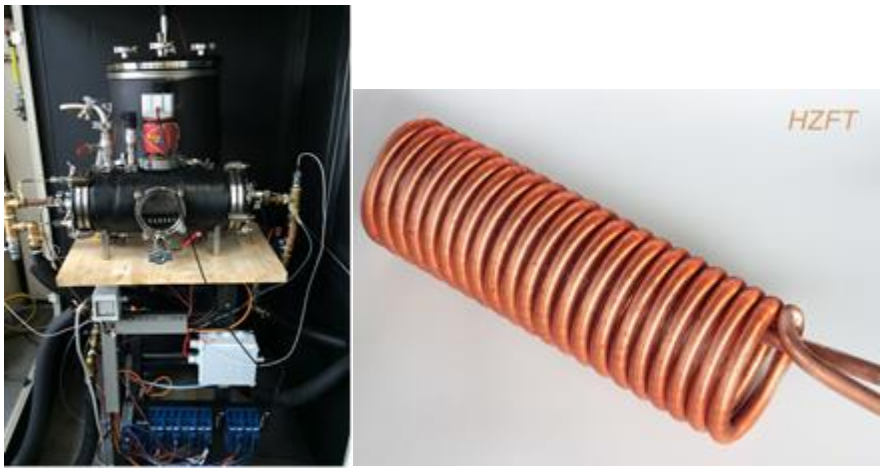
Project Acronym	StoRIES
Call	H2020-LC-GD-2020
Grant Agreement No.	101036910
Project Start Date	01-11-2021
Project End Date	31-10-2025
Duration	48 months

CNR-ITAE “COMPLAB”, Components laboratory for TESs

1. Photo

Sorption kinetics testing bench

Reactor/adsorber testing bench.



Evaporator/condenser testing bench

2. Geographical coordinates

38.14994751950342 N, 15.525945399607378 E

This project has received funding from the European Union’s Horizon 2020
Research and Innovation Programme under Grant Agreement N. 101036910

3. Description of the research infrastructure for the webpage

The CompLab (Components for Adsorption Heat Transformation) was conceived to support the design and development of adsorption heat transformers prototypes (heat storage, chiller/refrigerator/heat pumps) by dedicated testing benches able to experimentally measure the performance of the main components of AHTs under real operating conditions for the specific application.

Services offered.

1. *Sorption kinetics testing bench.* Dynamic optimization of the reactor/adsorber represents a key issue for the broader diffusion of adsorption cooling and heating or heat storage technologies. The sorption kinetics testing bench uses a Gravimetric version of the LTJ method (G-LTJ) for studying the dynamic behaviour of adsorber units with high complexity and realistic configurations under real operating conditions. This testing bench is mainly used to optimize the kinetics of small scale adsorber configurations scaled-up.
2. *Reactor/adsorber testing bench.* The testing bench is based on a laboratory-scale adsorptive cooling system installed at CNR-ITAE Institute. The prototype consists of a single adsorber connected to a single evaporator and a single condenser operating by an intermittent mode without heat or mass recovery. The machine allows to operate it reproducing the boundary conditions typical for cooling, heating or heat storage applications and to measure the COP, the VCP and the SCP of real scale adsorbers.
3. *Evaporator/condenser testing bench.* Adsorption heat transformations based on water as working fluid represent an interesting alternative to traditional energy technologies also for the chance to sue a natural refrigerant. Among natural refrigerants, water (R718) presents important advantages: i) zero GWP and ODP, ii) easy availability, iii) not toxic fluid, iv) excellent thermodynamic and chemical properties. Due to the low saturation vapor pressure of water, the evaporation process needs to take place at sub-atmospheric pressure conditions which implicates fundamentally different evaporation and boiling characteristics compared to elevated pressures. A big lack of knowledge is observed in literature about that. The evaporator/condenser testing bench was conceived to study the evaporation of water under operating conditions typical of adsorption heat transformers. The experimental setup consists of a single bed intermittent adsorption chiller composed of two vacuum chambers: i) chamber 1 where a full scale adsorber is placed and connected to two thermocryostats simulating the heating source and the medium temperature sink, ii) chamber 2 where the heat exchanger to be tested is mounted connected to a circulation thermostat. The system is able to perform a complete adsorption cooling cycle and the evaporation/condensation is realized and studied under isobaric temperature drop/jump.

4. Availability of the research infrastructure

Sorption kinetics testing bench:	*AVAILABLE*
Reactor/adsorber testing bench:	*UNDER REVIEW. AVAILABLE IN 6-8 WEEKS.*
Evaporator/condenser testing bench:	*AVAILABLE*

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5. Special considerations (confidentiality / NDA agreements, insurance requirement, special training, HSE training)

The access to the infrastructure requires the sign of a cooperation agreement.

6. Energy storage technology that can be analysed/studied by using the research infrastructure

- Electrochemical ☒
- Chemical ☐
- Thermal ☒
- Mechanical ☐
- Superconducting Magnetic ☐
- Cross-cutting ☒ (Specifically: Hybrid solutions)

7. Key words for the webpage

Adsorption, Latent Heat Storage, Sorption Storage, Sorption, TES, HEXs, Heat Exchanger, Water Evaporation, Sorption Kinetic

8. TRL level (if applicable):

- 1-3 ☒
- 4-6 ☐
- Above ☐

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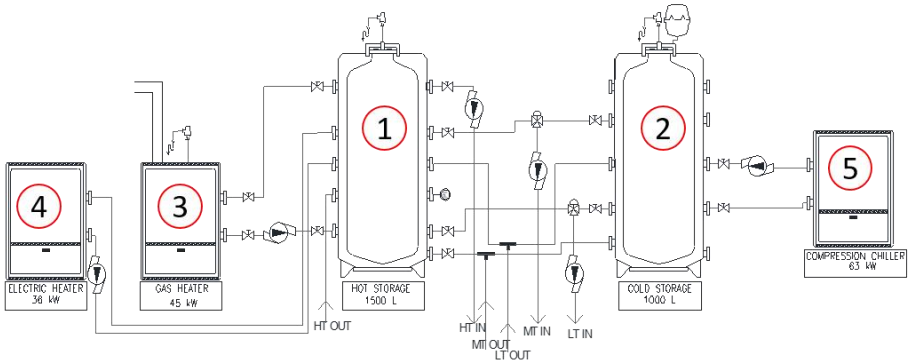
CNR-ITAE “CT-ST”, Testing Benches for TESs

1. Photo



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3. Description of the research infrastructure for the webpage

The testing rig for thermal energy storage and hybrid chillers/heat pump is located in CENTROPROVE and was designed to supply the power and temperature levels needed for the operation of low temperature thermal energy storage systems and generally thermally-operated systems. The main components in the testing rig are the hot storage tank, with a volume of 1.5 m3 (1) and the cold storage tank, with a volume of 1 m3 (2). A gas heater (3) and an electric heater (4) provide hot water to the hot storage tank, while a vapour compression chiller (5) cools down the water inside the cold storage tank. Water in the HT circuit of the system is taken directly from the hot water tank, while the temperature levels for the MT and LT circuits are obtained by mixing the water in the two storages through motorised mixing valves controlled with a PID algorithm. Heat transfer fluid in all the circuits is water. All the pipes are thermally insulated and equipped with variable speed pumps. Data from transducers are monitored and recorded using NI hardware and LabVIEW® environment.

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The following sensors are used for data measurement:

• Pt100 1/10 DIN and type T thermocouples to measure inlet and outlet temperature in all the hydraulic circuits;

• MVM 0-250 PA magnetic flow meters with ±5% full scale accuracy;

• Electricity meter with class 1 tolerances to measure the electricity consumption of the components (compressor, controllers, pumps, valve motors) in the system.

Services offered.

The testing bench allows the tests of thermally driven systems (namely thermal energy storage systems, adsorption chiller units, heat pumps, hybrid systems) and the definition of a map of performance of the unit, in terms of cooling capacity, thermal COP and electricity consumption as a function of the operating temperatures (i.e. heat source, condensation and evaporation temperatures). In particular, the following ranges can be set:

- HTin: 55-105°C
- MTin: 25-40°C
- LTin: -10 - 20°C

4. Availability of the research infrastructure

Availability of the infrastructure has to be checked. Please contact Dr Salvatore Vasta (salvatore.vasta@itae.cnr.it) to schedule the access.

5. Special considerations (confidentiality / NDA agreements, insurance requirement, special training, HSE training)

The access to the infrastructure requires the sign of a cooperation agreement.

6. Energy storage technology that can be analysed/studied by using the research infrastructure

- Electrochemical ☒
- Chemical ☐
- Thermal ☒
- Mechanical ☐
- Superconducting Magnetic ☐
- Cross-cutting ☒ (Specifically: Hybrid solutions)

7. Key words for the webpage

Adsorption, Latent Heat Storage, Sorption Storage, Hybrid storage, TES, Sorption, Seasonal Storage, Long Term Storage

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8. TRL level (if applicable):
    - 1-3 ☐
    - 4-6 ☒
    - Above ☒

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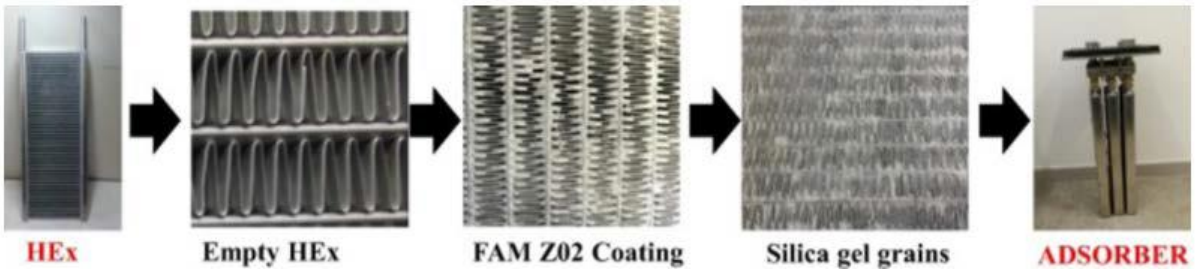
CNR-ITAE “MATeLAB”, Chemical laboratory for TESs

1. Photo



2. Geographical coordinates

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3. Description of the research infrastructure for the webpage

The activity of the laboratory is based on the synthesis and characterization of adsorbent materials and phase change materials for thermal energy storage.

Services offered.

1. DVS Vacuum Surface Measurement System: Traditional gravimetric methods used for study adsorption phenomena of vapors and gasses on porous materials and liquid adsorbents. It accurately and precisely measures adsorption-desorption isotherms and isobars over a broad range of temperatures and partial pressures.

DVS Vacuum

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2. LabSys Evo SETARAM: it is a powerful thermal analysis platform, suitably modified for working under vacuum and in water vapor environment. The system is used for the measure of the adsorption capacity of the porous materials (isobars and isotherms) and to evaluate at the same time the adsorption enthalpy.

Setaram LabSys Evo

3. DSC1 METTLER TOLEDO: Differential scanning calorimetry (DSC) is a technique that allows to determine the energy absorbed or released during a phase change or a variation of the chemical properties of a sample over a wide temperature range. The same technique allows the evaluation of the specific heat of the materials. This methodology is used both for the study of phase change materials, in order to analyze the energy associated with the state transition, and for the adsorbent materials, for the evaluation of their Cp.

4. C- Therm TCi: is a tool that allows the evaluation of the thermal conductivity and the effusiveness of the materials (solids, liquids, powders and slurry) using the technique defined "Modified Transient Plane Source (MTPS)", compliant with the ASTM D7984 standard.

The activity of characterization of adsorbent and phase change materials is also carried out by exploiting the institute equipment shared among all the laboratories, namely: X-ray diffractometer (XRD), X-ray fluorescence (XRF), scanning electron microscopy (SEM) accompanied by EDAX analysis, nitrogen phis-sorption at liquid nitrogen temperature (BET technique).

4. Availability of the research infrastructure

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5. Special considerations (confidentiality / NDA agreements, insurance requirement, special training, HSE training)

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The access to the infrastructure requires the sign of a cooperation agreement. A specifi training is required.

6. Energy storage technology that can be analysed/studied by using the research infrastructure

- Electrochemical ☒
- Chemical ☐
- Thermal ☒
- Mechanical ☐
- Superconducting Magnetic ☐
- Cross-cutting ☐ (Specifically: Hybrid solutions)

7. Key words for the webpage

Adsorption, Latent Heat Storage, Sorption Storage, PCM, SWS, Sorption, Sorbent, Zeolite, Silica-Gel.

8. TRL level (if applicable):

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- 4-6 ☐
- Above ☐

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