



CSP ERA-NET has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 838311



Thermal Energy Storage for Trigenation (TES4Trig)



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“Exchange of Experiences” Webinar – 28 September 2023





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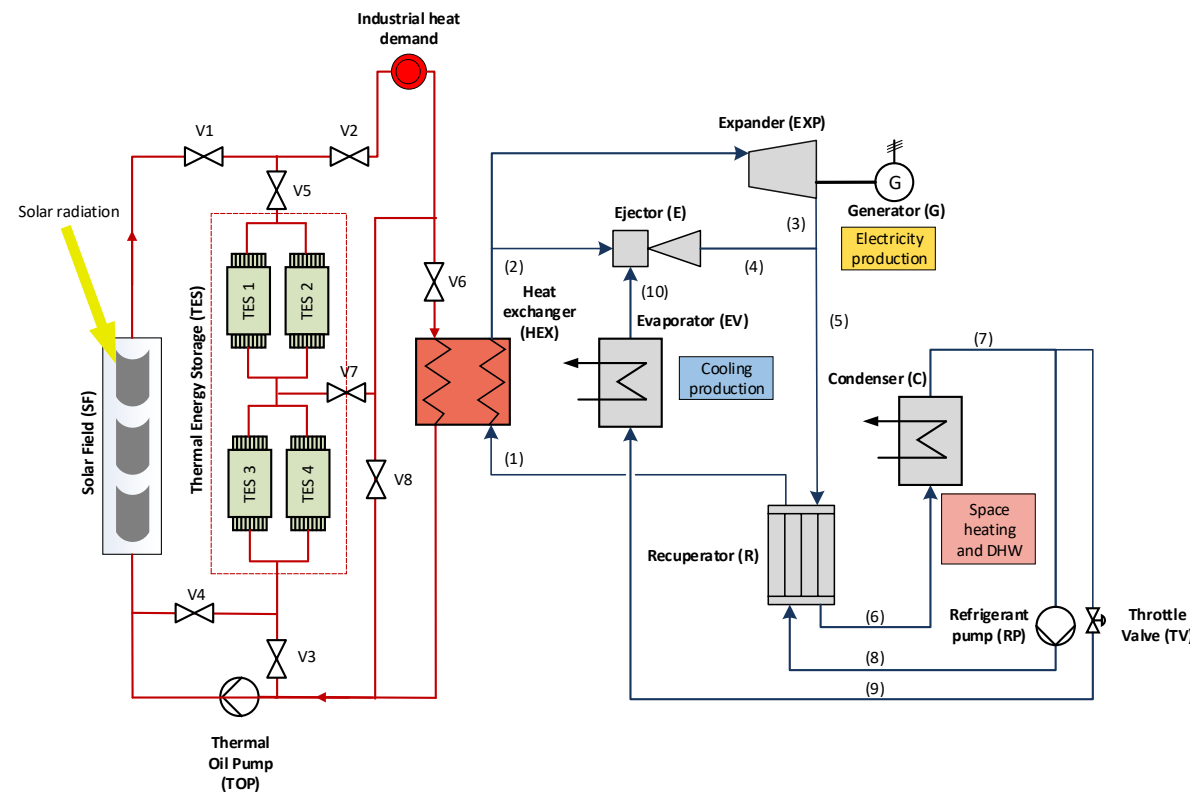
## The consortium



SOLAR & OTHER ENERGY SYSTEMS  
LABORATORY



## The project



## Key technologies

- High-temperature (about 400°C) parabolic trough collectors
- Solid thermal energy storage system
- Organic Rankine Cycle – Ejector cooling cycle for production of electricity, heating and cooling
- What we want to do:
  - 1) integrate all technologies together into single demonstrator
  - 2) interconnect demonstrator to consumer building to cover real heating and cooling needs





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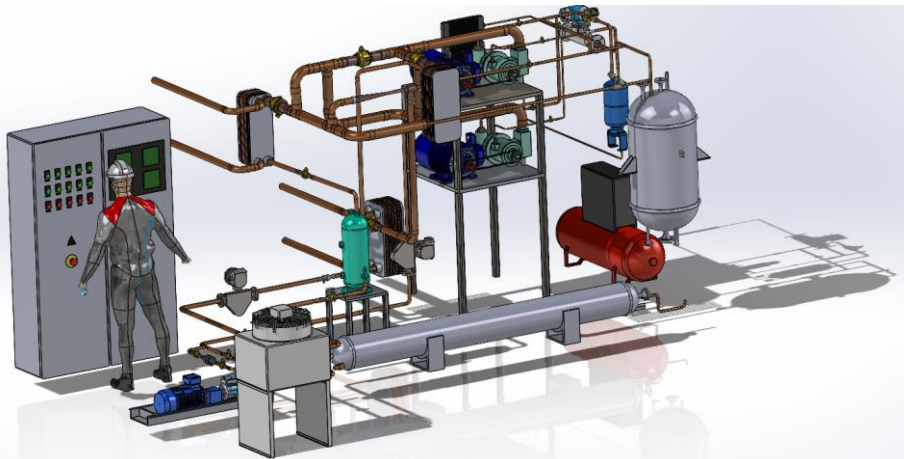
### Parabolic Trough Collectors by Protarget



### Challenges addressed

- **1<sup>st</sup> worldwide demonstrator** of solar ORC-ECC with solid-state TES integrated into a building
- Technical feasibility (engineering and control) of integrating multiple different technologies together
- Proving the economic feasibility of the concept via a real world application for an office building
- Integrating the demonstrator **into a historical building with significant architectural and cultural value**

### ORC-ECC trigeneration system by NTUA







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Thermal Energy Storage system developed by CADE





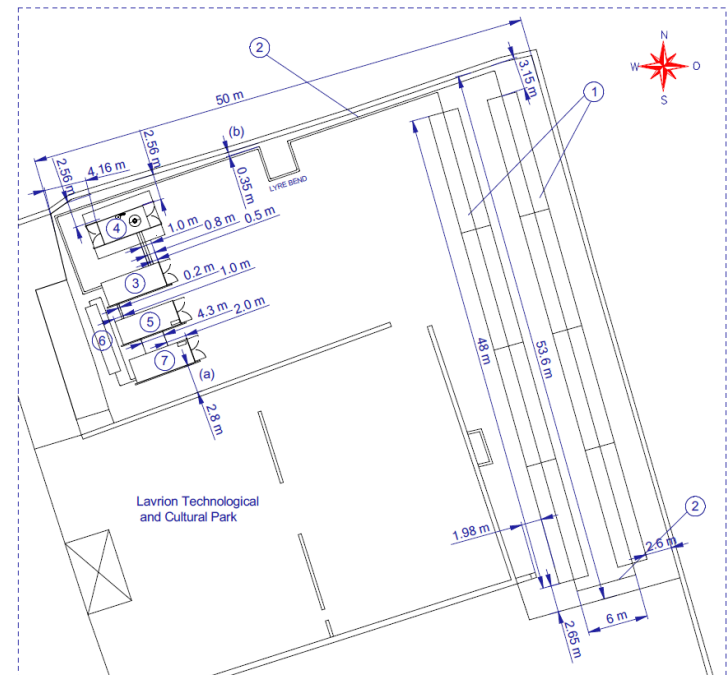
**Consumer building:** Administration Building (Serpieri Building) of Lavrio Technological and Cultural Park, NTUA (erected in 1875)



The TES4Trig demonstrator will be integrated into the heating/cooling infrastructure of the building to cover part of its heating/cooling demands and produce electricity



**Consumer building:** Administration Building (Serpieri Building) of Lavrio Technological and Cultural Park, NTUA (erected in 1875)







## Positive aspects of transnational set-up



- Opportunity to work together with pioneering industrial players in the field of CSP (Protarget, CADE) and research organizations (NTUA, SIJ, SESL)
- Improved dissemination across different countries and markets







## Critical difficulties encountered during the project



- Funding period timelines: significant discrepancies between time periods of funding agencies
- Limitations on funding ceilings per country: this inherently limits the scope of work that can be undertaken by partners belonging to different countries (funding difficulties in case of demonstrator projects in Greece)

For our project an additional difficulty is the selection of a demonstrator site and integration work

- Substantial area requirements of solar field and weight requirements made very hard finding a suitable consumer building causing severe delays in the project
- Significant time lost in search of suitable site (2 rejected sites before finding the one)
- Additional delays are attributed to long delivery periods of critical equipment during and after COVID-19.
- Integration aspects: extremely challenging given historical character of building





## Critical difficulties encountered during the project



A critical technical challenge is the integration of the demonstrator with the existing heating and cooling infrastructure of the consumer building in terms of engineering and control

### Consumer building boiler and chiller



**Boiler**  
**125 kW**



**Chiller**  
**62 kW**



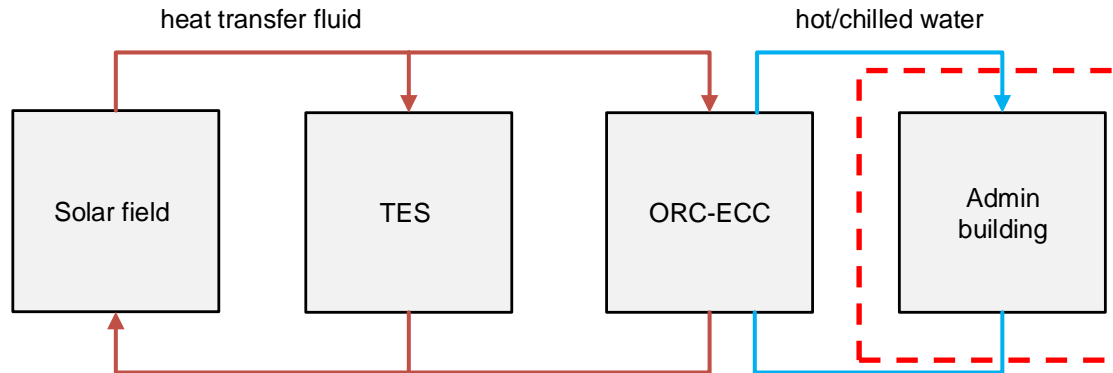


## Critical difficulties encountered during the project



A critical technical challenge is the integration of the demonstrator with the existing heating and cooling infrastructure of the consumer building in terms of engineering and control

Simple on a first glance...





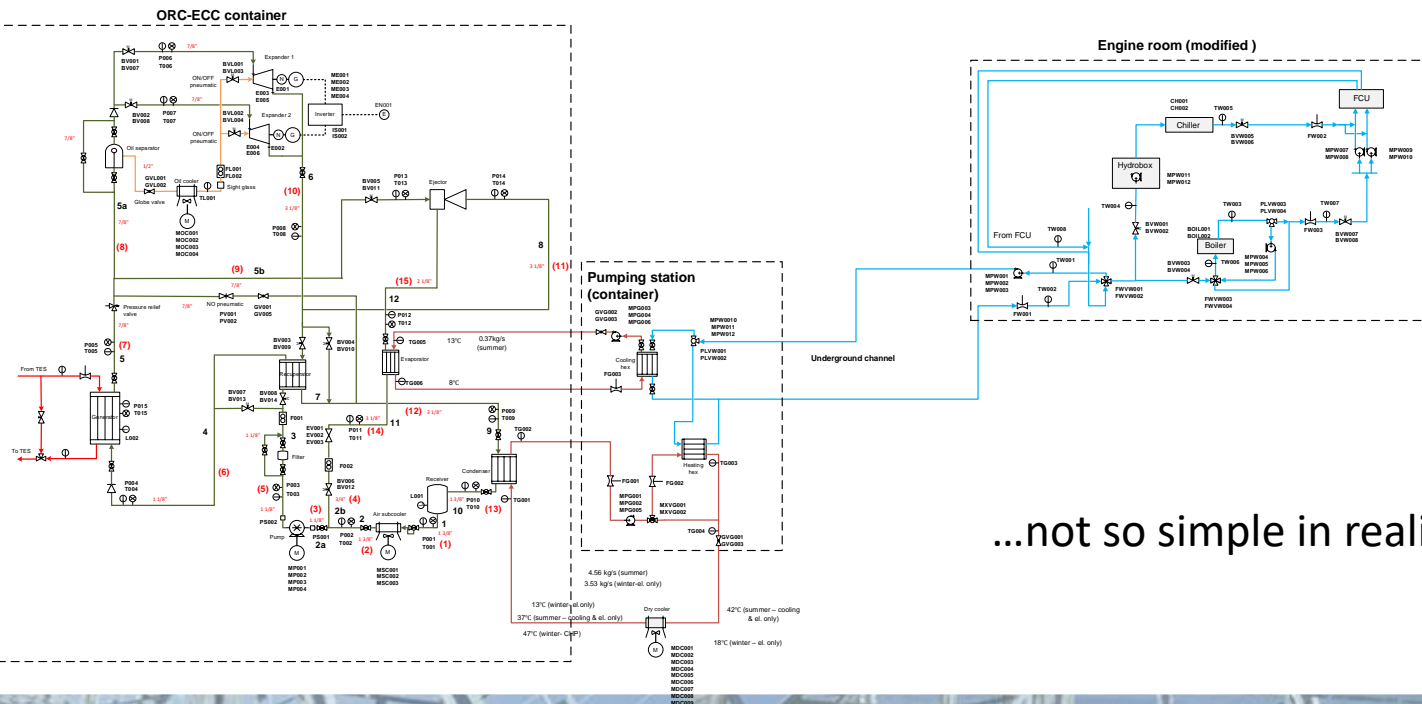


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### Critical difficulties encountered during the project



A critical technical challenge is the integration of the demonstrator with the existing heating and cooling infrastructure of the consumer building in terms of engineering and control



...not so simple in reality





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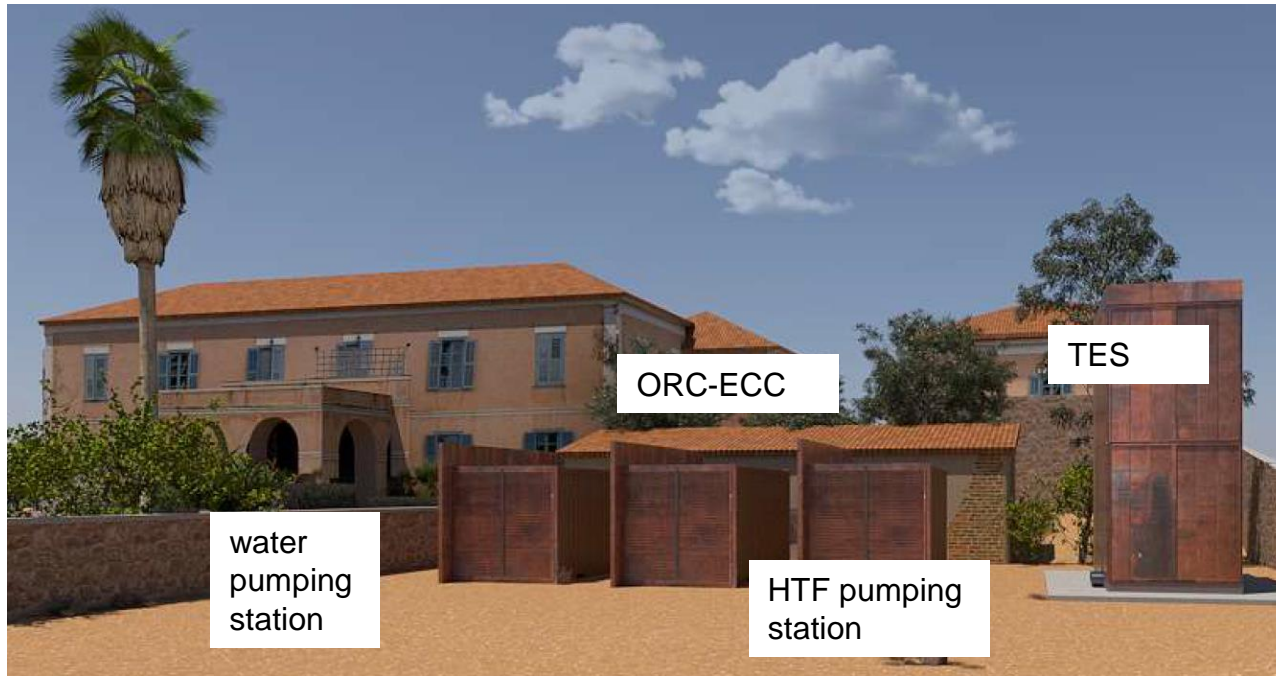


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Design approved by Architectural Committee of LTCP Containers and monolith to be covered by Corten sheets to ensure architectural integration with historical building





Containers and monolith to be covered by Corten sheets to ensure architectural integration with historical building







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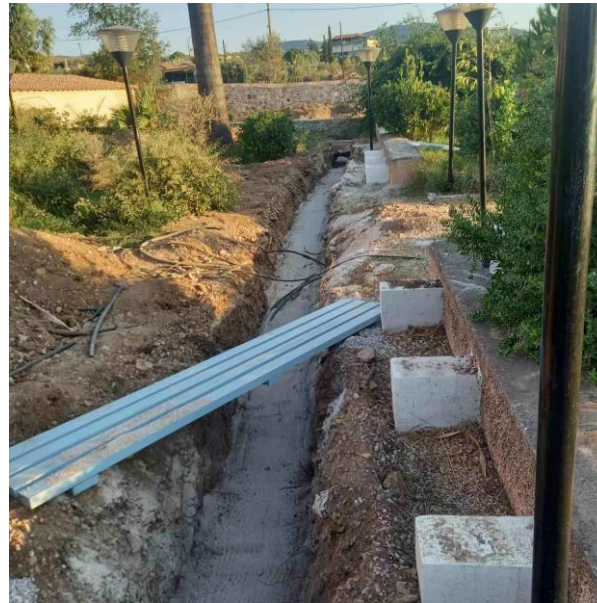


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To respect architectural value of site, an underground piping network had to be installed







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- First solar ORC demonstration project in Greece
- First worldwide solar ORC-ECC for demo TRL
- System installation planned in Q4 2023
- Demonstration campaign to start in 2024





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# Thank you!!

Presented by Kostas Braimakis, NTUA (CCCC, 2023, Greece)

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