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

NEWCLINE: Advanced thermocline concepts for thermal energy storage for CSP

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Project objectives and transnational factors

- Development of **new thermocline concepts** that can be applicable to different CSP plants (PTC and CR)
- Two concepts related to materials are proposed:
  - Use of innovative **structured ceramic filler refractories**
  - Combination of the solid filler material with specially selected encapsulated PCM located at strategic regions of the tank (**multi-layered TCF**)
- **Official project coordination started in May 2021**. However, and due to the National Agencies administrative/evaluation process, some partners started in **November 2020**, while others in **May 2021**. This issue is affecting a possible project extension.
- **It is suggested for future transnational R&I projects** to synchronize the participation of all the partners as much as possible.

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Consortium and experiences gained

Empresarios Agrupados Internacional S.A. (EAI), Madrid, Spain	Kraftblock (KB), Saarbrücken, Germany	Universitat Politècnica de Catalunya-BarcelonaTech (UPC), Spain	German Aerospace Center (DLR), Cologne and Köln, Germany	Institute for Solar Technology (SPF), Rapperswil, Switzerland

- **Strong interaction between the partners**. From May 2021: 5 biannual meetings, 25 progress meetings, and more than 65 bilateral meetings
- **Complementary background among partners**: advanced numerical simulation (UPC); experimental studies on thermocline systems (DLR); material development (KB); material compatibility (DLR); design from an engineering point of view / up-scaling (EAI); development of system simulation framework and thermo-economic analysis (SPF)

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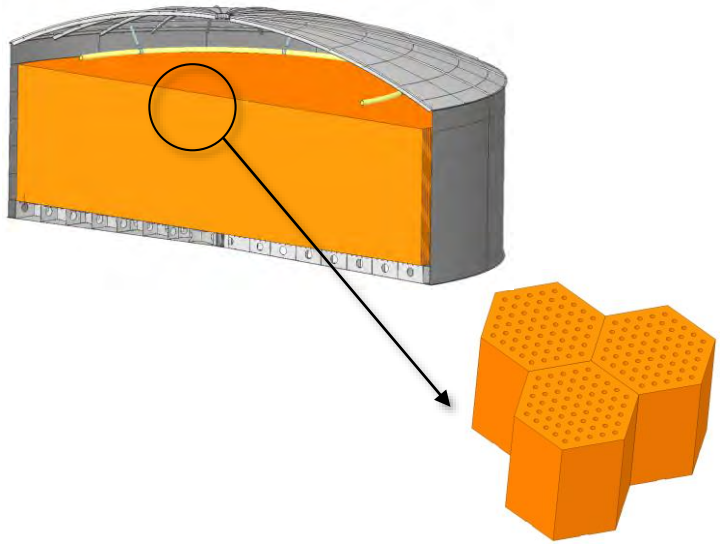
Key outcomes, results and benefits

- Novel analysis of **structured thermocline fill**er (TCF) without and with encapsulated PCM (EPCM) material using different simulation levels
- **Material development** based on waste ceramic products, and material compatibility of the solar salt and the filler material
- **Experimental studies** of the structured filler material and the multilayered EPCM
- TCF conceptual design from an engineering point of view; **up-scaling design** of the TCF tank concepts
- **Integration of the TCF concepts in the whole CSP plant** through transient dynamic simulations
- **Significant LCOE reduction** compared to two-tank solution



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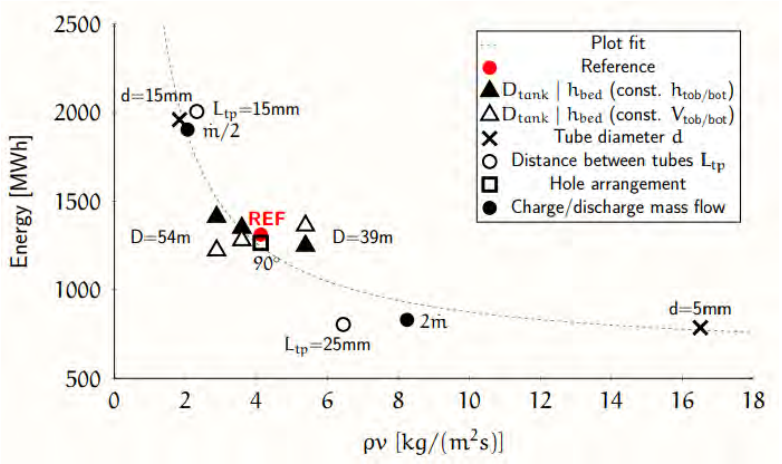
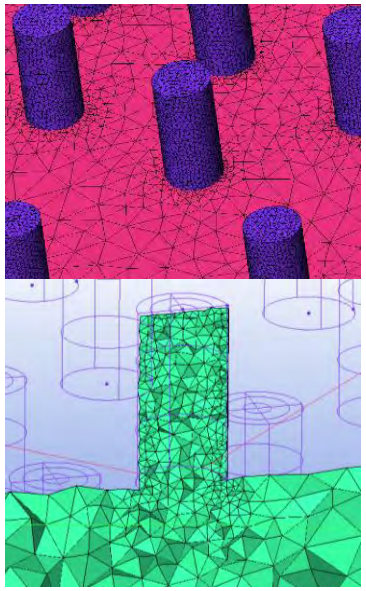
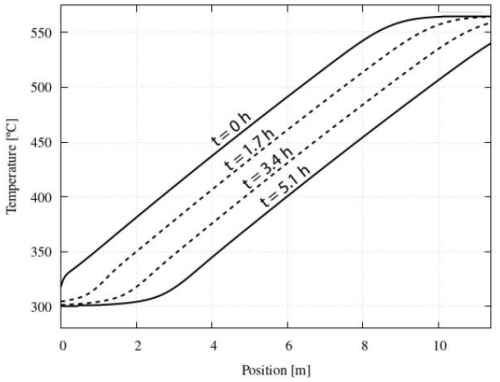
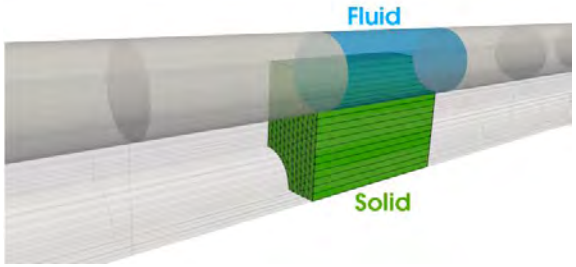
Simulation tools for structured thermocline

- **Three levels of analysis** fluid/structure: 1D/1D, 1D/3D, 3D/3D. Filler material **without and with EPCM** in strategic parts of the tank









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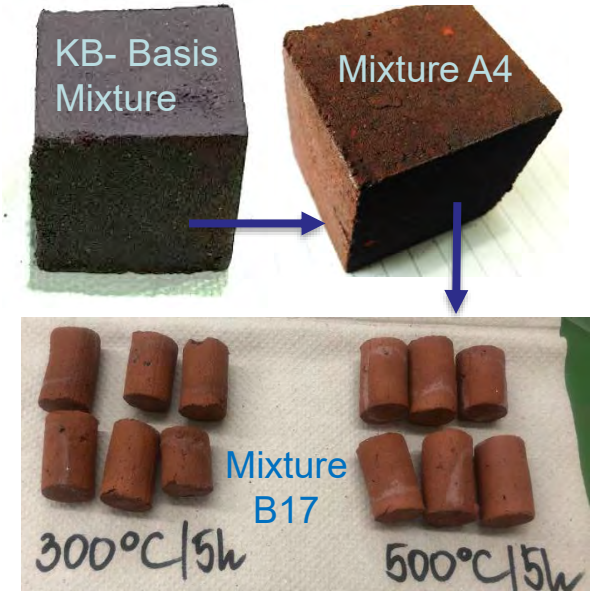
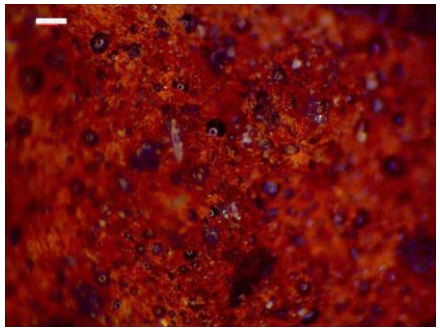
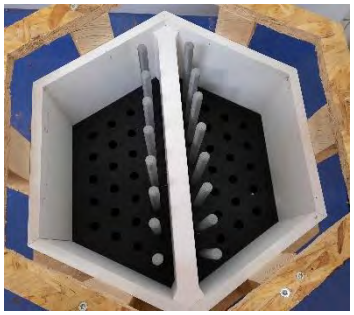
Material development and material compatibility

- Screening of different **recycled materials** and **compatibility tests** with the inorganic binding agent and with molten solar salt; design the **press mould** and filler **checkers production**







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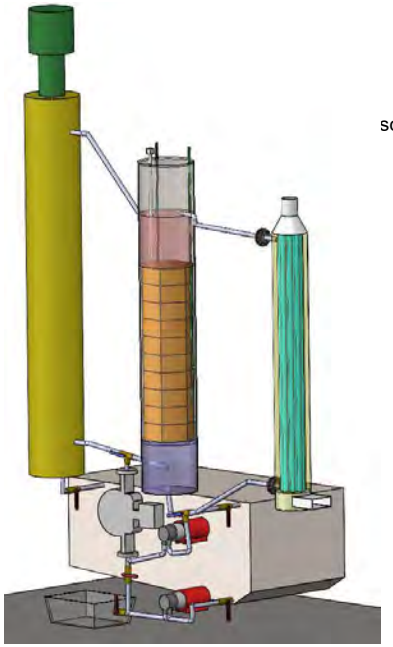
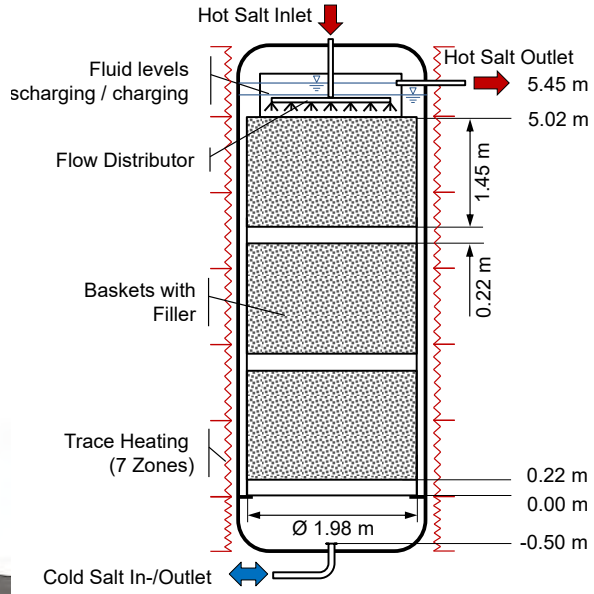
Experimental studies: lab-scale and pilot-scale setups

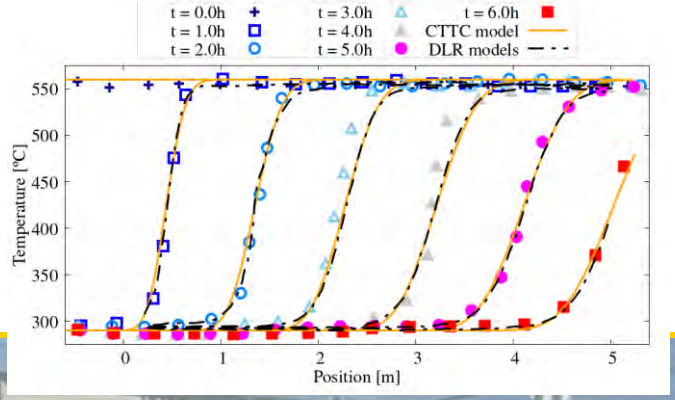
- **Lab-scale** (Barcelona) and **pilot-scale** (TESIS:store facility, 4MWh, Cologne) setups. Test of the **TCF concepts**; mathematical models **validation**



Lab-scale setup



Pilot-scale setup



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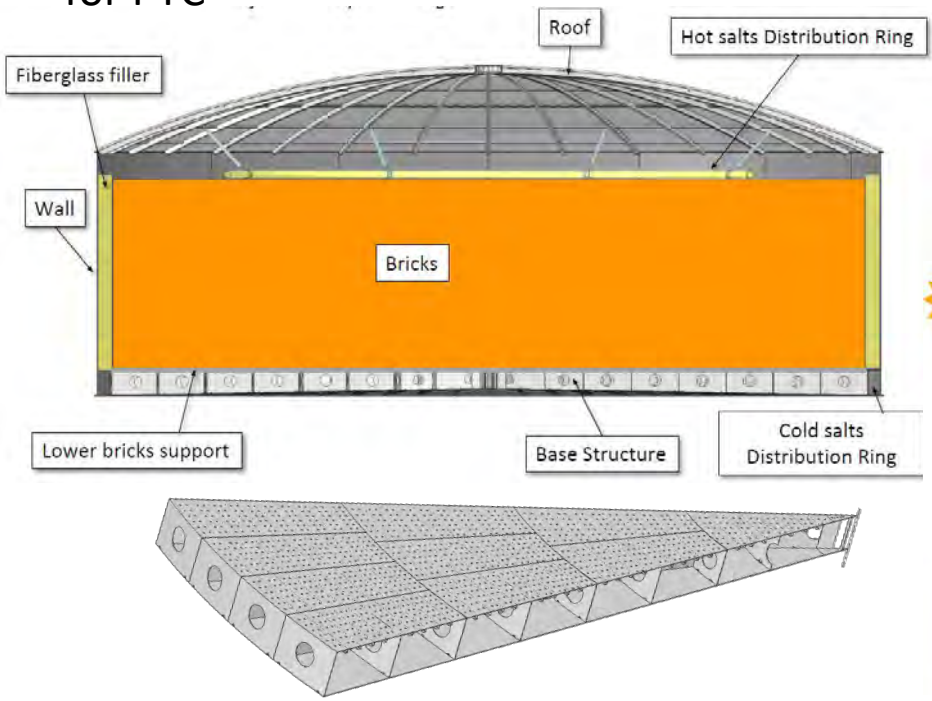
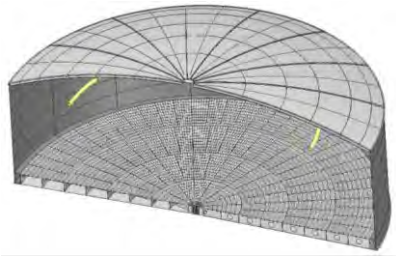
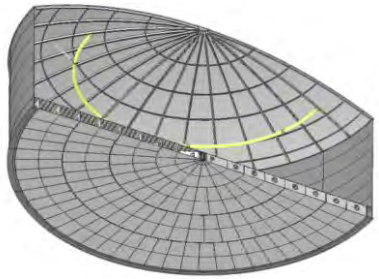
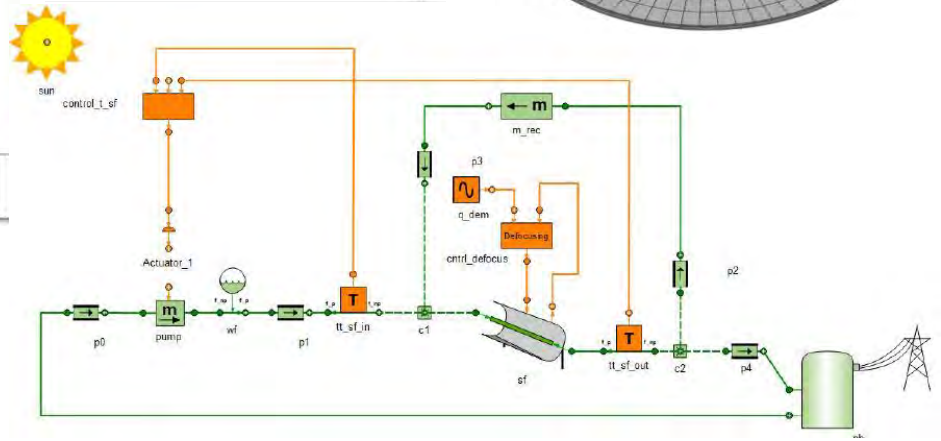
Engineering design of the tank and up-scaling

- **Mechanical design** (tank structure), **civil foundation**, model simulation in **ECOSIMPRO** for PTC









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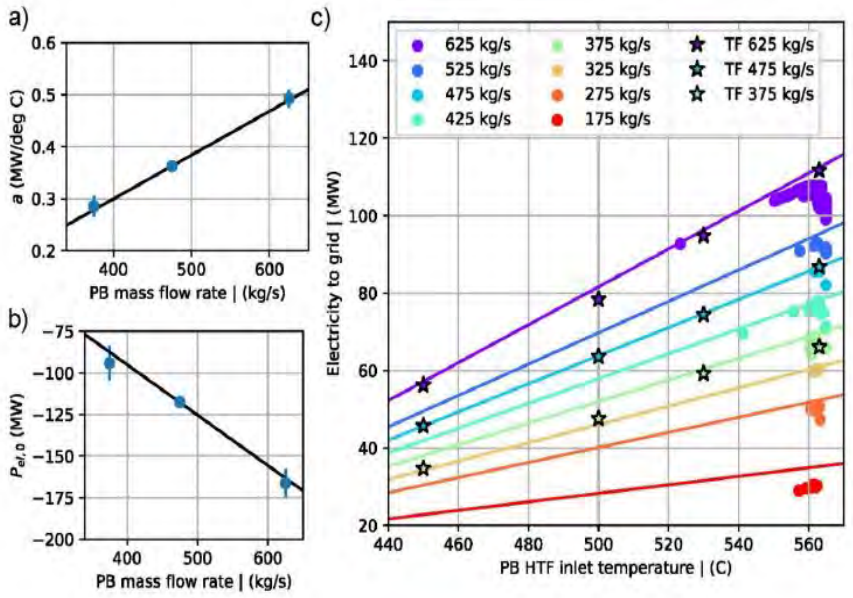
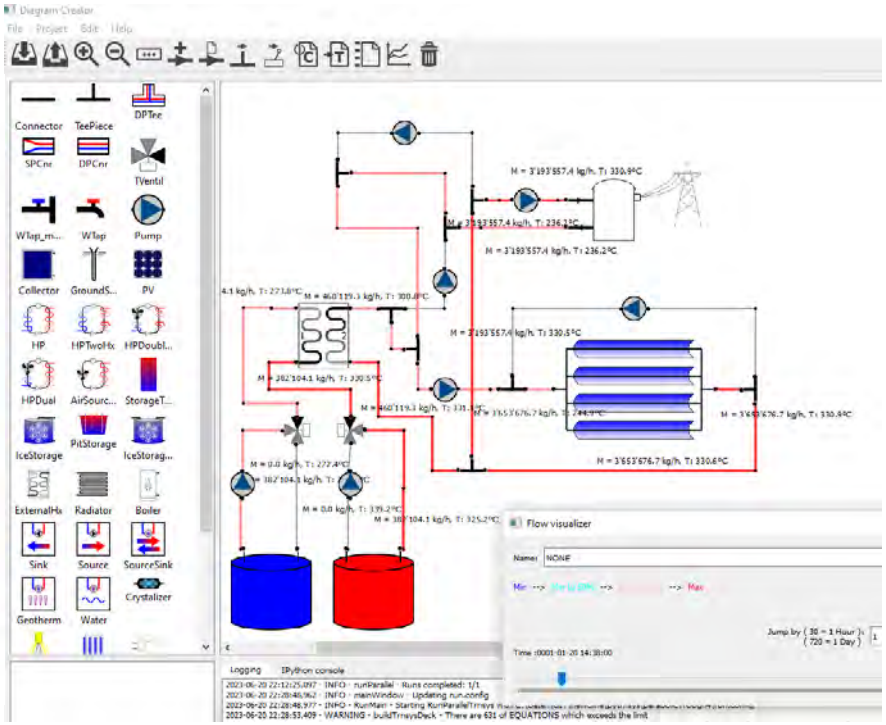
Integration of the TCF concepts in the whole CSP plant

- Open source **Python-based framework** for setting-up, running, and processing TRNSYS simulations; **transfer functions** for the PB





Thank you!!

Presented by Carlos D. Pérez Segarra, Heat and Mass Transfer Technological Centre (CTTC-UPC), Spain

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