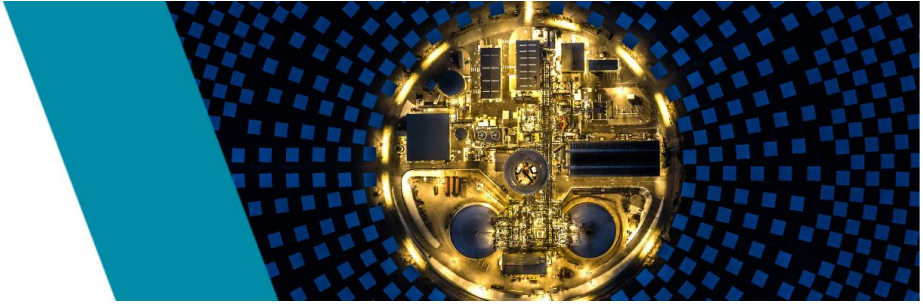

NEWSLETTER ISSUE 2 – OCTOBER 2021

In this issue

State of Play

One year on, many activities of the SOLARSCO2OL project have been intensively carried out by all partners. In this issue of newsletter, we would like to share with you our latest progress in the last six months, as well as key findings of our activities that may be of your interests.

The last General Assembly and Technical Meeting were successfully held on the 14-15th September 2021 in Abengoa Energía premises in Seville, Spain, where project partners participated in, either by physical presence or via conference call, due to COVID-19 restrictions. The pandemic may have changed our way of working; however it did not affect much our progress in the project.

The project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 952953.

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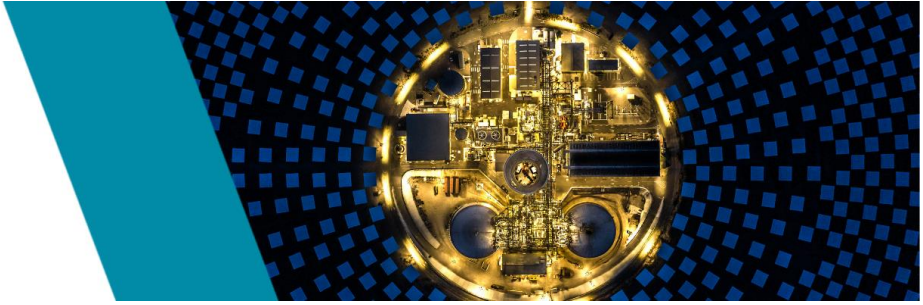

Message from the Project Coordinator

It has been a real pleasure meeting again the SOLARSCO2OL team in Seville on 14-15th September. Due to COVID-19 restrictions, it has been a challenging year for the whole consortium, but all the colleagues felt committed to the project supporting it thanks to their best defining SOLARSCO2OL cycle operating parameters and working on modelling activities at cycle and components level. A new R&D year is waiting for us now and it will be even more challenging as we target to start to realize our prototypes! Keep posted about SOLARSCO2OL as the best is yet to come.

Project Activities Updates

WP 1: SOLARSCO2OL Demo pre-engineering work completed and techno-economic model development in good progress.

The process and integration diagrams of the SOLARSCO2OL demo plant have been issued for the entire plant and the respective sub-systems, including balance of plant and respective list of equipment. Operation modes and suggested control strategies for the demo have been defined, also supported with dynamic model and simulations from WP5. Detailed engineering for site preparation, and procurement of components have begun, and will continue in WP6. These results have been documented in Deliverable D1.3, due M13. The development of techno-economic models for prospect advanced hybrid CSP sCO_2 plants is also under preparation and well advanced. By M18 KTH will issue D1.4 detailing on the methodology followed for techno-economic analysis and the physical models included in the simulation toolbox. Overall, the progress in WP1 has been on-track.

WP 2: Towards the completion of compressor and associated auxiliary systems preliminary design.

In the last six months, the Baker Hughes team finalised the conceptual design of the compressor and associated auxiliary systems and completed 90% of the preliminary design. In detail, the preliminary compressor layout and cross-section was released, as well as the preliminary aero-design of the first impeller, which is the most critical component for handling CO_2 in supercritical conditions, with the aim of ensuring performance at the design point and at the right limit of the operational range. Moreover, on the aerodynamic design side, the other two impellers have been finalised, and the suction plenum and discharge scroll have been completed to 70%. In addition, the compressor performance maps were released, and the tuning of the compressor internals leaks has started, with the final goal of minimising them, given the small size of the turbomachine. Finally, the overall Bill of Material and the corresponding master plan have been released. They will govern the deadlines for the publication of each technical document and specification, as well as each stage of the supply chain (i.e., procurement, machining, assembly, and final testing before the prototypes are shipped to La Africana site).

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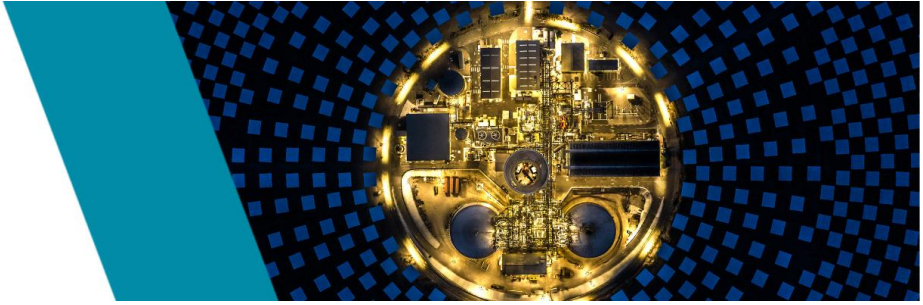

WP 3: Milestone on the feasibility study of the sCO_2 turbine achieved.

WP3 has reached its first milestone foreseen in the project planning, i.e., the feasibility study of the sCO_2 turbine. The work that led to this result reviewed all aspects of the design, confirming in most cases the relevance of the main initial assumptions. A strong interdependence between the mechanical (structural and dynamic) and aero-thermodynamic aspects was confirmed. The radial + axial configuration of the turbine has been finally chosen, in order to reduce the sensitivity to possible problems related to extremely high-power density, which can lead to unstable dynamic behaviour of the rotor, very high thermal gradients and difficulties in efficient aerodynamic design. The high thermal gradients and loads caused by the fluid characteristics confirmed, among other assumptions, that the shaft ends seals, for which the DGS type was chosen, must be carefully designed with dedicated solutions. The overall configuration of 1 radial stage + 2 axial stages, with rotor diameters of the order of 150 mm at rotational speed of 30 krpm, has confirmed to be a good basis for future large-scale applications, eventually after the removal of the radial stage for power over 10 MW with possibly inlet temperatures up to 650°C and higher.

Currently, the materials study phase has been launched, mainly based on the exploration and comparison of the creep characteristics of super alloys and high alloy steels; among the materials considered, a new patented superalloy will be also tested. Some advanced manufacturing solutions, particularly innovative for this size range, will soon enter the test phase, while next year the feasibility project will be transformed into a final project.

WP 4: Preliminary designs of the shell-and-tube heat exchangers and the electrical heater are completed and simulations are executed to assess their performance.

Having finalised the preliminary designs of the shell-and-tube heat exchangers (Heater & Recuperator) and the electrical heater, LOINTEK and SEICO have started the first stage of Computational Fluid Dynamics (CFD) simulation to assess the performance of the designed equipment. During this phase, CFD studies shall confirm the expected behaviour of the fluids inside the heat exchangers, while seeking optimization of internal parts. Moreover, IKERLAN, CERTH and RINA began to build the geometries of the heat exchangers prior to digging into the complexity of modelling the molten salts and sCO_2 performance inside the units. In this framework, various CFD approaches have been tested to best exemplify what the expected behaviour of these fluids is, while flowing inside the shell side of the exchangers. This calculation stage consists in a large group of tasks that require both manufacturers and R&D partners to work together, sharing not only data and information, but also individual lessons learned, while working in their specific tasks. This collaboration is of paramount importance to select the optimum analysis approach, shorten iterative calculations and reduce the computational cost of the simulations. Following this work principle, the WP4 partners are confident that they will obtain valuable information about the flow distribution and heat exchange of the preliminary heater designs and will identify any necessary alterations required to obtain a better performance of the units.

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WP 5: Operational envelope of the demo cycle achieved.

A main objective of WP5 is to study the off-design and dynamic response of the demonstration site to be placed at the La Africana plant. To that end, a dynamic analysis tool was developed and validated in the first months of the project. Led by UNIGE, WP5 partners identified and later analysed the main control loops of the cycle, while inputs from the design of components from the other WPs were collected and implemented. Off-design analyses were then performed to study the operational envelope on the demo cycle and the influence of main control parameter, among others. The results of this study will be the foundation for further analysis in WP5 and will serve as the basis for the work in other WPs.

WP 8: Project video launched!

The SOLARSCO2OL consortium is pleased to announce that the project video has been launched. This promotional video is used for the dissemination of the project to a broad audience including policy makers, politicians, researchers, and the general public. It is uploaded to the Project's YouTube channel for easy sharing on social media, such as on Twitter and LinkedIn, and is also available at the media corner of the SOLARSCO2OL official website: https://www.solarsco2ol.eu/media-corner/.

Events Participation

Past events

The SOLARSCO2OL project hosted the webinar "Concentrated solar power (CSP) and sCO_2 – perfect match towards a zero-pollution future" as a partner event at EU Green Week 2021 on 4th June (Time: 10:30 – 12:00 CET). In this event, SOLARSCO2OL partners presented the project concept and how sCO_2 can be used in CSP power plant to archive the decarbonisation of energy system.

More information along with the partners' presentations and recording of the event is available here.

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The SOLARSCO2OL project organised the side event "Can an innovative sCO_2 CSP Plant design be a game changer?" at SolarPACES 2021 on 27th September at 17:00 UTC (19:00 CEST).

In this event, key partners presented the project concept, demo site plans, advancements in sCO_2 cycle and turbomachinery, as well as advancements in sCO_2 heat exchangers and molten salt electric heaters in SOLARSCO2OL Demo.

The agenda and recording of the event are available here.

Upcoming event

Supercritical CO_2 Power Cycles Symposium

7th International sCO_2 Power Cycles Symposium February 21, 2022 – February 24, 2022

The SOLARSCO2OL project will be presented in the 7th International Supercritical CO_2 Power Cycles Symposium, bringing together industry, academia, and government agencies to advance supercritical carbon dioxide power cycle technology. Dr. Rafael Eduardo Guédez from KTH will participate in the Symposium with the paper entitled "*First Year of the EU SolarSCO2OL Demonstration Project - Enabling Hybrid Supercritical CO_2 CSP Plants integrated with PV*" to present the project objectives and preliminary results from the conceptualisation phase in the first year of SOLARSCO2OL.

Relevant Sister Projects Collaboration: COMPASsCO$_2$

COMPASsCO$_2$

The Horizon 2020 COMPASsCO$_2$ project brings a series of key **innovations** in terms of **renewable energy system integration, material durability and process improvement**. Specifically, COMPASsCO$_2$ focuses on the efficient and reliable integration of storable energy provided by Concentrated Solar Power (CSP) systems into the innovative sCO_2 Brayton cycle. The **main components for a particle/sCO_2 heat exchanger** are designed, tested and validated in a relevant environment at the expected operating conditions.

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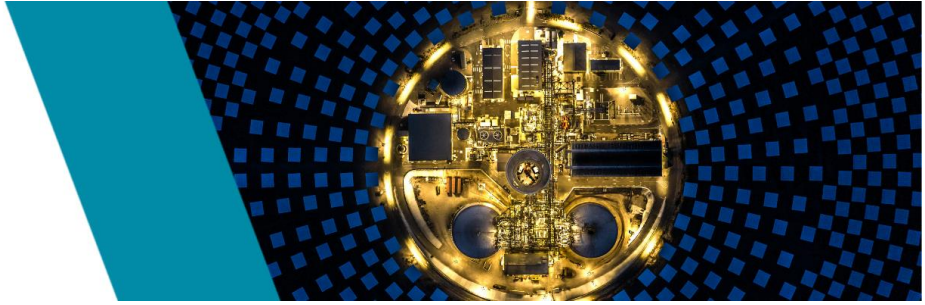

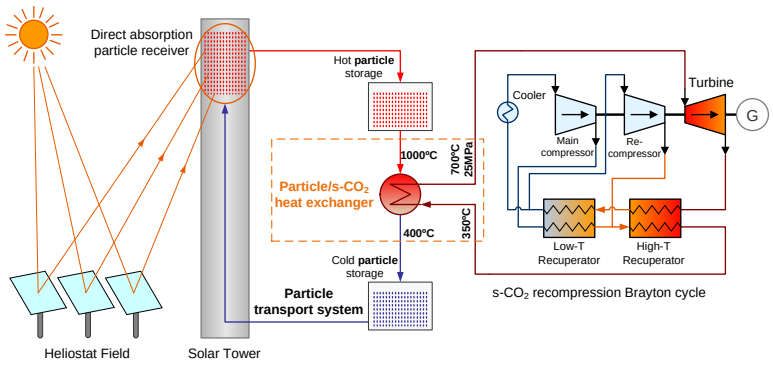

Conceptual design of a CSP plant with solid particles integrated into a sCO_2 Brayton cycle

The research focus of COMPASsCO_2 is on three main technological developments:

- **New particles:** In order for particles to have enhanced performance at high temperatures (stable at 900°C) **ceramic particles with new compositions or coatings** will be developed and tested under relevant conditions.
- **New metal alloys:** Answers about how the processing and combination with substrate steels will affect the microstructure, phase composition and also chemical stability of the newly developed materials will be provided. The **developed materials (monolithic and/or coatings) will be investigated in regard to their behaviour and performance at high temperatures (700°C) and high pressure (250 Bar) under the presence of sCO_2 and solid particles**.
- **Heat exchanger:** To validate the interaction between the developed particles, the new structural materials and sCO_2 in a relevant environment, the project includes the **design, construction and testing of a heat exchanger section**.

To learn more about the project's activities, please check the COMPASsCO_2 webpage and follow it in social media networks: COMPASsCO_2 COMPASsCO_2

The COMPASsCO_2 project has received funding from the European Union's Horizon 2020 Research and Innovation Action (RIA) under grant agreement No. 958418.

SOLARSCO2OL and COMPASsCO_2 will exploit synergies and develop joint communication and dissemination activities to present their R&D activities, exchange views on technological aspects, and increase visibility and impact of both projects.

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Social media: @Solarsco2ol @Solarsco2ol or look for **#SOLARSCO2OL** posts on social media.