NEWSLETTER

COMPASsCO$_2$

Contents

OCTOBER 15, 2021

Issue : II

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

Consortium: 12 partners from 7 countries

Research focus: New particles, metal alloys and heat exchanger

Duration: 1 November 2020 – 31 October 2024

Status of Implementation

ONE YEAR after the kick-off meeting that took place virtually on November 2nd, 2020, several results, deliverables, milestones have been achieved. All public deliverables and main activities are freely accessible through the project's website: https://www.compassco2.eu/. The section below summarizes the status of project activities by work package:

WP1 - MATERIALS OPERATION CONDITIONS AND THEIR FEASIBILITY STUDIES

WP1 focused first on investigating 10 sCO_2 Brayton cycles looking for the highest power block efficiency. Both particles and sCO_2 process parameters were then defined optimizing the sCO_2 cycle efficiency. Solar particle loop and particles-sCO_2 heat exchanger (HEX) designs were then carried out yielding to the pre-selection of materials withstanding these process parameters (high temperature and pressure). Based on it, state-of-the-art particle-alloy candidates were pre-selected. This led to the final choice of heat exchanger tube material and heat carrier particles in line with both manufacturing aspects and HEX design.

WP2 - DEVELOPMENT AND TESTING OF PARTICLES

In WP2, five different particle types are currently under characterization. Three of those particle types correspond to state-of-the-art bauxite proppants, originally developed for the oil and gas industry. Two novel particle types are being developed by Saint-Gobain specifically for solar thermal applications. One of them is based on a by-product of the steel industry (rich in iron) and the other one is based on a complex oxide system. Those particle types are being benchmarked against the state-of-the-art proppants in terms of durability and efficiency. The so far accomplished measurements involve: softening temperature, microstructural characterization, chemical composition, porosity, sphericity, hardness, room temperature wear resistance, optical absorptance and emittance spectra. Meanwhile the development of coatings to increase the absorptance of the particles is ongoing.

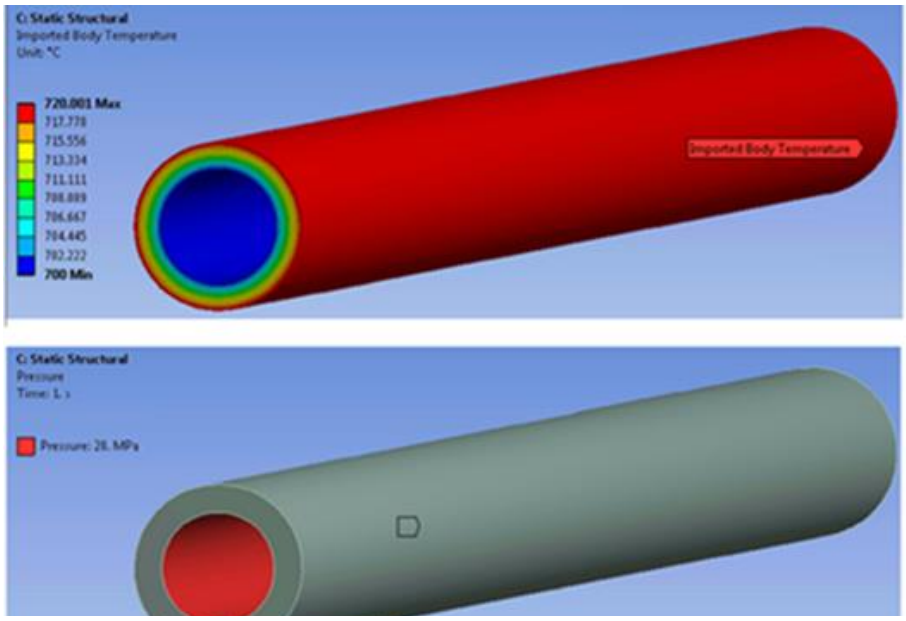
Novel particles bonded to a ceramic matrix composite substrate to be used in the high temperature abrasion test bench, which is currently under development
Credit: Gözde Alkan (DLR)

WP3 – DEVELOPMENT OF METALS

In WP3 ‘Development of Metals’ for particle to s-CO_2 heat exchangers, state-of-the-art commercial nickel and steel samples have been carefully selected and procured, and delivered for characterisation and mechanical evaluation. The research focus is on novel ‘Cr-based bcc-superalloys’ and Cr-silicides, regarding composition tailoring with modelling, microstructure demonstration & advanced characterisation, as well as mechanical studies, and environmental resistance. Within work package 3 there are close collaborations between partners, namely for the demonstration of mechanical properties & oxidation/corrosion resistance, and modelling of the newly developed Cr-superalloy and Cr-silicide materials.

Tom Blackburn (Left) and Kan Ma (Right) working on the Transmission Electron Microscope (TEM) at UoB

WP4 – EVALUATION AND MODELING OF METAL/MEDIUM INTERACTION



Exemplified stress distribution for boundary conditions 20MPa and 20K radial temperature gradient

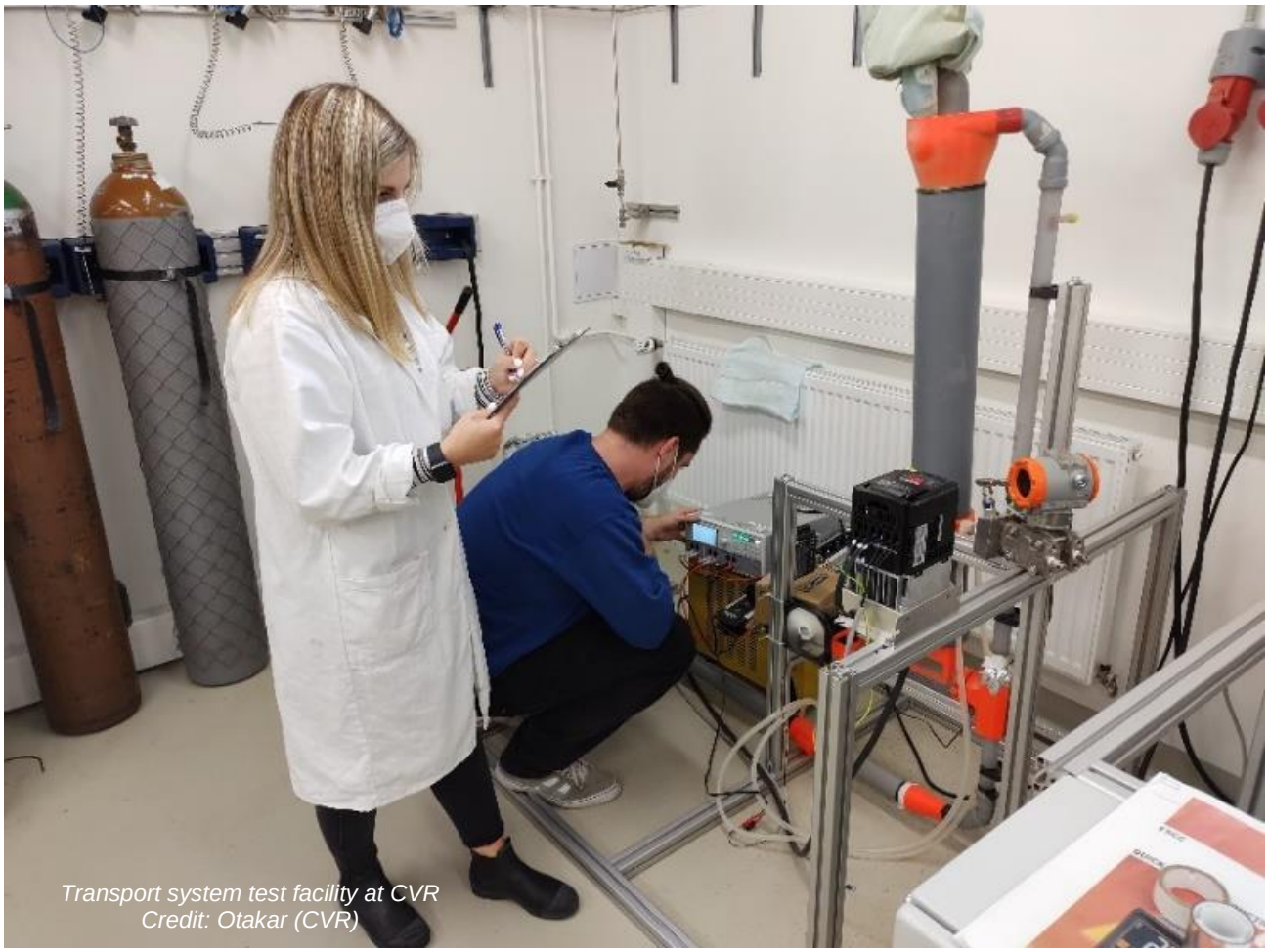
In WP4 the testing plan was designed so that it will provide all the experimental data needed for the modelling of the degradation behavior and lifetime estimation. For example, the relevant stresses for the tests were determined for a finite element model (see picture). The experimental materials have been distributed to the relevant partners and the tests are on-going.

WP5 - TECHNOLOGY VALIDATION

Development, fabrication and verification of the particles/sCO_2 HX as the key component of the technology being developed in the project is a goal of WP5. The experiments will be done according to the parameters defined in WP1, using construction materials and particles developed in the frame of WP2 and WP3. The key challenge for WP5 is the design, build-up, commissioning and successful operation of a particles test loop. For this reason, several experimental test benches and various experiments were proposed, specifically a cold test, hot heater verification, transport system test, long-term abrasion test, and finally evaluation of heat transfer and performance measurements of the developed particle/sCO_2 heat exchanger.

The cold test experiment will provide the team with two important results. At first, the optimal tube distribution in the heat exchanger will be identified. Further, the design of the long-term experiment will be verified and therefore the homogenous particle flow during the abrasion tests will be assured. The design of the cold test facility is being finalized and its fabrication is about to begin.

The particles transport system was identified as a possible weak point of the long term experiments. Therefore, it is being intensively solved. The pneumatic transport system was identified as the best candidate technology. For this reason, a simplified test facility was assembled and tested. The required mass flow of the particles was reached and the system seems to be suitable for the following experiments. Further aspects as power consumption and particle damage are evaluated.



Transport system test facility at CVR
Credit: Otakar (CVR)

COMPASsCO$_2$ First Stakeholders Workshop

In order to interact with stakeholders to exchange knowledge, validate results and identify areas for collaboration, the first COMPASsCO$_2$ stakeholders workshop was organized on June 10th via video-conferencing.

The workshop had the purpose **to introduce the project, discuss the main research activities conducted, and identify areas in which to cooperate with other projects, institutions or companies**.

The main **focus areas** for this workshop were:

- the use of concentrating solar technology and its integration in the Brayton cycle;
- evaluation of state-of-the-art materials that could withstand the extreme operating conditions; and
- research, development and testing of innovative materials that guarantee reliability and sustainability under harsh conditions.

Daniel Benitez

Scientist at the Institute of Solar Research, Systems Qualification Group,

DLR

Welcome, Project Overview and Objectives

Lukas Heller

Scientist at the Institute of Solar Research, High Temperature Technologies Department,

DLR

Charly Rensonnet

Development engineer at Solar and Thermal Storage Department,

JC

Investigated system: Description of solar plant combined with Brayton cycle, benefits and limitations

Xabier Montero

Senior Scientist at the High Temperature Materials Group, Dechema-Forschungsinstitut

DFI

Materials for heat exchangers' tubes: selection, development and evaluation

Samuel Marlin

R&D Director of the Specialty Grains & Powders Division in the Ceramic Materials Branch

SGCREE

Materials for heat carrier particles: selection, development and evaluation

The workshop was addressed to researchers, EU and international consortia working on similar topics, industry representatives and any other interested stakeholder willing to learn more about innovation for sustainability in industry. More than **50 participants** attended the workshop. Through a dedicated questionnaire, participants provided their feedback on the workshop and expressed opinions on the future role of the investigated technologies:

%	Item	Evaluation
83	Overall event	Excellent/very good
83	Workshop allocated time	About right
66	Communication materials	Sufficient
n/a	CSP plants with particles as heat carriers are a good contributor to solve the energy challenges in the industrial heat and electricity sector?	Yes, but proof concerns were raised
n/a	sCO_2 Brayton cycle is a promising technology for power plants?	Yes for large plants, but more work is needed to prove.
n/a	The possibility to use materials being developed in COMPASsCO_2 for other technologies	Tube materials can be used for producing ethylene in crackers, tube and shell materials for fluidized catalytic crackers, heat exchanger as a recuperator for making hydrogen using high temperature electrolysis
n/a	Topics for future webinars	organize joint sCO2-CSP projects workshops

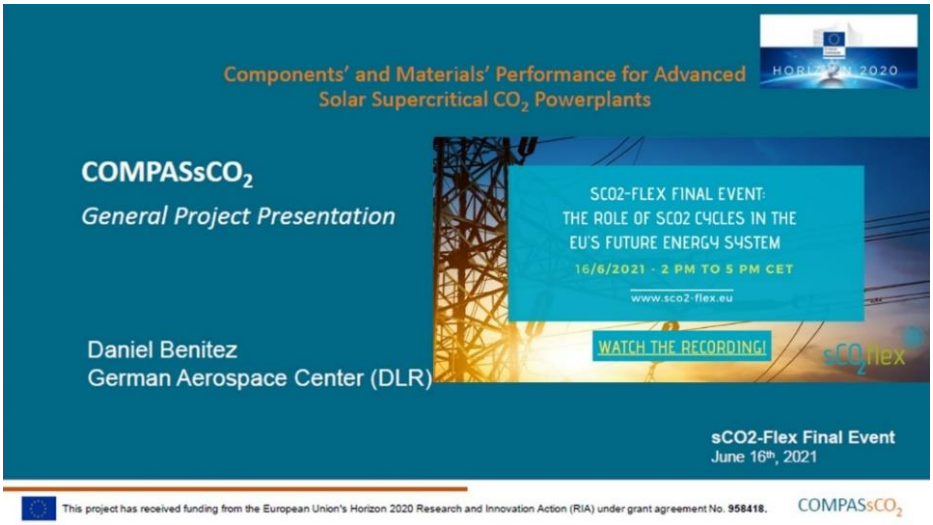
The workshop presentations can be downloaded through the project's webpage.

COMPASsCO_2 activities presented at SolarPACES

A poster presentation developed by Saint-Gobain CREE, one of the COMPASsCO_2 project participants, was presented at the 27th SolarPACES conference edition, which took place online from September 27th to October 1st. The presentation gives an overview of all the thermal energy storage media manufactured by Saint-Gobain for CSP, ACAES and sensible heat applications, which includes preliminary results on development of granulated and fused particles in comparison to current state-of-the-art sintered bauxite.

Joint activities with similar projects

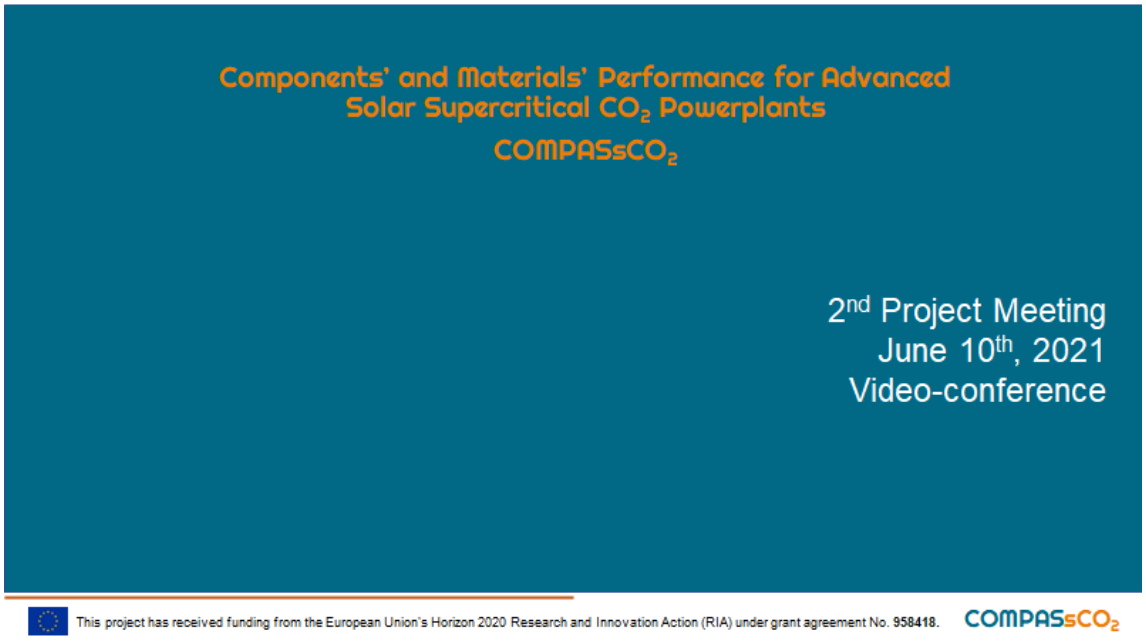
Within the framework of SCO2-FLEX project final event "The Role of sCO2 cycles in Europe's future energy system," Daniel Benitez (project coordinator – DLR) gave a presentation, including an overview of COMPASsCO$_2$ project, in terms of concept, objectives & scope, technical description, current results and cooperation potential with similar projects.



Meetings

Second project meeting - The 2nd project meeting took place on June 6th. The meeting was organized virtually. It gathered the project's participants who discussed the overall progress, on-going activities, challenges, and next steps.

Dedicated WP Meetings – Several dedicated WP meetings were organized to discuss the technical aspects of the project with involved partners.



Networking with SOLARSCO2OL

SOLARSCO2OL is an EU H2020 funded project aiming at developing an innovative, economically viable and easily replicable supercritical CO2 (sCO2) power block for demonstrating the use of sCO2 cycles as a potential key technology to increase the flexibility of concentrated solar power (CSP) plants, also studying their hybridization with PV plants thanks to the integration of an Electric heater that properly coupled with molten salt storage tank can facilitate the integration of sCO2 power blocks with state of the art CSP plants/solar fields. This will reduce their Levelised Cost of Electricity to values below 10 c€/kWh in Europe and promote an innovative power plant cycle layout not requiring water.

The innovative SOLARSCO2OL plant layout, coupled with fast-reactive electric heaters and efficient heat exchangers, will enable the operation and design of novel integrated CSP plant layouts.

The 15-partner consortium is led by RINA Consulting and KTH, with participation from ESTELA, 3 other research centres (UNIGE, Ikerlan and CERTH), and 9 prominent industries from the CSP and turbomachinery sectors (Abengoa, Magtel, Masen, SEICO, Lointek, MAS Europe, Baker Hughes, Franco Tosi Meccanica, and OCMI OTG).

Learn more: https://www.solarsco2ol.eu/

Stay connected with us on:

- @Solarsco2ol
- @Solarsco2ol

or look for #SOLARSCO2OL posts on social media.

How to get involved in COMPASsCO$_2$ activities

Become a member of the project's stakeholders' network

Whether you want to learn more about specific WP activities, collaborate with the consortium or act as an external expert, kindly contact us at contact@compassco2.eu. We will keep you updated about project activities, invite you to attend the project's public events and ask your feedback on the progress and main outcomes of the project.

Check our website and follow us on social media networks

https://www.compassco2.eu/

THANK YOU

For more information

Check the project's website: www.compassco2.eu

Contact us: contact@compassco2.eu

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