

COMPAS_sCO₂

PROJECT OVERVIEW

DANIEL BENITEZ, DLR

COMPAS_sCO₂ Second Stakeholders Workshop

*Next generation advanced materials for
particle/supercritical CO₂ heat exchangers*

Hybrid- physical venue: Hotel Anker,
Kolpingstraße 7, 97828 Marktheidenfeld,
Germany
Online: Zoom

September 25th, 2023
11h00 – 15h00 CET
No registration fees

Presentation Structure

- About COMPAS_sCO₂
- Project Overview
- Workshop Objectives

About COMPASsCO₂

The project “**Components’ and Materials’ Performance for Advanced Solar Supercritical CO₂ Powerplants**” is funded by the EU’s H2020 Research and Innovation Action supported by the “Sustainable Process Industry through Resources an Energy Efficiency” (spire2030.eu) association.

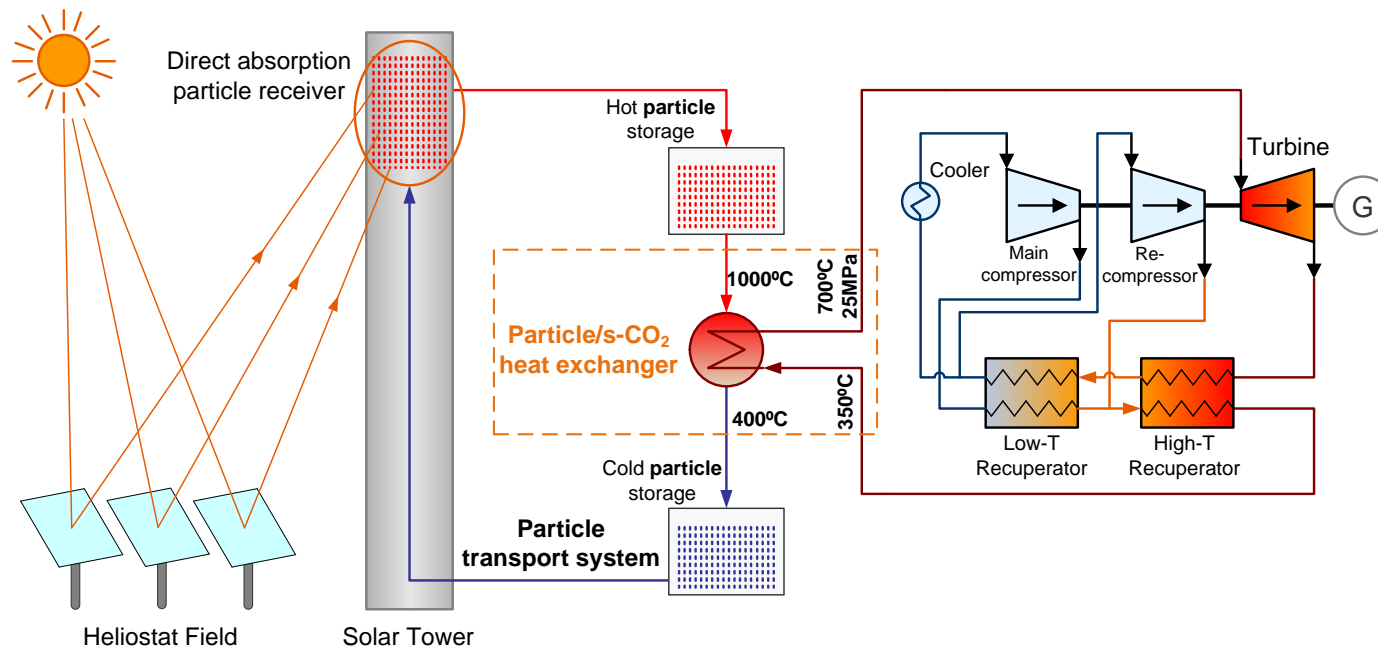
Project start: November 2020

Project end: October 2024



Project Goal

COMPAS_sCO₂ aims to integrate CSP particle systems into highly efficient sCO₂ Brayton power cycles for electricity production.

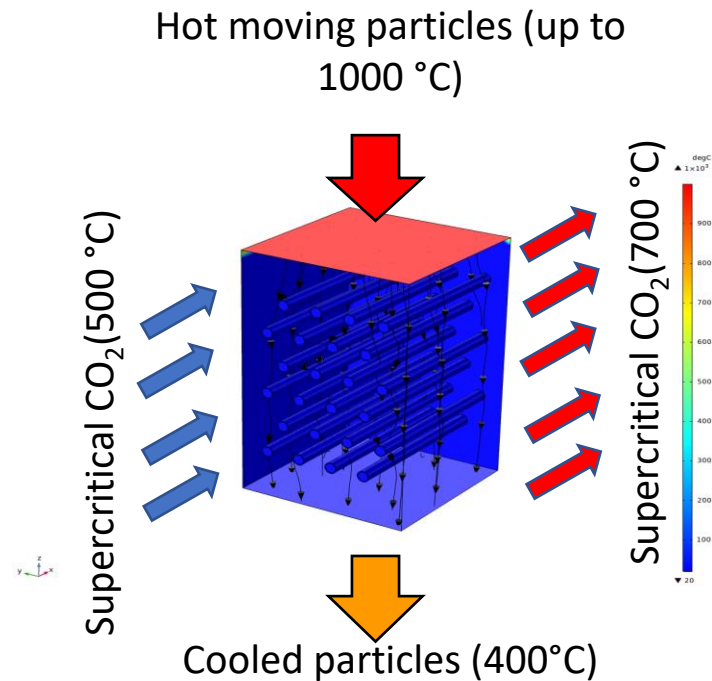


CSP Plant with particles

sCO₂ Brayton cycle

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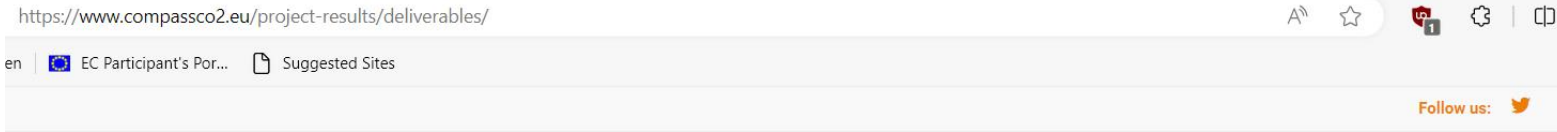
Project Objectives

- Develop highly durable and efficient particles for CSP plants
- Develop optimized structural materials for heat exchanger tubes in contact with particles and sCO₂
- Demonstrate material lifetime by measuring and modeling the degradation of the materials
- Design, construct and operate a particle/sCO₂ heat exchanger section in order to validate the degradation and heat transfer models
- Evaluate the economic benefits of a CSP sCO₂ plant using the materials and components developed in COMPASsCO₂ in comparison to state-of-the-art CSP plants

Workshop Focus

- Develop highly durable and efficient particles for CSP plants
- Develop optimized structural materials for heat exchanger tubes in contact with particles and sCO₂
- Demonstrate material lifetime by measuring and modeling the degradation of the materials
- Design, construct and operate a particle/sCO₂ heat exchanger section in order to validate the degradation and heat transfer models
- Evaluate the economic benefits of a CSP sCO₂ plant using the materials and components developed in COMPASsCO₂ in comparison to state-of-the-art CSP plants

Current Results: 7 Public Deliverables



COMPASsCO₂

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COMPONENTS' AND MATERIALS' PERFORMANCE FOR
ADVANCED SOLAR SUPERCRITICAL CO₂ POWERPLANTS

Process parameters of solar sCO₂ Brayton cycle

Deliverable Number 1.1

WP1 "Materials operation conditions and their feasibility studies"

Date: January 13th, 2021

Deliverable type: Report

Dissemination level: Public

Lead participant: John Cockerill

COMPONENTS' AND MATERIALS' PERFORMANCE FOR
ADVANCED SOLAR SUPERCRITICAL CO₂ POWERPLANTS

Process Parameters of Solar Particle Cycle

Deliverable 1.2

WP1: Materials operation conditions and their feasibility studies

Date: January 31st 2021

Deliverable type: Report

Dissemination level: Public

Lead participant: DLR

Particle optimization by surface treatment

Deliverable Number 2.1

Version: 1

WP2: Development and Testing of Particles

Date: November 3rd, 2022

Deliverable type: Report

Dissemination level: Public

Lead participant: CIEMAT

Particle optimization by modifying chemical composition

Deliverable Number: 2.2

WP2: Development and testing of particles

Date: November 16th, 2022

Deliverable type: Report

Dissemination level: Public

Lead participant: Saint-Gobain CREE

Demonstration of New Cr aluminides and production of coupons for WP4 testing

Deliverable Number: 3.1

WP3: Development of Materials

Date: November 3rd, 2022

Deliverable type: Report

Dissemination level: Public

Lead participant: University of Birmingham

Demonstration of new Cr silicides and production as coupons for WP4 testing

Deliverable Number: 3.2

WP3: Materials Development

Date: November 4th, 2022

Deliverable type: Report

Dissemination level: Public

Lead participant: DECHEMA Forschungsinstitut (DFI)

Production of optimised steel / Ni substrates with advanced Cr aluminide/silicide coatings, coupons for WP4

Deliverable Number: 3.3

WP3: Development of metals

Date: June 2nd, 2023

Deliverable type: Report

Dissemination level: Public

Lead participant: OCAS

Current Results: 4 Newsletters



NEWSLETTER 1

April 2021



NEWSLETTER 2

October 2021



NEWSLETTER 3

April 2022







NEWSLETTER 4

November 2022

Current Results: Presentations and Papers

Lead Participant	Type of activity	Event/Media	Name of Event/Journal, etc	Place	Date	Description of the action (general info about the project, event announcement, etc.)
UoB	Oral presentation	Conference	TMS 2023	San Diego, USA	19-23/03/2023	Chromium-based bcc-Superalloys Tailored by Iron Addition
UoB	Poster	Conference	TMS 2023	San Diego, USA	19-23/03/2023	Mechanical Testing of Novel Chromium Superalloys Strengthened by Intermetallic Precipitates
DFI	Oral presentation	Conference	TMS 2023	San Diego, USA	19-23/03/2023	Alloys of Chromium-Silicon Alloys with Iron and Nickel for Structural High Temperature Applications
CIEMAT, DLR	Oral presentation	Conference	MRS 2023	San Francisco, USA	10-14/04/2023	Material candidates for the heat exchanger tubes for solar sCO ₂ Brayton cycles
CIEMAT	Oral presentation	Conference	MRS 2023	San Francisco, USA	10-14/04/2023	Advances in Optical Coating Materials for CST
DFI	Oral presentation	Conference	GFKORR	Frankfurt, Germany	11-12/05/2023	Heat exchangers for particle-based solar thermal power plants: Reduction of high temperature corrosion and erosion through new Cr-Si slip coatings
VTT	Poster	Conference	Euro Nano Forum	Lund, Sweden	11-13/06/2023	Ab initio study on the effect of alloying elements for Cr-based superalloys toward next generation concentrated solar power
UoB	Presentation	Conference	Thermec 2023	Vienna, Austria	2/7/2023	Mechanical Properties of Novel Chromium Superalloys for High Temperature Applications
SGCREE	Oral presentation	Conference	ECERS 2023	Lyon, France	2-6/07/2023	New ceramic media for Concentrated Solar Power (CSP) Plants

Lead Participant	Name of Journal	Date	Description of the action
DLR		31/05/2022	Improved Performance of Ceramic Solar Absorber Particles Coated with Black Oxide Pigment Deposited by Resonant Acoustic Mixing and Reaction Sintering
UoB		26/05/2023	Accurate identification and measurement of the precipitate area by two-stage deep neural networks in novel chromium-based alloys
DLR		04/07/2023	Variability and associated uncertainty in image analysis for soiling characterization in solar energy systems
UoB		26/07/2023	Chromium-based bcc-superalloys strengthened by iron supplements

Agenda

Time	Topic	Speaker(s)
11:00 – 11:15	Welcome Coffee	
11:15 – 11:25	Welcome, Project Overview (CSP HEX) and Workshop Objectives	Daniel Benitez, DLR
11:25 – 12:15	Session 1: Advanced materials for abrasive environments (Exterior HEX wall)	Mathias Galetz, DFI
11:25 – 11:40	External wall investigation results	Florian Lebendig, FZJ
11:40 – 11:55	Development of new materials	Thomas Blackburn, UoB
11:55 – 12:15	Roundtable discussion with stakeholders	
12:15 – 13:15	Networking Lunch	

Agenda

Time	Topic	Speaker (s)
13:15 – 13:45	Keynote Speech: Current status of materials for sCO ₂ processes for more efficient and sustainable energy systems: approaches and challenges	Bruce Pint, ORNL
13:45 – 14:55	Session 2: Material behaviour in sCO₂ environment (Interior HEX wall)	Mitsutoshi Ueda
13:45 – 14:00	Materials requirements for sCO ₂ (oxidation/carburization)	Dmitry Naumenko, FZJ/CIEMAT
14:00 – 14:15	Testing results on state-of-the-art materials (mechanical properties - creep)	Christoph Grimme, DFI
14:15 – 14:30	Exploitation opportunities: an industrial perspective	Company participants
14:30 – 14:55	Roundtable discussion with stakeholders	
14:55 – 15:00	Concluding Remarks & Takeaways	Daniel Benitez, DLR
15:00	End of meeting	



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

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ENJOY THE WORKSHOP!



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UNIVERSITY OF BIRMINGHAM



VTT

