



Solar based sCO₂ Operating Low-cost plants

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Presentation structure

- Project Summary
- Objectives & expected impact
- Main preliminary results/outcomes
- Options for exploitation/collaboration activities

Project summary



Funding source	H2020_LC-SC3-RES-35-2020
Budget	Approx. 15 M EUR total (10 M EUR Grant Agreement No. 952953)
Duration	48 months (start: October 2020) – Currently under amendment
Start-End TRL	5-7



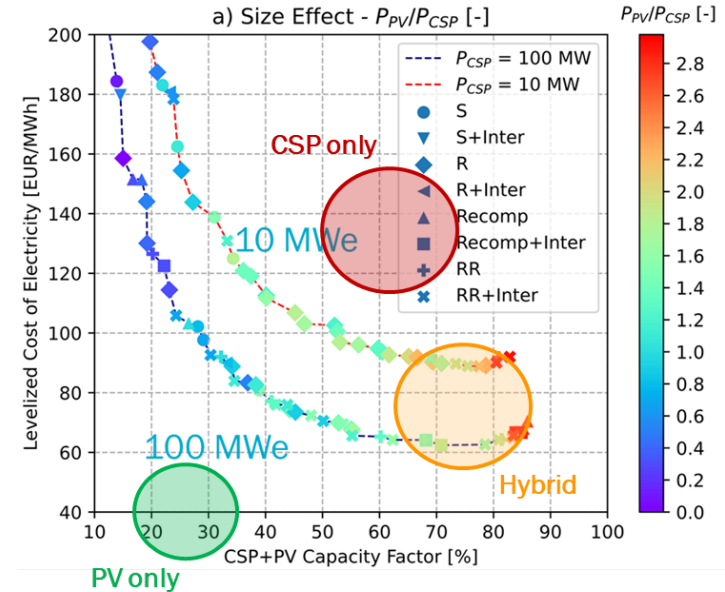
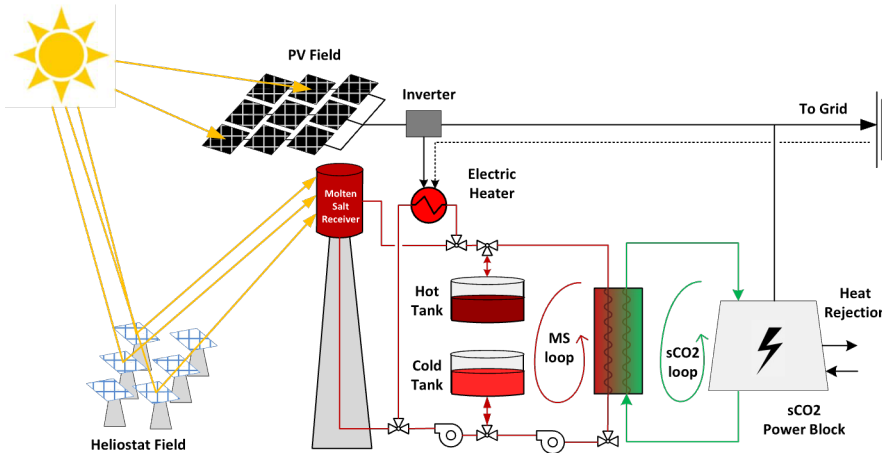
Objectives



1. Demonstration of MW scale sCO₂ cycle (operating from molten salts)
 - 2 MW-scale simple-recuperated cycle, including new turbomachinery and HEx
2. Demonstration of MW scale molten salt electric heaters
3. Techno-economic investigations of high temperature Hybrid PV-CSP-sCO₂ power plant layouts (incl. Gen 3 and new HTFs)

Expected impact (vision)

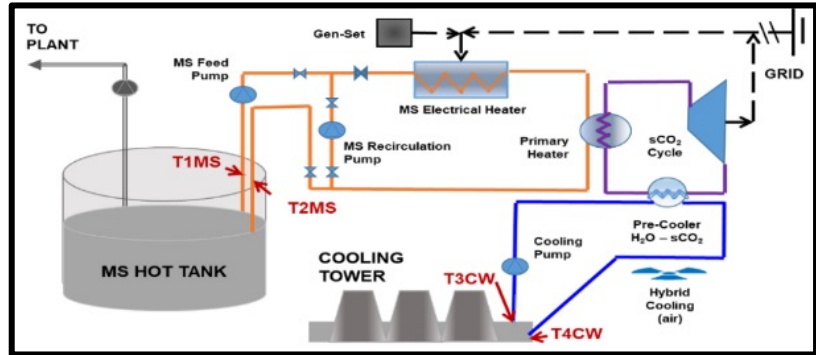
- Cost-competitive hybrid PV-CSP-sCO₂ using conventional “solar salts”



Demo site

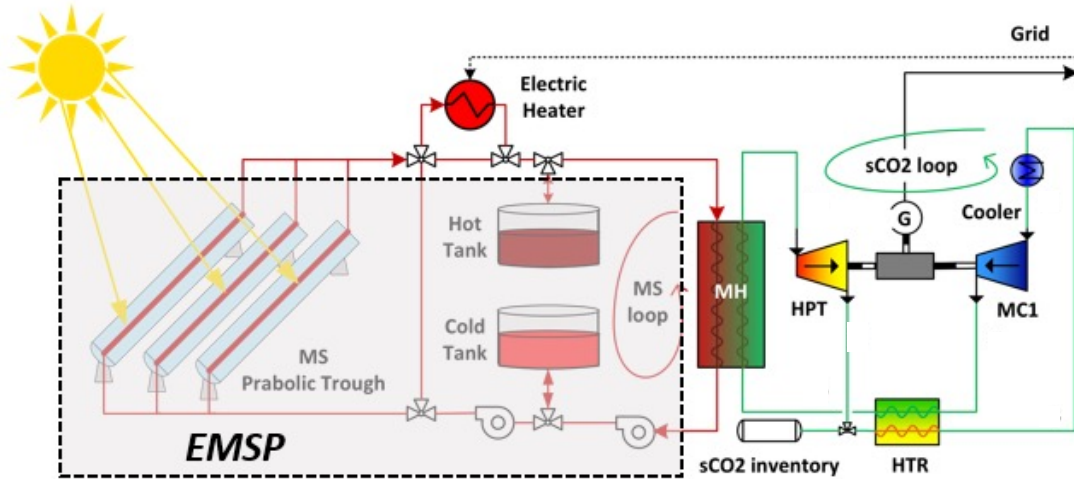


- Initial goal: direct integration in operating CSP plant in southern Spain
 - Taking advantage of existing molten-salt system, cooling and infrastructure (utilities)
- Frustrated due to new ownership – new site under investigation



Demo site (new)

- Discussions on-going for new demo-site and integration plan
 - Awaiting approval from EC.
- Simple-recuperated cycle (same as initially proposed)

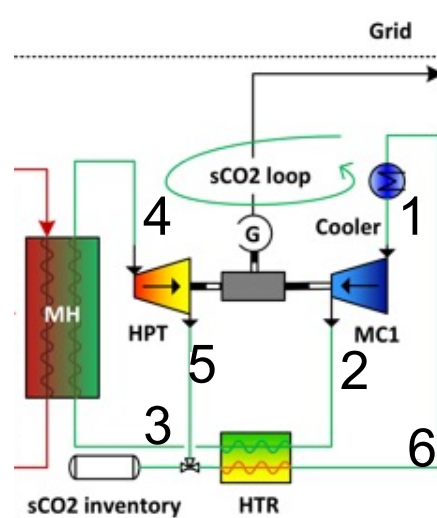
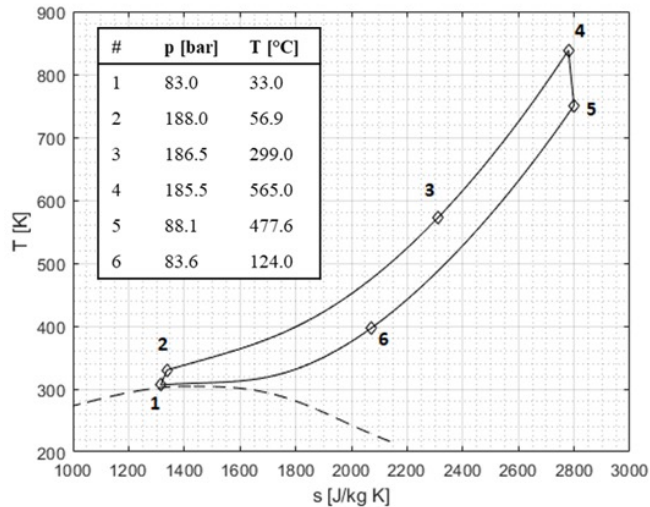


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Preliminary Results

- Cycle specification and optimization based on costs and scalability

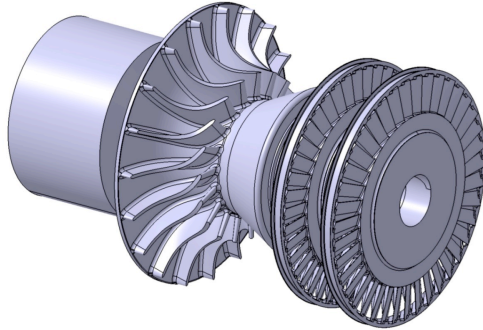


Parameter	DEMO SC-R 2 MW	Upscaled SC-R 10 MW	Upscaled RR 100 MW
Total efficiency [%]	21.3	31.4	49.5
Compressor eff. [%]	67.2	75.0	84.0
Re-compressor eff. [%]	-	-	88.0
Re-compressor slit [%]	-	-	31.0
Turbine(s) efficiency [%]	86.5	88.5	92.0
Mechanical eff. [%]	96	98	99
Electrical efficiency [%]	96	98	99
Turbine Inlet P [bar]	185.5	185.5	250.0
Intermediate P [bar]	-	-	165.0
Δp Heater [bar]	1	1	1
Δp Hot side Recup. [bar]	4.5	2	2
Δp Cold side Recup [bar]	1.5	1.5	1.5
Δp Cooler [bar]	0.6	0.6	0.6
Recuperator(s) Eff. [%]	80	95	95

Preliminary Results

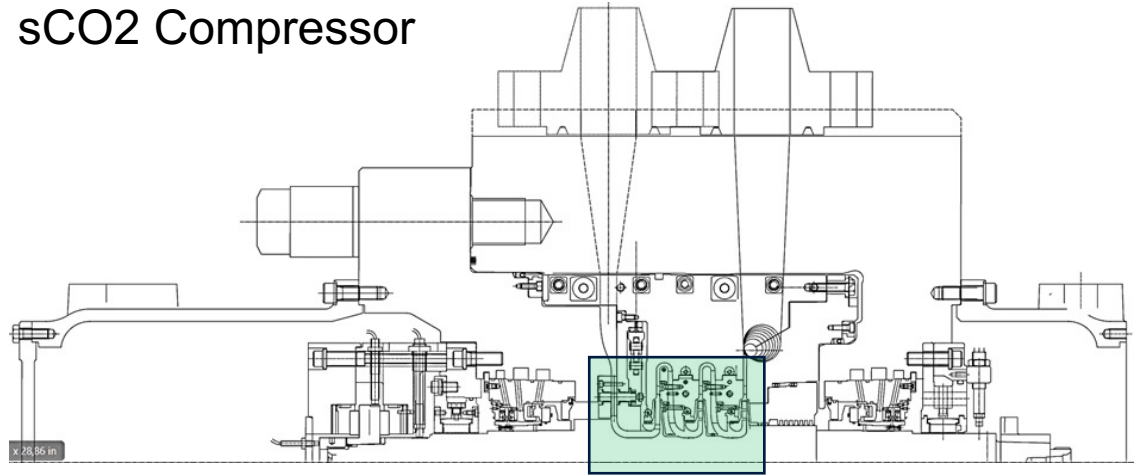
- Turbomachinery conceptual design

sCO₂ Turbine



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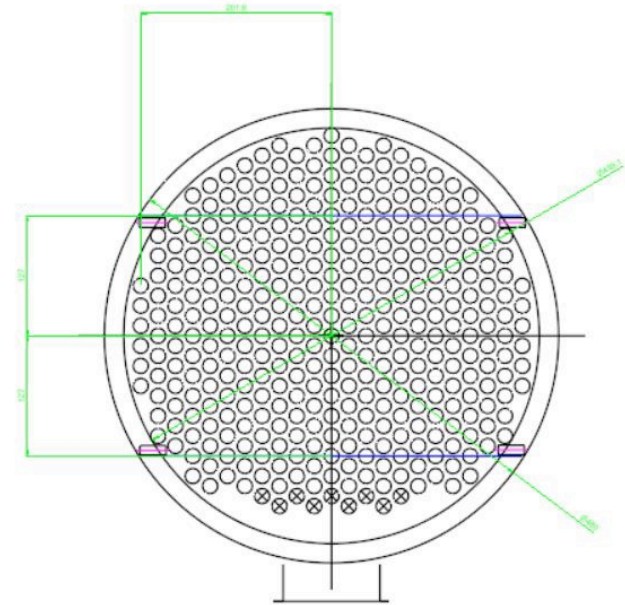
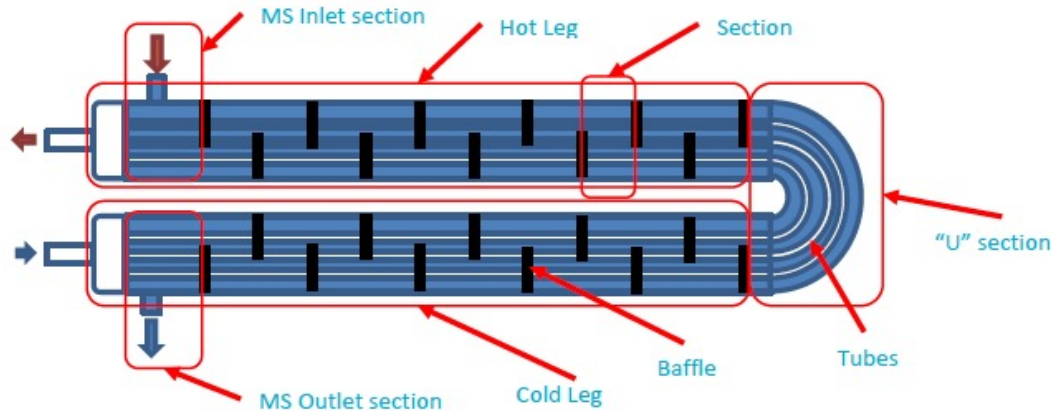
sCO₂ Compressor



Baker Hughes

Preliminary Results

- Primary molten salt to sCO₂ HEx
 - **CO₂**: in: 186.5 bar; 299 °C; out: 185.5 bar, 565°C
 - **MS**: in: 3 bar; 580°C; out: 2.65 bar, 380°C





Summary

- SOLARSCO2OL is a 4-year project, 15 partners (+2?), approx. 15 M€ (10 M€ EU grant).
- Project goal: demonstrate a 2 MW sCO₂ cycle and MW-scale electric heater to enable near-term cost-competitive sCO₂ CSP – PV plants (FOAK in EU)
- Achievements: system conceptualization, demo pre-engineering and component design.
- Challenges presented related to site – final site yet to be determined.
- Conservative approach: turbine 565°C, 185.5 bar; compressor T = 33 C; P: 83:188 bar
- Turbomachinery scalable up to 10 MW, possibly more:
3-stage turbine (1 rad + 2 ax), 30'000 rpm; 3-stage centrifugal compressor, 12865 rpm
- Primary HEx scalable undergoing CFD based optimization. Recuperator under design.

Options for collaboration

Following activities are carried within the consortium, but collaboration with third parties could be possible:

- Evaluation and optimization of hybrid CSP-PV plants
- High-fidelity CFD and FEM for component design optimization
- Testing and modelling of material degradation

Scientific publications, joint dissemination events, etc.

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