CO2OLHEAT NEWSLETTER

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Let's meet CO2OLHEAT!

EU Horizon 2020 project aiming at waste heat recovery and its conversion into electricity via sCO_2 power cycles. CO2OLHEAT will be demonstrated in a real industrial environment at high Technology Readiness Level (TRL7).

This is Rene Vijgen, the Project Coordinator

Rene joined ETN Global in September 2021 to replace Ugo Simeoni as the Project Coordinator. Previously he worked as a Head of Sulzer's Gas Turbine Services EMEA and was involved in the business growth in China and Russia. He started his career as an R&D engineer in gas turbine component repair and gradually took over different management positions in the turbomachinery service business. Rene studied Mechanical Engineering and received a PhD degree at Eindhoven, University of Technology.

Rene, can you please summarise the CO2OLHEAT project's main goals?

Design, production and full integration of a sCO_2 waste heat recovery system into a cement plant that delivers 2MW electrical power. This system aims at being economically profitable, innovative and replicable.

What do you perceive as the main challenges in this project?

The biggest challenges, at the same time extremely exciting, are the high Technology Readiness Level (TRL 7) and the tough nature of the demonstration site. Next to this, we must pay attention to the typical project management triangle: deliver the project scope within the given budget and time.

Communication highlights

- CO2OLHEAT's website is now online! www.co2olheat-h2020.eu
- The project's leaflet, poster and roll-up banner are completed and available online
- The CO2OLHEAT's YouTube channel is live!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022831. The information and views set out in this document are those of the authors and do not necessarily reflect the official opinion of the European Union.

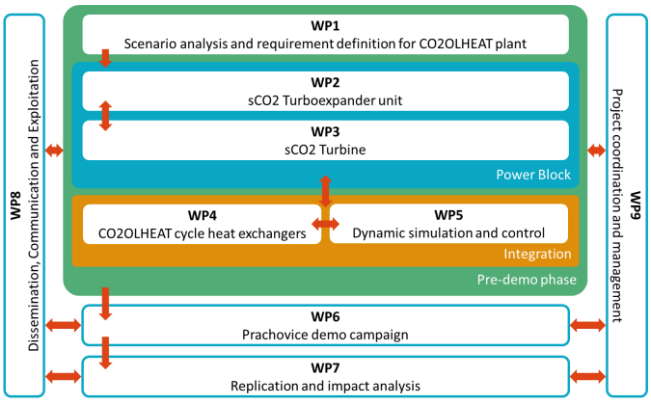
CO2OLHEAT's update

CO2OLHEAT project officially started on 1 June 2021. Much work was concentrated on **Work Package 1 (WP2) – Scenario analysis and requirement definition for CO2OLHEAT plant** (led by Roma Tre University). In this context, the preliminary cycle for the sCO_2 demo plant and the heat and mass balance for each key component are assessed. It will be used as a reference starting point for the design of the main components, the industrial plant integration, the thermodynamic and economic optimisation, and the off-design analysis of the WHR plant. As a result, the first deliverable of this WG was elaborated: **1.1 – Preliminary CO2OLHEAT cycle layout**. This deliverable contains the selection of the cycle concept among various options, taking into account different criteria.

WP3 – sCO_2 Turbine (led by Siemens Energy) also submitted its first deliverable: **3.1 – sCO_2 Turbine feasibility design and proper material definition**. A preliminary blade path has been designed, and the overall turbine performance has been calculated. Furthermore, a first concept for integrating the core turbine with all relevant auxiliary systems, the gearbox and the generator on a turbine skip has been defined, and preliminary scope of the supply list is provided.

WP2 – sCO_2 Turboexpander (led by Baker Hughes) started with the launch of the project. From Baker Hughes (BH) side, the first addressed topics have been related to the trade-off analysis for the definition of the turbines interconnection (cascade vs parallel) and the definition of the compressor inlet condition requirements to guarantee operability and controllability of the overall plant. Once the cycle conditions have been frozen (WP1), Baker Hughes's engineering team has managed several design activities on the turboexpander allowing to define the mechanical architecture, the train control philosophy, the dry gas seal configuration and leakages, the preliminary performance curves and the preliminary rotordynamic behaviour of the shaft-line. In parallel, BH defined material samples (related to the turbines) for the compatibility test with CO_2 and the related test conditions that will be used by RINA-CSM lab; the aerodynamic design in collaboration with PoliMi has been also kicked off. On this side, PoliMi has performed a computational fluid dynamic (CFD) assessment of the sCO_2 compressor, whose intake thermodynamic conditions are close to the critical point, studying multiple thermodynamic models to consider non-ideal and two-phase effects. Similarly, PoliMi is now working on the CFD assessment of the sCO2 radial turbines of the turboexpander. Finally, PoliMi has developed a 3D geometry parametrization for radial turbomachinery bladings and channels, to be applied in the forthcoming months for the shape-optimization of the first impeller of the sCO_2 compressor.

WP4 – CO2OLHEAT cycle Heat Exchangers (led by Bosal) faces many challenges, as the demo plant environment is demanding due to its dusty nature. WP4 elaborated deliverable **4.1 – HEXs for sCO_2 WH2P Plant pre-design**. The boundary conditions for the heat exchangers were determined in WP1, using the design of the overall power cycle. The architecture, heating surfaces, most suitable materials and configuration of the fluid path are determined in this deliverable report. Deliverable **4.2 – Recuperator pre-design** reflects operating conditions resulting from WP1 at this stage. However, these designs are considered preliminary until the influence of part load/off-design conditions can be determined.



At the same time, the Consortium worked very hard on the overall project plant engineering, led by SimeROM which assigned a dedicated Project Engineer to lead the overall development. The first Basic engineering document have been issued and shared among the partners, to fix the basis of the plant development. Lots of emphases was then given to the choice of the CO2OLHEAT plant location inside the existing plant, a critical decision that will have deep influence also on safety, maintenance and replicability aspects. Target has been set to complete this choice and to fix the plant Process Flow Diagram within the first quarter, as per agreed project overall schedule.

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Interview with CO2OLHEAT partners:

Ambra Giovannelli, Assistant Professor of Fluid Machinery and Energy Conversion Systems (Roma Tre University) and **Matteo Baggiani**, Business Unit Manager (SimeROM)

What is your role in the project?

Ambra: Roma Tre covers the modelling activities related to the CEMEX demo plant in Prachovice in the Czech Republic. This means a definition of the overall waste heat recovery system layout and its integration in the existing cement plant facility. It also includes the demo cycle modelling and optimisation from the thermodynamic and economic point of view. There are also other partners involved in this work package because we need many diverse skills to manage all the activities.

Matteo: SimeROM is an engineering and construction company. Its role in the project will be to prefabricate Power-Cycle Independent Modules in our workshops, assemble, and install them in the CEMEX demonstration plant in Prachovice. This is an essential task in the project as the modules represent a full-scale prototype. To have it installed and make it work in a real industrial plant environment is a big challenge but also a huge advantage of this project. We are not talking here only about R&D, but about an actual demonstration.

Read the whole interview

Our first GA took place in Prachovice

CO2OLHEAT partners gathered for their 6-month's General Assembly on 23 and 24 November 2021. Despite the adverse pandemic situation, several colleagues arrived at the venue – the project demonstration site of CEMEX cement plant in Prachovice (CZ). Next to the virtual meetings, a CEMEX plant tour was planned for the physical participants, where the cement production process was shown.

At the same time, they got familiar with the demo site challenges. The site tour also brought an aural experience: the omnipresent noise of the fascinating giant rotational kiln reminded us where the heat for the CO2OLHEAT project would come from.

Furthermore, the project coordinator visited the Mayor of Prachovice to present her the project, its objectives and the timeline. We agreed to keep the Prachovice community informed also by means of their newsletter contribution.

The next GA will take place in May 2022.

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CO2OLHEAT on the stage

Since its kick-off, CO2OLHEAT was present in quite a few events:

- ORC Munich (presentation, Oct 2021)
- International Gas Turbine Conference (virtual booth, Oct 2021)
- Şişecam's glass symposium (keynote speech, Nov 2021)
- SET Plan Conference (online presentation, Nov 2021)
- and Enlit Europe (online presentation, Nov 2021)

Moreover, the project was featured in the official SET Plan Action 6 video.

Soon, CO2OLHEAT will present its brand new technical poster at the Supercritical CO_2 Power Cycles Symposium in the USA in February 2022. Several CO2OLHEAT partners will participate as speakers (The University Duisburg-Essen, Politecnico di Milano, Baker Hughes, Heatric). Next to this, the project will have a presentation in the webinar of the European Aluminium Innovation Hub in March 2022.

CO2OLHEAT project Consortium

Get in touch with us!

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