

NEXTOWER

ADVANCED MATERIALS SOLUTIONS FOR NEXT GENERATION HIGH EFFICIENCY
CONCENTRATED SOLAR POWER (CSP) TOWER SYSTEMS

FOREWORD



Dr. Antonio Rinaldi
NEXOWER Project Coordinator

Dear reader,

too often, we hear news about this or that European Project. For those working in this field is something happening daily so we do not get excited about everything. In this way, it is easy to think of NEXOWER as "another European Project".

More than four years ago #NEXOWER began a hopeful project that aimed at helping the energetic future of Europe thanks to the commitment of 19 partners spread throughout the continent.

Today, four years later, NEXOWER comes to its natural end. In this issue, we will try to resume all the results, achievements and goals obtained during this long period of time.

In these four years we have become more than just "partners", we have also developed friendships, and probably this is the most important thing not only for us but for Europe itself, because it represents a common ground to build on!

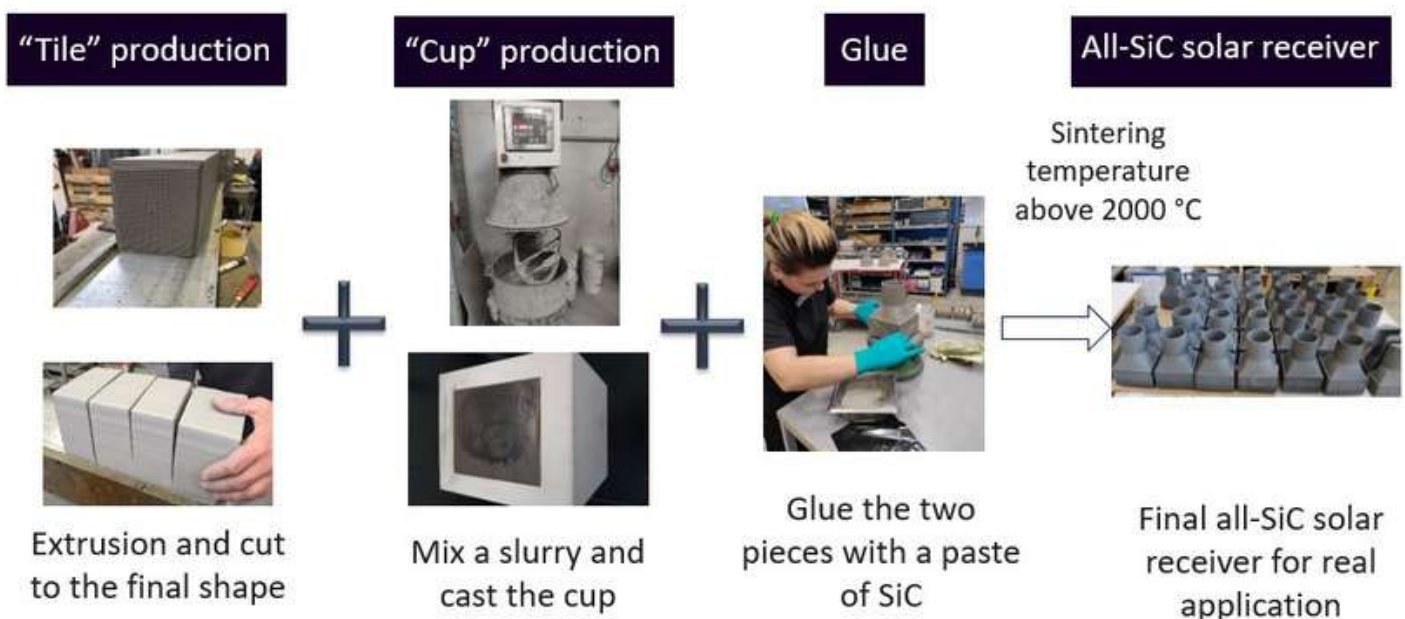
NEXOWER, therefore, ends now, but other projects are ready to take up where we left and move forward because this is the spirit of the Union: progressing to leave the fertile ground on which to work for those who will come later. We, today, leave the field to others, but we are proud to make them start not from scratch as we have to thank also those who came before us, because they allowed us to be here, sharing with you all this story of success: NEXOWER.

NEXTOWER RESULTS

CERAMIC SOLAR RECEIVER

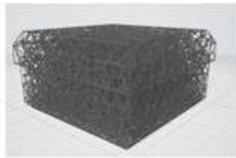
- Innovative ceramic for high-temperature open volumetric receivers based on all-SiC honeycomb design by VPS for more durability to oxidation.
- Innovative ceramic for high-temperature open volumetric receivers based on more flexible multi parts Si-SiC 3D printed design with self-healing glass ceramics and brazing alloys for higher toughness, higher thermal conductivity, and more open design.
- Joining technique with proven scalability able to avoid interfacial cracking of the receiver made of three pieces.
- Coating and surface treatments to improve thermomechanical properties and emissivity:
 1. For increased thermal conductivity and thermal shock resistance: introduction by CVI of highly thermal conductive aluminum nitride (AlN).
 2. For reduced emissivity: Innovative metal-oxide coating by sol-gel deposition; engineering surface roughness by micropatterning; engineering surface coatings filled with nanocavity by plasmonic technology based on nanoparticles.
- Innovative and more durable all-SiC and SiSiC solar receivers have been produced, installed, and tested both in accelerated conditions (solar furnaces) and in field at Plataforma Solar de Almeria-CIEMAT (Spain).

INNOVATIVE ALL-SiC RECEIVERS



NEXTOWER RESULTS

NEW GENERATION OF SiSiC SOLAR ABSORBER LATTICES OPTIMIZED FOR HIGHER TOUGHNESS AND THERMAL CONDUCTIVITY



Voronoi design



3D printed template



Final items with cups



Coated template (green body)

Final Receivers

- Voronoi geometry with gradient selected based on best lab/furnace test results
- Realization of SiC pin joint for Cup-Lattice interphase
- Tests with RM-wrap joining on full-scale item

Production technology:

- Negative additive manufacturing technique
- Coating of a 3D printed template
- Thermal processing and liquid silicon infiltration

NEXTOWER SOLUTIONS: RM-WRAP JOINING PROCESS



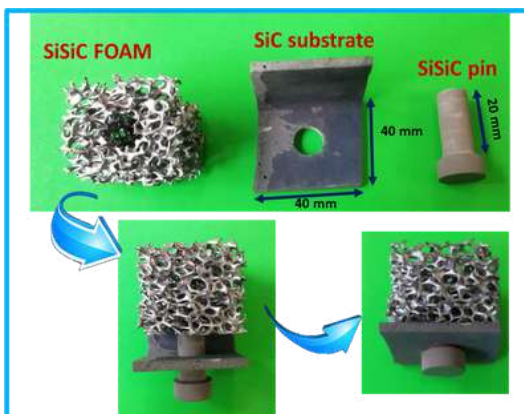
SiSiC foam



SiSiC disc



Development of a brazing process suitable for the production of Si-SiC solar receivers.



Hybrid Mo-wrap/pin technology: prototype manufacturing.

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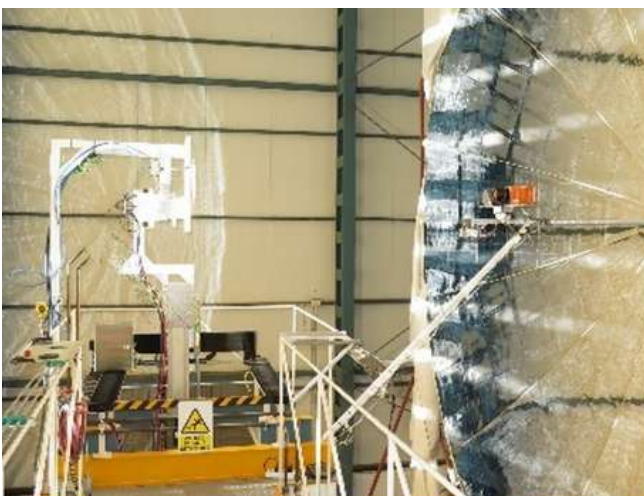
CERAMIC SOLAR RECEIVER

- A proposal of amendment to the ISO 18755:2005 current standard on thermal diffusivity determination with the Laser/Light Flash Method (LFA) has been drafted and submitted to the ISO Standardization Body. The objective is to propose to employ a single standard and only the LFA method to characterize the whole thermal behavior of the ceramic materials under investigation, in terms of thermal diffusivity, specific heat, and thermal conductivity.
- A CEN Workshop Agreement (CWA 17726) titled "High temperature accelerated ageing of advanced ceramic specimens for solar receivers and other applications under concentrated solar radiation" has been promoted by NEXTOWER partners and published in open access on the CEN-CENELEC website:

https://ftp.cencenelec.eu/EN/ResearchInnovation/CWA/CWA17726_2021e.pdf

SOLAR AGEING OF SiC CERAMIC PIECES AND VOLUMETRIC CUPS

Two novel tests benches have been developed to carry out accelerated ageing testing of SiC ceramic slabs and volumetric cups under concentrated solar radiation at PSA Solar Furnaces.



Accelerated ageing of materials under high fluxes of concentrated solar energy can predict their behaviour under real CSP conditions.

NEXTOWER RESULTS

THERMAL STORAGE MATERIALS

- LIQUID LEAD AS HEAT TRANSFER fluid as technology transfer from nuclear fission to CSP of high-temperature lead-based thermal fluid.
- CORROSION-RESISTANT ALUMINA FORMING STEELS: Innovative FeCrAl-alloys with better performance than reference commercial ones (good corrosion resistance in the liquid lead at 750°, minor oxidation, self-healing properties) used for the construction of steel piping and plates of the full-scale demo.
- INNOVATIVE WELDING FEEDSTOCK AND PROCEDURES: Innovative welding feedstock based on the newly developed FeCrAl alloy and optimized robotic GTAW welding procedures and SAW Strip Cladding used with NEXTOWER innovative alloy at high-temperature strength of the welds.
- An innovative single-tank thermocline indirect thermal energy store (TES) system using liquid lead at 800°C as heat storage medium has been tested at ENEA Brasimone (Italy).

NEXTOWER RESULTS

CORROSION RESISTANT ALUMINA FORMING STEELS

Completed manufacturing of experimental composite tubes, welding wires and strips, plates and heat exchangers components.

The innovative solution developed in the project combines both high-strength steel (Alloy 800HT) and a high-temperature corrosion-resistant alloy (FeCrAl) in the same alloy.

It enables the utilization of highly corrosive fluids such as liquid lead in high-temperature and high-strength applications with long service life and low degradation rates.

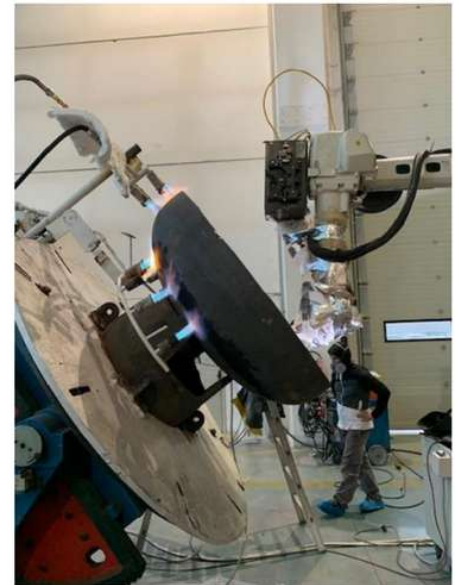


NEXTOWER RESULTS

INNOVATIVE WELDING FEEDSTOCK AND PROCEDURES

- Greater repeatability and faster execution of the welding process compared to a semi-automatic procedure.
- Welding feedstock based on the newly developed FeCrAl alloy will help welding companies and manufacturers of large parts for corrosive environments to achieve longer service lives and higher operating temperatures. A FeCrAl alloy weld overlay provides environmental protection for high-strength steels that are otherwise prone to corrosion and oxidation.

Bottom cladding using robotic GTAW welding



Weld-overlay activity on the 2nd course



Weld-overlay activity on the 1st course

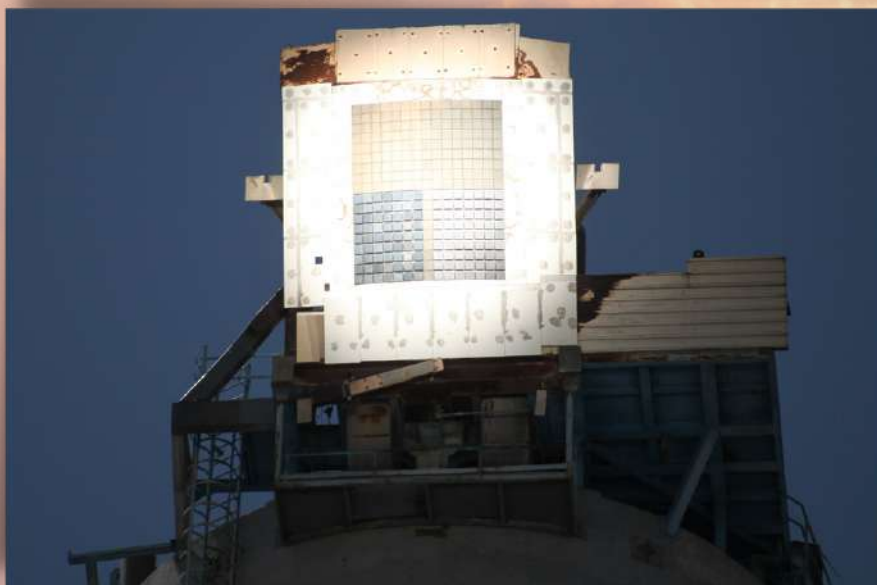


Execution of the weld overlaying on the W1C circular joint



NEXTOWER RESULTS

CIEMAT-PSA DEMO SITE



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ENEA BRASIMONE DEMO SITE



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NEXTOWER LATEST NEWS

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📖 There's a new Special Issue by MDPI about "Advanced Materials Solutions and Architectures for a New Generation of High-Efficiency CSP Plants".
 Deadline for manuscript submissions: 20 February 2022.
 Do not forget to send yours. Every detail can be found here: <https://bit.ly/3ipczEY>



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✅ One of the most relevant #NEXTOWER standardization results. CWA 17726 High temperature accelerated ageing of advanced ceramic specimens for solar receivers and other applications under concentrated solar radiation has been published and it is available for free downloading in the @Standards4EU CWA download area:
<https://bit.ly/3h7FWud>

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CWA 17726
 High temperature accelerated ageing of advanced ceramic specimens for solar receivers and other applications under concentrated solar radiation
Published! ✓
 # Energy4Europe
<http://www.h2020-nextower.eu/>

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🗋️ Is this the end?
 Today the #NEXTOWER Project Consortium held its last meeting to organise final developments releases and communication & dissemination activities.
 Is this the end? NOT AT ALL! 🙌
 You'll hear from us again soon, stay tuned! 🤗
 #H2020 #goals
 CertiMaC | Materiali. Energia. Innovazione. Politecnico di Torino ENEA Sapienza Università di Roma ICCRAM - University of Burgos Walter Tosto S.p.A. R2M Solution UNE Asociación Española de Normalización EngiCer Sandvik Materials Technology University of Oxford Sil'tronix Silicon Technologies



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🗋️ Today's Workshop is over!
 A final round table closed this interesting event in which we had chance to share achievements and experiences. But it's not all here, there's more to come, so: keep following our social media and for any inquiry write us! 🤗
 #Energy4Europe #CSP #H2020



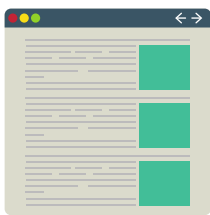
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NEXTOWER

Thank you for the time spent together!



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