SFERA-III

Boosting the innovation potential and development of concentrated solar power research infrastructures

Introduction

SFERA-III (Solar Facilities for the European Research Area - Third Phase) is a Horizon 2020 project funded under the Research Infrastructures programme.

Main Objectives

- To foster the **innovation potential and sustainability** of Concentrating Solar Thermal (CST) RIs
- To **reduce fragmentation** of the CST research and innovation ecosystem through the support to the consolidation of a CST network
- To boost and better coordinate the use of CST RIs by **international researchers**
- To join European R&D forces **to improve services and equipment** of SFERA-III RIs

Main activities

- **Networking activities** to further develop the cooperation between the SFERA-III RIs, the scientific community, industries and other external stakeholders
- **Transnational access activities** to provide access to European and non-European researchers from both academia and industry to world-class scientific and technological concentrated solar RIs
- **Joint research activities** to improve the integrated services provided by the RIs

SFERA III Vision

- Become a unique distributed RI for CST technologies
- Optimize RI development and R&D coordination in Europe
- Provide high-quality scientific infrastructure services at international level
- Boost researchers' access to highly specialized RI through a single access point
- Ensure the alignment of the RIs activities with the industry's needs
- Maintain Europe at the forefront of CST technology development

Facts & figures

Duration

60 months starting January 2019
Coordinated by CIEMAT-PSA (Spain)

Consortium

15 partners from **9** countries

Involved Key Actors

European advanced Concentrating Solar Power research infrastructures

The European Solar Thermal Electricity Industry Association (ESTELA)

Key professionals, Scientific communities, Policy makers, General public, Students

Budget

9,103 M€

Funded under

H2020-EU.1.4.1.2.
Integrating and opening existing national and regional research infrastructures

What is a "European Research Infrastructure"?

Research Infrastructures are facilities that provide resources and services for research communities to conduct research and foster innovation.

They can be used beyond research, e.g., for education or public services, and they may be single-sited, distributed, or virtual.

The European Commission defines, evaluates and implements strategies and tools to provide Europe with world-class sustainable Research Infrastructures.

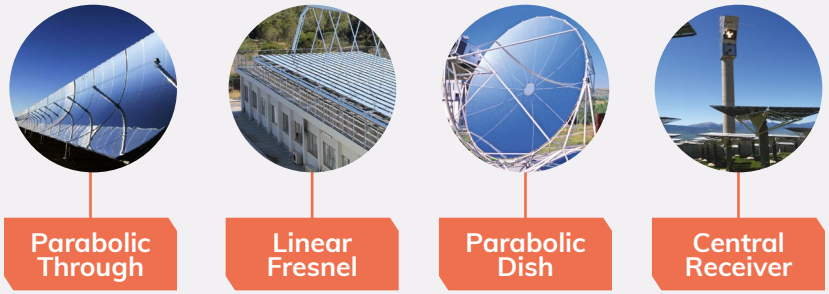
The Commission does this while cooperating closely with EU Member States and Horizon 2020 Associated Countries. It also ensures that these research infrastructures are open and accessible to all researchers in Europe and beyond.

Concentrating Solar Thermal Technologies

CST technologies use mirrors or lenses to concentrate sunlight onto a receiver where sunlight is transformed into thermal energy.

According to how sunlight is concentrated, CST technologies are classified into line-focusing and point-focusing technologies. The main line-focusing CST technologies are parabolic trough and linear Fresnel, whereas the main point-focusing technologies are parabolic dish, beam down and central receiver systems.

The four main CSP technologies



CST application

The main applications of the CST technologies are power generation, process heat, cooling, desalination and solar chemistry. Commercially, the most widely used application is power generation, known as Solar Thermal Electricity (STE). Thanks to its thermal storage system of large capacity is one of the few renewables, with hydro and biomass, able to be defined as dispatchable.

Access possibilities in SFERA-III

Thanks to world-class CST research infrastructures, the SFERA-III project offered access to a wide spectrum of experiments:

- **Solar thermal electricity generation** (from research on components and methods to full prototype systems): thermodynamic cycles such as Brayton and Stirling, receivers and their coatings, concentrating optics and mirrors, control algorithms and solar resource evaluation, heliostats and linear collectors, high concentration PV cells, etc.
- **Solar fuels production**: H2, Syngas, liquid and gas hydrocarbons, etc.
- **Cycles for chemical storage** of solar energy for short and long duration: ZnO, CeO, Iron, etc.
- **Solar water treatment**: desalination, disinfection and decontamination.
- **Solar heating and cooling of buildings** to improve energy efficiency.
- **Modeling and automatic control** of concentrating solar technologies for power generation and for industrial processes heat applications.
- **Thermal storage with molten salts**, testing its main components and also thermohydraulic simulation models, not only for power generation but also for industrial processes
- **High-value material synthesis and/or coatings deposits** (experimental or test of processes): nanomaterials like C or ZnO nanotubes, new ceramics or metals, foams, catalytic layers, etc.
- **High-flux photochemistry** and **photo-physics**
- **Characterization of materials' behavior and properties under extreme conditions** such as for solar, space, or nuclear fields: thermal shields, high-temperature materials, and parts, etc.
- **Solar pumping of LASER** for industrial and space applications.

SFERA III Solar Facilities

Jülich, German Aerospace Centre (DLR)

Freiburg, Fraunhofer Institute for Solar Energy Systems ISE

Zürich, Swiss Federal Institute of Technology (ETH Zürich)

Casaccia (Rome), Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA)

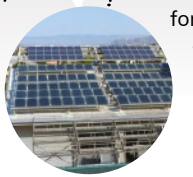
Ankara, Middle East Technical University (METU) - Centre for Solar Energy Research and Applications

Móstoles (Madrid), IMDEA Energía

Lisbon, National Laboratory for Energy and Geology (LNEG)

Évora, University of Évora, Renewable Energies Chair

Tabernas (Almeria), Centre for Energy, Environment and Technology Research, Plataforma Solar de Almería (PSA-CIEMAT)



Almeria, Solar Energy Research Centre (CIESOL)

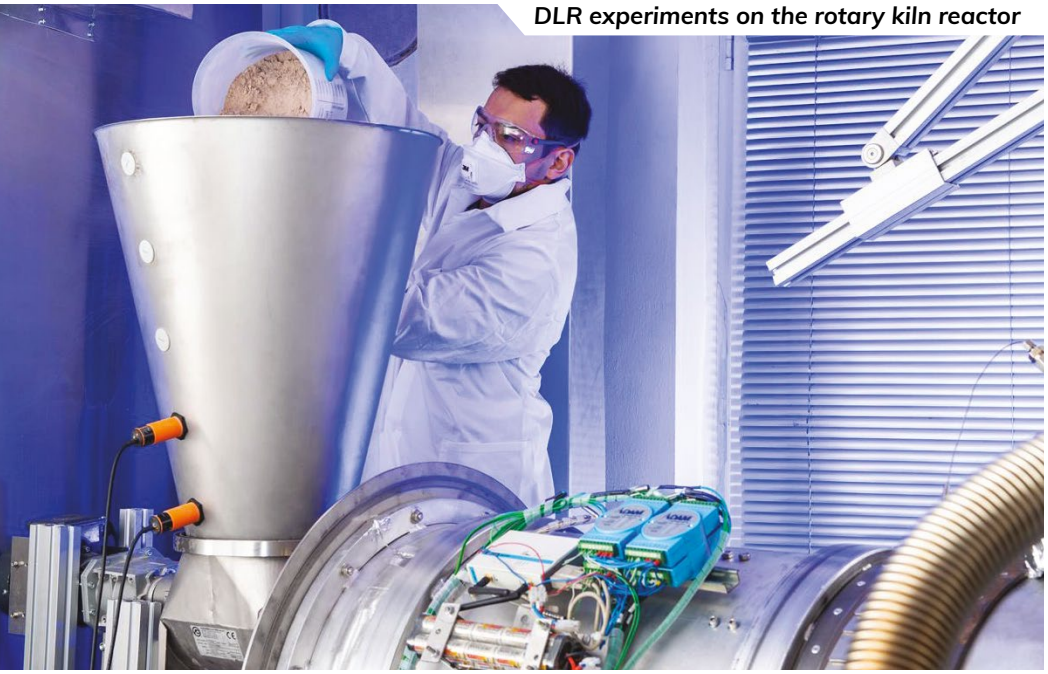
Font-Romeu-Odeillo-Via, National Centre for Scientific Research – CNRS-PROMES

Le Bourget-du-Lac and Grenoble, CEA DURASOL and CEA ESTHER

Nicosia and Pentakomo, The Cyprus Institute (Cyl) Campus and PROTEAS solar tower

Transnational access provided within SFERA-III

SFERA-III Transnational Access ensured free-of-charge access to the best European research infrastructures in the CST technology field.



DLR experiments on the rotary kiln reactor

5
Transnational access calls

241
User projects received

132
Projects granted

Joint Research Activities

The Joint Research Activities (JRAs) aimed to increase the research capacities of the infrastructures and improve the services offered to the users. Six research areas & activities were proposed and led by the R&D centers of the consortium:

- Development of test procedures for materials and components of thermal storage systems
- Development and testing of new technological concepts for solar desalination and water treatment facilities
- Dynamic control and diagnostics of integrated systems for the production of solar fuels
- Monitoring physical properties of receiver materials at the focal area of concentrated solar facilities
- Sensor calibration and techniques for accurate determination of performance parameters of prototypes installed in RIs
- Towards a European e-Infrastructure on CST technologies to provide virtual access to RIs and support the creation of new services

11 Key Exploitable Results

- Corrosion procedure of molten salt mixtures under dynamic conditions: homogenized protocol to study the corrosion of structural materials under dynamic conditions using devise where either the coupons or the salts move have been defined and validate experimentally.
- Guidelines for testing sensible and latent thermal storage prototypes: agreed guidelines and key performance indicators, validated with experimental results, are available from this project
- Standardization of testing procedures for multi-effect distillation technology
- Open SCADA
- Countercurrent chemical looping regenerative reactors
- Prototype camera system for temperature emissivity separation in central receiver systems
- Spectral simulation software tool (visible to LWIR) for the evaluation of radiometric chain and thermal camera systems in different CSP configurations
- Image processing software tool for multispectral image datasets
- Device for measuring forces and torques in flexible connection joints for parabolic trough collectors
- VISproPT instrument for 3D shape measurement of parabolic trough panels
- Detailed engineering of an e-infrastructure for European CST R&D centers

Networking Activities

The Networking Activities (NAs) aimed at

- Enhancing and strengthening the co-operation between the participants to nurture the birth of innovative actions
- Guaranteeing a broad information exchange platform between the scientific community, the industry and other stakeholders (i.e. standardization bodies but also with policy-makers)
- Ensuring the long-term viability sustainability of the single European Solar Research Infrastructure
- Creating a pool of high-qualified professionals via adequate training activities targeted at the industry, early-stage researchers and the general CST community

Key figures of SFERA III networking actions

4 winter/Summer Schools

4 doctoral Colloquia for the SFERA III PhD students

5 dedicated on-site training for industries

9 workshops on standards and protocols

42 staff exchanges

15 short-term Trainings

18 standardisation projects in IEC and UNE, out of which 9 major contributions from SFERA-III

38 open-access Scientific Publications

A word from the coordinator

"The importance of the SFERA-III project lied in organizing and implementing the networking activities (NA), the transactional access activity (TA), and the joint research activities (JRA) of all the R&D centers participating in the project as if it were a single European Solar Research Infrastructure.

This project brought significant innovation not only arising from the development of novel concepts and from the improvement of the existing services through joint research activities but also from a much stronger and more consistent integration of these services through networking activities.

Furthermore, SFERA-III aimed to design an e-infrastructure involving European R&D centers devoted to CST technologies. An e-infrastructure connecting all the centers and offering remote access to the facilities, experimental data, public reports, specific software, and other e-services for CST systems.

This integrated concept aimed to improve RI services for the benefit of users, internal or external, European or non-European, public or private. Indeed, SFERA III, thanks to EU funding, has developed an attractive program for transnational access to its research infrastructures. We are proud to welcome in our RIs' high-quality access projects that could not carry out their research without this great opportunity offered by SFERA III.

This combination of these three activities (NA, TA, JRA) resulted in an extended capability of the RIs as a whole, providing a significant added value for the industry and researchers working in this field."

Ricardo Sánchez Moreno, CIEMAT-PSA

the SFERA-III consortium

Coordinator

Ricardo Sanchez
ricardo.sanchez@psa.es
+34 950 387 800

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SFERA III - CSP Facilities for the European Research Area

www.sfera3.sollab.eu

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