Portugal and Spain's Innovative Solar Solutions for Waste Management in the Iberian Peninsula

The SECASOL project is implementing innovative solar thermal solutions in wastewater sludge and municipal solid waste drying processes in southern Portugal and Spain.

The management of wastewater treatment (WWT) and municipal solid waste (MSW) installations pose significant challenges when considering both the economic and environmental aspects. These challenges tend to increase whenever custom designed solutions are required, which can be highly complex in nature when choosing the right treatment options, considering the environmental requirements (e.g., legal restrictions for discharging wastewaters into the environment or wastes disposal regulations) and local regulations that can vary from region to region.

When industrial companies face these challenges and are confronted with the need to treat and, whenever possible, to economically valorize the produced waste, the first question is:

What Available Solutions Could Be Implemented?

A number of technical and technological solutions are currently available or under development that effectively apply solar thermal energy. And, *IEA SHC Task 62: Solar Energy in Industrial Water and Wastewater Management* started work the end of 2018 on developing and providing the most suitable and accurate information on the technical and economic possibilities for effectively applying solar thermal energy and solar radiation to disinfect, decontaminate and separate industrial process water and wastewater.

To help choose the most adequate solutions for each specific case, some questions may help:

- What are the waste characteristics (e.g., type and amount of contaminants, moisture content and composition)?
- What are the legal and environmental regulatory requirements?
- Which wastes can undergo economic valorization?

Considering the answers to these three questions as well as the abundant solar resource found in the Iberian Peninsula, particularly in its southern region, the energy needs of several thermal processes and the need to increase the share of renewable sources in the energy system means that Concentrated Solar Thermal (CST) technologies could offer a sound option for the decarbonization and sustainability of this sector.

SECASOL Project

The SECASOL project (http://www.diphuelva.es/secasol) was developed by an Iberian consortium of public and private entities to foster the inclusion of solar-based technologies in the WWT and MSW sectors. With a total budget of approximately €790,000€co-financed by FEDER, the European Regional Development Fund), this project aims to promote and demonstrate the implementation of innovative solar thermal solutions using CST technology for waste drying processes and targeting WWT and MSW facilities located in the cross-border region of Andalucía-Algarve-Alentejo.

Through this cooperation and joint work, replicable experiences are under development in the Andalucía-Algarve-Alentejo cooperation region, which has similar drying needs and available solar resources.

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Concentrated Solar Thermal Technology

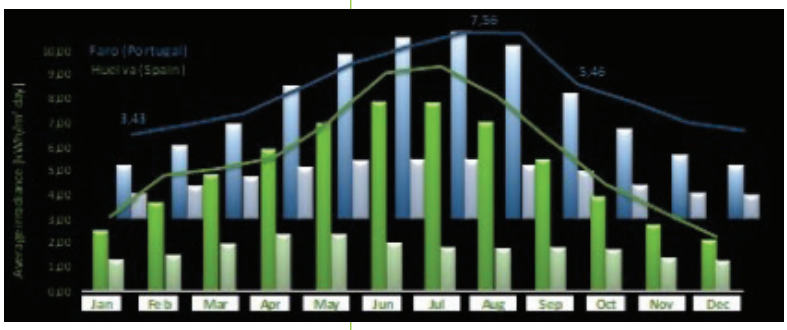
Apart from power generation, solar energy also plays an important role in fuel savings for heating and cooling applications using CST technologies. Indeed, CST can be used to drive a variety of thermal processes through different geometries and arrangements, although with the same principle of operation: A solar concentrator focuses the solar radiation into a solar thermal receiver (absorber) converting it into thermal energy.

CST technologies present a huge potential to impact the carbon footprint. The implementation of CST systems are distinguished from other renewable energy sources, mostly due to their unique integration potential in processes that require heat produced by conventional fuel-based systems.

In addition, the solar solution can very easily be adapted to a custom size design thus taking advantage of the on-site resource without the need to transport the waste to large processing facilities the added the expense of transport (both economic and environmental).

Generic concept of the concentrating solar drying solution for WWT and MSW facilities

Average irradiance in the SECASOL project areas in southern Portugal and Spain.



The inclusion of solar technologies in these sectors will contribute to energy security, and in this way, contribute favorably to the development of a more green economy.

The use of solar radiation as a renewable source of thermal energy is suitable for use in different industrial applications that require large amounts of heat, not only in the production processes but also in the various stages of waste treatment. Thus, solar thermal energy could be used to partially replace the fossil fuels used in the production of heat in a wide range of industrial processes. Processes requiring temperatures below 100°C could technically be supplied by heat produced by non-concentrating solar thermal systems. Heat requirements for higher temperature levels could be adequately supplied throughout current solar concentration technologies.

Municipal solid waste solar drying process

As a result, and considering the direct irradiance estimated in the normal plane (DNI), for those regions in the scope of the project, there is the needed solar thermal energy for drying applications suitable for using solar concentrator systems.

For the MSW drying processes, a first rough estimation of the solar drying capacity reaches values between 4,100 kg/(m^2 year) to 4 550 kg/(m^2 year) for the Algarve region and 4,300 kg/(m^2 year) to 4,500 kg/(m^2 year) for the Alentejo region. For the Andalusia region, the values range between 4,100 kg/(m^2 year) and 4 600 kg/(m^2 year).

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For WWT, the estimated values range between 2,050 kg/(m^2 year) and 2,450 kg/(m^2 year) for the Algarve region and 2,100 kg/(m^2 year) to 2,350 kg/(m^2 year) for the Alentejo region. For the Andalusia region, no significant differences were found in the values ranging between 2,100 kg/(m^2 year) and 2,350 kg/(m^2 year).

Additional information on the subject can be found in Deliverable PP1 of the SECASOL project (Potencial de aplicação da energia solar térmica de concentração aos processos de depuração de águas residuais e de tratamento de resíduos sólidos urbanos).

Expected Project Outcomes

- More efficient use of locally available natural resources - solar energy
- Increase in the implementation of solar solutions for a greener economy
- Incorporation of innovative solutions based on solar thermal energy in waste treatment drying processes
- Improve knowledge transfer capability between research centers, universities and private and public institutions as well as identification of shortcomings in research and training
- Demonstration of the technical feasibility of implementing CST solutions in a solar drying prototype
- Development of a solar dryer simulation and validation tool
- Promote the reduction of the environmental impact throughout the integration of renewable energy in waste treatment processes
- Contribution for the EU cohesion and sustainable growth policy through Portugal-Spain cross-border cooperation mechanisms focused on the risk prevention and improvement of natural resource management

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EUROPEAN UNION

The University of Évora Renewable Energies Chair is participating in a new INTERREG Atlantic Area project - **EERES4WATER** - devoted to the promotion of direct use of renewable energy sources and energy efficiency in the water cycle. One of the project actions, related to the objectives of *IEA SHC Task 62: Solar Energy in Industrial Water and Wastewater Management,* will be focused on the direct use of solar photons in photochemical and photocatalytic processes for wastewater decontamination and disinfection, which could provide an efficient solution, particularly in the case of emerging contaminants. The reactor of such a system is the receiver of a solar collector that captures and uses both direct and diffuse solar radiation in the visible and UV range. Different collector configurations and reflector designs of the CPC-type, along with the use of low-cost materials, will be investigated and validated. A case study will be selected and a complete solution will be designed to achieve 100% solar by including a PV system with electric storage that will provide energy to run the auxiliary components, including pumping.