

Nano4CSP Nanomaterials for reduced maintenance costs in CSP plants

Project duration: from 12.2019 to 07.2023

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Publishable Summary

Concentrated solar thermal power (CSP) generation is a promising technology that can successfully address future energy needs in a renewable and sustainable way. Several research and commercial installations exist worldwide, with an installed capacity (as of 2020) of 6.5 GW; there is a huge growth potential within the coming decades due to the significant drop of the weighted average levelized cost of electricity (LCOE), which has fallen by approximately 47% between 2010 and 2019. Despite this level of penetration of the technology, the LCOE remains high as compared to conventional power plants.

As the mirror is the first component to interact with the sunlight in the energy harnessing process, its efficiency is critical to the system performance. Mirror reflectivity is one of several factors affecting the energy delivered by the solar field to the receiver (along with cosine effect, shading and blocking, spillage, and atmospheric transmissivity). Although the other factors may be calculated through knowledge of the field layout and time of day, reflectivity varies based on atmospheric conditions and therefore changes constantly and at a varying rate. A 1% loss in reflectivity leads directly to a 1% increase in the LCOE, and so preventing heliostat soiling is a concern, while keeping reflectivity at a high level incurs a significant operation and maintenance (O&M) cost for plant operators. Plant O&M costs contribute about 11-15% to the LCOE, and mirror washing and water costs are a significant portion of these costs. They vary from location to location due to differences in rain events, plant design, technology, labour costs, individual market cleaning components pricing, etc. It should be noted here that the reflective mirror area of a commercial CSP plant can reach a total area of several million square metres, hence the associated large O&M costs.

The overall objective of Nano4CSP was to explore novel approaches for the reduction of the O&M costs and water consumption while increasing the efficiency of a CSP solar collector field. This has been achieved by tuning the properties of self-cleaning surfaces of mirrors to the specifications of CSP applications by suitable treatments and coatings. It should be noted that the partners have already experience with solutions for self-cleaning surfaces for other applications. Nano4CSP was focused on coatings that are applied at the mirror manufacturing stage, as well as on coatings that can be applied on already deployed installations. We have coated mirrors with four different, scalable, coating technologies and compared their efficiency. Our results indicate that even though there are serious difficulties in introducing such coatings to the final products, there are also several windows of opportunity where they can help significantly reduce the O&M costs; our rough estimation indicates a decrease in the LCOE in the range of 1,5% for the most efficient layers. Coating technologies are well-known to depend heavily on the final configuration of the materials selected in the manufacturing stage (substrates, impurities etc). Therefore, in order to proceed to the next stage of work, close collaboration with manufacturers is essential: not simply to select the

right type of coatings for their product, but also to work with them in the process details and tune the final properties especially with regards to durability and long-term functionality and performance consistency.

Project consortium

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Participating countries and financing:

Country	Number of organisations involved	Project costs in EUR	Public funding in EUR
Greece	2	264 250	176 696
Cyprus	1	165 294	165 294
Austria	1	71 250	22 296
<i>Total</i>	<i>4</i>	<i>762 983</i>	<i>625 413</i>

Funding agencies involved and contracts

Funding Agency	Contract N° and Title
GSRT	1st Revision of contract of State Aid Acts in the frame of the call ERA-NETS 2019b, No 128525/03-12-2020
Research and Innovation Foundation	P2P/SOLAR/0818/0006 Nanomaterials for reduced maintenance costs in CSP plants
FFG	873783, Nanomaterials for reduced maintenance costs in CSP plants