ENERGETICS

ENI Young Talent Award - Photovoltaic cell cooling kit

Funded By	ENI S.P.A. [P.iva/CF:00905811006]
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Context of the research activity	This research proposal addresses the critical issue of temperature-induced power losses and potential damage in photovoltaic installations. Recognizing the advantages of Phase Change Materials (PCM) cooling, including temperature regulation, high heat absorption capacity, absence of electricity consumption, and minimal maintenance costs, the study aims to enhance the efficiency of solar energy conversion. The research focuses on implementing a cooling kit tailored for commercial panels in both the Mediterranean climate and the intense conditions of the Sahara in Africa and other continents. The primary objectives are multi-faceted: firstly, to assess the impact of PCM-based thermoregulation on commercial photovoltaic panels through a real-scale outdoor experimental configuration; secondly, to optimize the efficiency of PV/PCM systems and improve heat transfer between the PV module and the cooling kit. Different methods will be followed and tested for that, including the shapes of the kits, the selection of materials (PCM, aluminum, etc.), the interior design, etc. Furthermore, the study endeavors to innovate by developing diverse designs and marketable product ranges of cooling kits. An experimental parametric study will investigate how different kit configurations influence system performance, providing reliable results for calibration and numerical validation. The research also seeks to minimize PCM quantity for PV/PCM applications, ensuring economic feasibility and environmental benefits through a comprehensive life cycle assessment. Additionally, the research project emphasizes the development of mathematical models and numerical simulations to gain insights into the physical behavior of these cooling kits. Ultimately, the anticipated outcomes of this research will not only optimize the coupling of PV/PCM but also pave the way for its widespread application, contributing significantly to the advancement of sustainable energy solutions. 1- Parametric Study for System Performance and assessing PCM Impact on Photovoltaic Panels. 2- Optimizing PV/PCM System Efficiency. Improve the efficiency of PV/PCM systems by enhancing heat transfer between the PV module and the cooling kit. Different methods will be followed and tested for that, including the shapes of the kits, the selection of materials (PCM, aluminum, etc.), the interior design, etc. 3- Innovative Designs for Cooling Kits.

	Develop innovative designs and diverse marketable product ranges of cooling kits, tailoring solutions for various applications and environments, such as the Mediterranean climate and the Sahara in Africa. 4- Evaluate how different configurations of cooling kits influence the performance of the entire PV/PCM The position is reserved to candidates who have participated in the selection of the competition "Debut in Research: Young Talents from Africa" of the year 2024

Objectives	This study aims to implement a cooling kit for commercial panels during summer in the Mediterranean climate and the intense heat of the Sahara in Africa. The research activity is supported by ENI (the grant for this position is granted by an ward of the ENI Spa company). The primary objectives include: (i) Evaluate the potential effect of PCM-based thermoregulation on commercial photovoltaic panels by develop a real-scale outdoor experimental configuration; (ii) Improve the efficiency of PV/PCM systems and enhance heat transfer between the PV module and the cooling kit; (iii) Develop innovative designs and different marketable product ranges of cooling kits; (vi) Conduct an experimental parametric study to evaluate how different kit configurations influence system performance; (v) Offer reliable experimental results for calibration and numerical validation purposes; (vi) Minimize the quantity of PCM required for a PV/PCM application; (vii) Perform a life cycle assessment to determine economic feasibility and environmental benefits; (viii) Focus on the development of mathematical models and numerical simulations to understand the physical behavior of these cooling kits. The outcomes of this research will pave the way for optimizing PV/PCM coupling and facilitate its large-scale application.

Skills and competencies for the development of the activity	MSc degree in mechanical engineering, knowledge about PV, PCM materials and heat transfer