

Experimental assessment of a solar photovoltaic-thermal system in a livestock farm in Italy

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Abstract

This paper presents an experimental evaluation of the performance of a solar photovoltaic-thermal (PVT) system in a swine farm at Mirandola in Italy. In this project named RES4LIVE, funded by the EU's Horizon 2020 program, a PVT system is installed to replace fossil fuel consumption in one of the barns on the farm. The electrical energy from the collectors is utilized to operate the heat pump and provide electricity to the barn, whereas the thermal energy from the collector is stored in a borehole thermal energy storage (BTES) for further use by a 35 kW heat pump. The hybrid solar field consists of 24 covered PVT flat plate collectors (7.68 kW and 25 kW) with a total aperture area of 39.3 m², which can increase the temperature of the heat transfer fluid (HTF) to up to 40 °C. The PVT system is connected to a modular solar central (SC) with a standardized design that can also be used for other similar applications. The hybrid solar system complemented by energy storage is expected to save approximately 20,850 kg CO₂/year. The data collected from the PVT system, SC, and BTES are rigorously analyzed to evaluate its overall performance. A comprehensive performance assessment reveals the capability of the solar system to reduce carbon emissions and effectively replace fossil fuel consumption in the agricultural sector.

Keywords: Renewable energy source (RES), Livestock farm, Photovoltaic-thermal (PVT), RES4LIVE, Borehole thermal energy storage (BTES)

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