RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

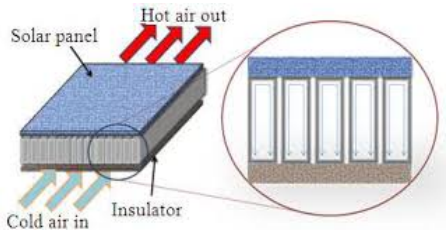
eip-agri
AGRICULTURE & INNOVATION

Photovoltaic - Thermal collectors for electrical and thermal demands in livestock farms

Intensive livestock buildings consume a considerable amount of thermal and electrical energy. Therefore, Photovoltaic thermal collectors, typically abbreviated as PVT collectors that convert solar radiation into usable thermal and electrical energy are a promising form of renewable energy generation.

PVT collectors combine photovoltaic solar cells, which convert sunlight into electricity, with a solar thermal collector, which transfers the otherwise unused excess heat from the PV module to a heat transfer fluid. Three common types of PVT collectors already readily available on the market:

1. PVT Air Collector: Air used as a heat transfer medium
2. PVT liquid Collector: Liquid used as a heat transfer medium)
3. Concentrating PVT Collector: Liquid used a heat transfer medium (commonly used for higher temperature applications)



PVT Air collector

PVT liquid collector

Concentrating PVT collector

In a solar PV panel, photovoltaic cells typically reach an electrical efficiency[1] between 15-20%, while the largest share of the solar spectrum (65-70%) is lost as heat, increasing the temperature of PV modules. It is shown that by reducing 1°C in PV cell temperature, the electrical efficiency increases by 0.4–0.5%. Thus, PVT collectors make better use of the solar spectrum, supplying both electrical and thermal energy within the same area, while increasing the electrical efficiency[2].

PVT collectors offer a practical life of at least 20 years. Thanks to the cooling, and under proper maintenance, the loss of efficiency of the electrical part due to the passage of time is reduced. The average saved costs by PVT installation with available data is about 22 EUR/m^2 annually. Investments of about 600 EUR/m^2 are covered by saved fuel costs, considering the typical lifetime of a PVT system, and reduce dependency on rising and fluctuating fossil fuel prices.[3]

Through their implementation in RES4LIVE's swine and cattle farms, it is possible to achieve the co-generation of solar electricity and heat in a single component, increased combined efficiency and yield an optimized utilization of available space.

[1] Refers to the portion of energy in the form of sunlight that can be converted into electricity
[2] By reducing 1°C in PV cell temperature, the electrical efficiency increases by 0.4–0.5%. See: Weller, B., Popp, C., Seeger, J. and Scheuring, L., 2018. Energetic capability of a photovoltaic thermal collector in the façade. ce/papers, 2(5-6), pp.263-276.
[3] Depending on local feed in tariffs and prices for electricity, oil and gas, this value might vary a lot from case to case, See: Schubert, M. and Zenhäusern, D., 2020. Performance Assessment of Example PVT-Systems.

The RES4LIVE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under grant agreement No 101000785.