Contribution ID: **38** Type: **Apresentação regular**

Integrated Battery Management in Photovoltaic Power Plants: A Real Case Study

The transition to renewable energy presents significant challenges in managing production and consumption efficiently. This study addresses the optimization of the energy usage for owners of photovoltaic plants equipped with storage systems. The main objective is to develop a decision-support model that maximizes profitability by intelligently and dynamically managing consumption and storage of electricity, by considering OMIE market prices and consumption costs.
The research is supported by real operational data from a photovoltaic installation with battery storage. Historical data on electricity consumption, solar energy production, and market prices were analyzed to identify inefficiencies in conventional reactive management strategies. A predictive approach was proposed, integrating forecasts of market prices, weather conditions, and consumption patterns.
A Mixed-Integer Linear Programming (MILP) model is currently being developed to optimize the charge and discharge cycles of the batteries. This model considers technical constraints and market dynamics to generate cost-effective energy management strategies. Preliminary results indicate that strategic battery usage significantly reduces operational costs, improves energy autonomy, and increases profitability. The approach is scalable and adaptable, offering a replicable framework for other small-scale renewable energy producers aiming to enhance sustainability and efficiency.

Acknowledgement:
This work has been supported by national funds through FCT - Fundação para a Ciência e Tecnologia, under the projects UIDP/04728/2020 and UIDB/04728/2020.

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Session Classification: Session 5.2 - OR in Energy 2