EMS4 PV/BEV

Advanced Experimental Infrastructure for PV-Powered Battery-Integrated EV Charging Stations

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White paper

CYPRUS PUBLIC TRANSPORT
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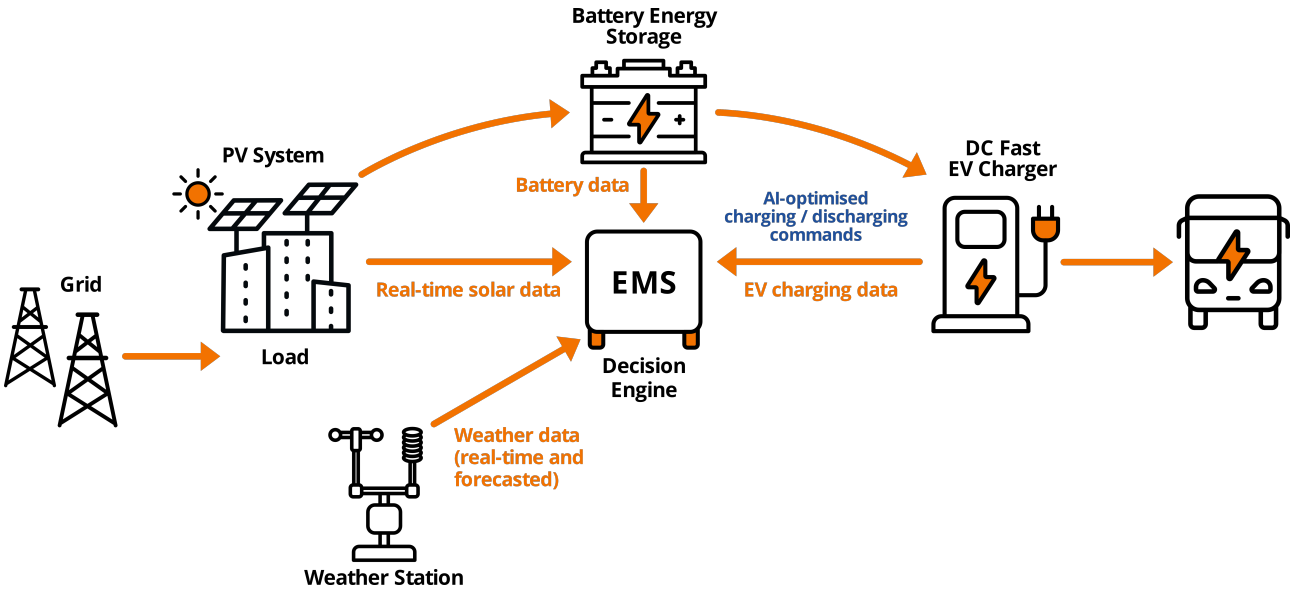
Introduction

The **EMS4PVBEV project**, launched in July 2024, is an industry-driven project aiming to accelerate Cyprus's clean energy transition through the development of a renewable-powered and battery-integrated electric vehicle charging station. The project responds to the growing demand for sustainable mobility solutions, integrating smart energy management technologies to optimise electricity usage, reduce charging costs, and improve grid resilience.

Project Scope

EMS4PVBEV targets the efficient management of photovoltaic (PV) generation, battery energy storage systems (BESS), and electric vehicle (EV) charging operations using an artificial intelligence (AI)-driven energy management solution. The project represents the first attempt to develop a PV-powered battery-integrated EV charging station for commercial application in Cyprus.



Experimental Infrastructure Overview

The experimental infrastructure of the PV-powered, battery-integrated EV charging station consists of:

- BESS HUAWEI Smart String Energy Storage (LUNA2000 – 97kWh), 100kW/97kWh capacity
- PV system 60 kWp (n-type modules of 575 Wp)
- Weather station (RIKA)
- EV charger unit – DC fast charger (160 kW, 2 plugs/charging ports)
- Energy management system (EMS) – Customised platform

EMS Key Technological Features

The infrastructure's Energy Management System, developed by the UCY, possesses the following characteristics:

- Real-time data monitoring
  (PV, ESS, weather and EV charging data).
- AI-driven forecasting algorithms for PV generation and EV load demand.
- Smart EV charging and predictive algorithms.
- Decision optimisation engine.

Installation & Operation

The infrastructure was successfully installed and commissioned in May 2025 at the Cyprus Public Transport premises in Geri, Nicosia.

The PV-battery system operates under a zero-export scheme, employing a time-based control protocol that prioritises charging the BESS with solar generation during morning hours.

Key Results

Over the six-month evaluation period, May–November 2025, the PV-battery system delivered the following performance outcomes:

>95% data availability, ensuring reliable operation.

30% of total energy demand supplied, generating **€15,020** in revenue.

30% reduction in electricity costs.

92% self-consumption rate.

31% self-sufficiency.

24.27 tons of CO_2 emissions avoided.

Lessons Learned

- No temperature-related operational issues identified for the PV-battery system.
- Curtailment occurs due to installation in a congested area.
- Adjusting the PV-battery operation strategy (e.g., seasonally) can help minimise curtailments under a zero-export scheme.
- Monitoring and automatic alerts are needed to reduce downtime losses.

Summary and Future Perspective

- This infrastructure is the first of its kind in Cyprus that combines a PV-powered and battery-integrated EV charging station for commercial application and marks a major milestone in the country's clean energy transition, setting a precedent for future innovations in smart mobility and renewable solutions.
- The system showcases real-world benefits of RES integration and reduces energy costs by using on-site renewables.
- The installation operates as a Living Lab, enabling further research into energy optimisation, smart grid interaction, and scalable renewable integration for future projects.

Consortium

Project Coordinator

CPT Cyprus Public Transport Services and Operations Ltd
www.publictransport.com.cy

Project Partners

University of Cyprus (UCY)
www.pvtechnology.ucy.ac.cy

NPT Nicosia Public Transport Services and Operations Ltd
www.publictransport.com.cy

LPT Larnaca Public Transport Services and Operations Ltd
www.publictransport.com.cy

Contact Information

For more information, you may contact the Project Coordinator, Cyprus Public Transport, at **research.cpt@publictransport.com.cy**.

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