International Energy Agency
Photovoltaic Power Systems Programme

FACT SHEET

Task 17 PV & Transport

PVPS

PV-Powered Charging Stations

Sizing, Optimization and Control

July

2026

What is a PV-Powered Charging Station?

A PV-powered charging station combines solar electricity generation with electric vehicle (EV) charging and intelligent energy management. Depending on local conditions and user needs, these systems can operate grid-connected or off-grid and may integrate battery storage and Vehicle-to-Grid (V2G) functionality. *

A PV-powered electric vehicle charging station.

Why PV-Powered Charging Matters

The rapid expansion of electric mobility is increasing electricity demand worldwide. PV-powered charging stations enable the use of locally generated renewable electricity for EV charging, helping to:

- reduce CO_2 emissions
- lower dependence on fossil fuels
- minimize grid congestion
- reduce energy losses
- optimize charging infrastructure investments

Through smart coordination of PV generation, storage, and charging demand, PVCS can support both energy and mobility transitions.

Smart sizing for workplace charging

A workplace charging facility in southern France was analysed using six years of operational data, including more than 32 000 charging sessions from over 350 EV users across approximately 80 charging points. The study compared uncontrolled charging with solar-aligned smart charging strategies [1].

Key outcomes:

- Smart charging strategies can reduce required PV capacity by up to 50% compared to basic approaches.
- Aligning charging demand with solar production significantly lowers infrastructure needs.
- Modular sizing allows fast replication across multiple similar sites.

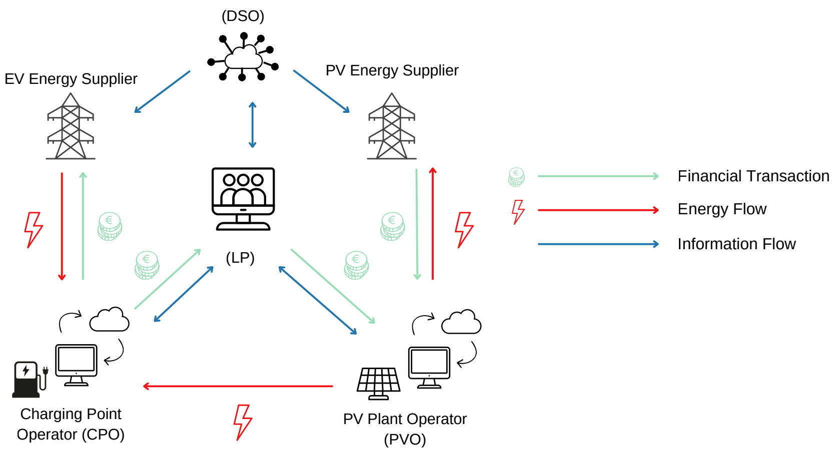


Figure 1: Interactions of the EVCI's stakeholders

* This fact sheet summarises a comprehensive report by IEA PVPS Task 17: Sechilariu M. (2025, Ed.), Celik B. (2025), Robisson B. (2023), Ngo V.L. (2023), Kassab F. A. (2024), Cheikh-Mohamad S. (2023), Brito M.C (2024), Locment F. (2025), Dougier N. (2023) and Alchami A. (Ed.) PV-Powered Charging Stations: Sizing, Optimization and Control (Report No. T17-8:2026). IEA PVPS Task 17.

Cost and emissions optimization

Designing an efficient PV-powered charging station requires balancing both economic and environmental objectives. The optimal combination of PV capacity, battery storage, charging infrastructure, and grid interaction depends strongly on local operating conditions, electricity prices, mobility patterns, and solar resources [2, 3].

Case studies demonstrate that no single system configuration is optimal for all applications. Instead, PVCS design should be adapted to the specific site and charging profile to achieve the best balance between cost, renewable energy use, and emissions reduction.

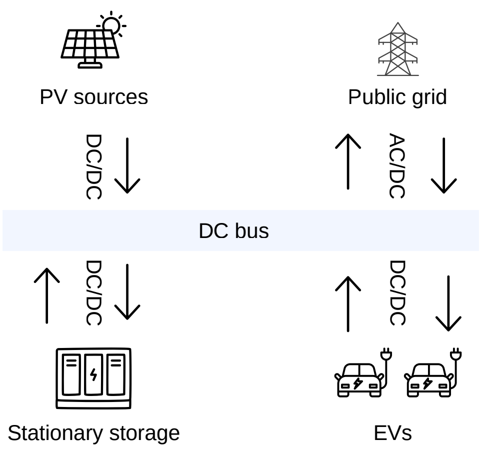
Component Optimization	Economic Impact (LCOE)	Environmental Impact (LCE)
Increased PV Capacity	Lowers Levelized Cost of Energy over time.	Reduces reliance on carbon-heavy grid mixes.
Larger Battery Storage	Increases initial capital investment (CapEx).	Lowers Life Cycle Emissions by capturing excess solar.
Grid Interaction	Drastically improves financial viability.	Buffers seasonal solar drops, stabilizing the system.

Key outcomes:

- Larger batteries reduce life-cycle emissions; increased PV capacity lowers energy costs.
- Grid interaction generally improves both cost and environmental performance.
- Site-specific conditions strongly influence optimal system design.

Vehicle-to-Grid (V2G) integration

Vehicle-to-Grid (V2G) technology enables electric vehicles to act not only as electricity consumers, but also as flexible energy resources. When connected to a charging station, parked EVs can temporarily store excess solar electricity and feed electricity back to buildings or the grid when needed [4].



PV generation, stationary storage, electric vehicles, and the public grid are connected through a common DC bus. Bidirectional power flows enable EVs and battery storage to act as flexible energy resources, supporting charging demand, renewable energy integration, and grid interaction.

Figure 2: Scheme of PV-powered charging station with V2G service

Key outcomes:

- Parked EVs can provide flexibility and grid services.
- Large-scale V2G applications (campuses, fleets) deliver the strongest benefits.
- Smart scheduling minimizes costs while respecting user requirements.

V2G can improve the integration of renewable electricity, increase system flexibility, and support more efficient operation of PV-powered charging stations.

PVCS for electric buses

Electric buses are essential for clean and efficient urban transport. Integrating solar PV into bus depots can reduce operational emissions, lower electricity costs, and support the transition to low-carbon public transport [5].

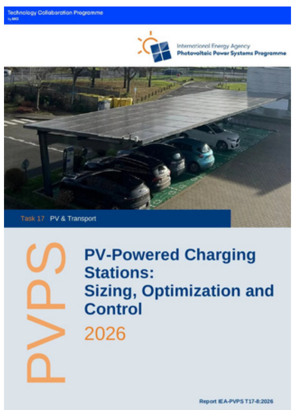
The report analyses how PV-powered charging stations can be optimized for electric bus depots, considering battery size, charging power, grid interaction, and solar generation.

Key outcomes:

- Electric buses significantly reduce tailpipe emissions and improve urban air quality.
- Charging strategies involve trade-offs between battery size, grid impact, and infrastructure cost.
- PV integration reduces CO_2 emissions and peak demand, though seasonal variability requires storage solutions.

Want to know more?

If you are interested in more insights and detailed data, explore the full "PV-Powered Charging Stations: Sizing, Optimization and Control" report.



About IEA PVPS Task 17

IEA PVPS Task 17 explores how PV can support the decarbonisation of transport by integrating solar energy into electric vehicles, charging infrastructure, and mobility systems, while providing technical knowledge and practical guidance for their large-scale deployment.

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