Karlsruhe Institute of Technology

Division III – Mechanical and Electrical Engineering

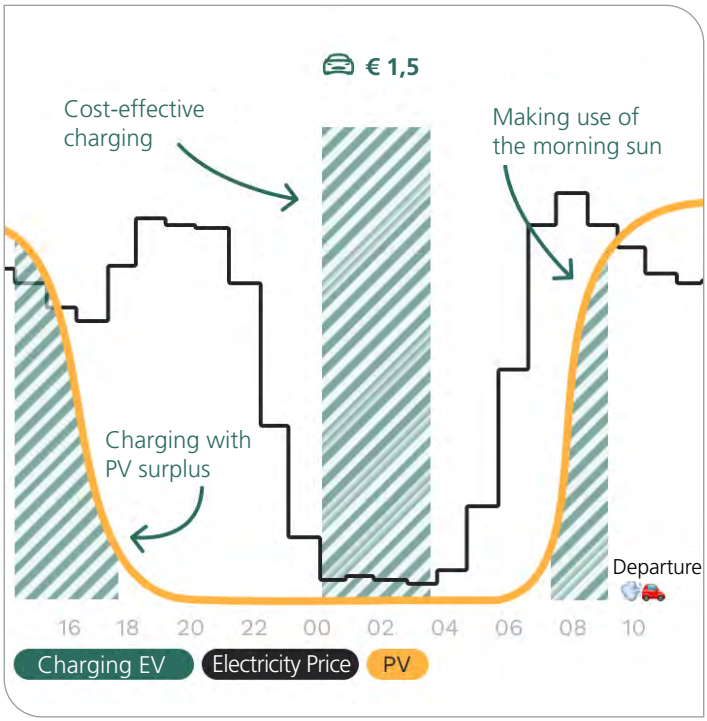
Institute for Automation and Applied Informatics (IAI)

RAZO Energy

Your plug-and-play home energy solution. We optimize wallbox, EV, heatpump and battery to build an AI-driven Virtual Power Plant.

The increasing electrification of the energy sector poses particular challenges for those consumers who are also producers. Many of these prosumers would like to connect and control electric vehicles, batteries, and heat pumps for the efficient use of self-generated solar power. The RAZO energy management system can be used to connect and intelligently control these devices. End users can make optimum use of their own photovoltaic surplus and purchase additional electricity when it is cheapest.

The flexibility in the consumption behavior of decentralized energy resources (DERs) offers an innovative way of adapting consumption to the availability of renewable energy. For example, electric vehicles can be charged during the day directly with electricity from your own solar system, and additional electricity can be purchased at night when demand and prices are low. Batteries complement this concept by storing surplus solar energy during the day and returning it in the evening when demand for electricity increases and prices are at their highest.



Charging process with the RAZO control unit.

Green Power – Lower Costs

RAZO Energy increases the use of renewable energies through intelligent control. Green power is often also cheaper electricity, because a surplus of renewable energy in the grid ensures low prices and displaces fossil fuels. Thanks to their large batteries, electric cars have the greatest potential for optimization.

Charging process with the RAZO control unit

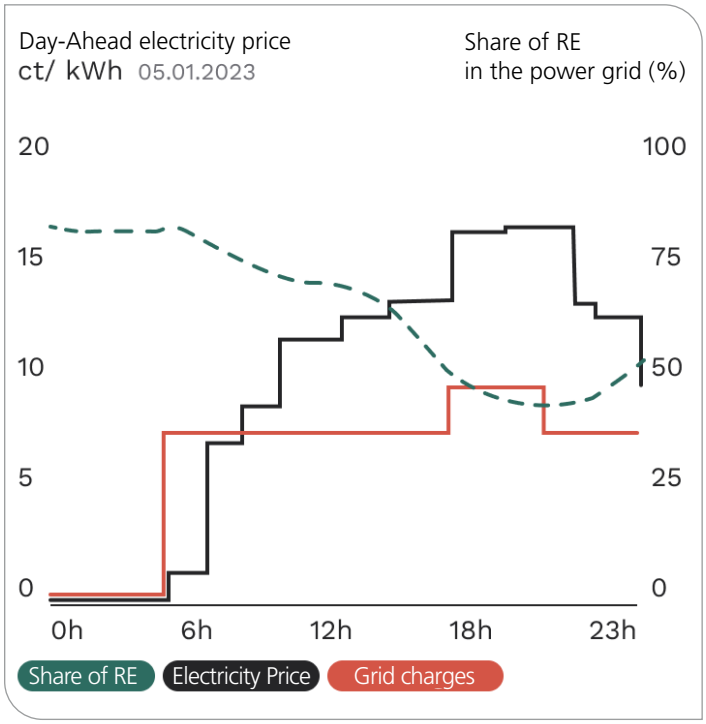
Prosumers can choose between three charging modes: Charging exclusively with their own PV electricity, on the basis of dynamic electricity tariffs, or a combination of both. The control system starts automatically as soon as the vehicle is plugged in. The system calculates the amount of energy required and the most cost-effective charging period with the help of an AI-supported departure time prediction or the personal timetable. The intelligent charging control system enabled RAZO users to reduce their costs from around €6/100 km to an average of €2/100 km – based on a comparison between controlled and uncontrolled charging.

Price Incentives for Load Shifting

Since January 2025, electricity providers have been obliged to offer dynamic tariffs with hourly changes in the electricity price. In addition to this important step, the introduction of variable grid charges in April 2025 provides a further incentive to shift loads. Distribution grid operators have divided these variable grid charges into three levels: Off-peak, standard, and peak rate. A provisional price table from EWE Netze illustrates the difference between the peak rate (9.73 ct/kWh) and the off-peak rate (0.74 ct/kWh). This potential for cost reduction can only be fully exploited with an intelligent energy management system.

Pilot Project for a Virtual Power Plant

RAZO is currently working on a pilot project for a virtual power plant (VPP) for grid-supportive control. The aim is to connect DERs into a holistic system in order to offer demand response and to market unused flexibility. Prosumers benefit from remuneration if they contribute their flexibility to the VPP. By 2030, approximately 15 million electric vehicles, battery storage systems, and heat pumps are expected to be in operation among end consumers. The flexibility of these DERs can be used to participate in the electricity market while simultaneously stabilizing the power grid. Due to the thermal inertia of buildings, heat pumps also benefit from intelligent control: The flow temperature can be increased during the hours of sunshine so that less energy is required in the evening. The batteries in electric vehicles, which are generally between 40 and 60 kWh in size, have the potential in future to supply a family with energy for two to three days or to additionally stabilize the power grid by using bidirectional charging technology.



Forecast of electricity price development and variable grid charges compared to RE generation.

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Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

eXIST Existenzgründungen aus der Wissenschaft