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Fraunhofer-led project scales up charging for heavy-duty transport

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A closer look at the hardware enabling megawatt charging without megawatt grid connections

The HV-MELA-BAT programme is advancing megawatt-scale charging with modular DC/DC converters, achieving high efficiency and enabling over 1 MW charging on a limited grid connection.

As the transition from the Combined Charging System (CCS) to the Megawatt Charging System (MCS) gathers pace, rising demand from heavy-duty electric transport is pushing infrastructure beyond the limits of conventional fast-charging systems.

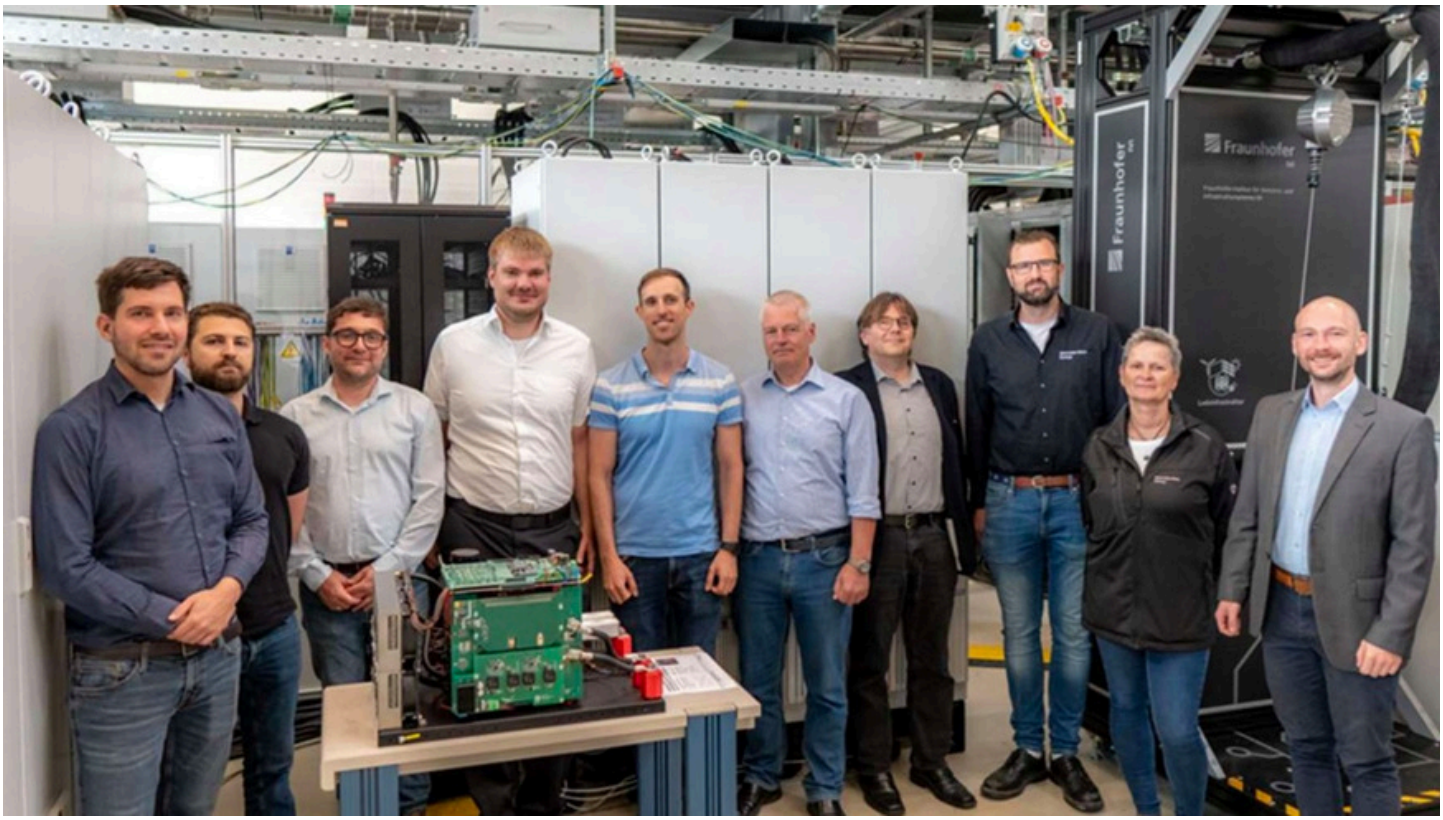
Recent work by Fraunhofer ISE and project partners has been addressing these challenges at system level, combining grid-side rectifiers, modular high-frequency DC/DC converters and a high-current contact system. Project partners include Motion Control & Power Electronics, STS Spezial-Transformatoren Stockach, Mercedes-Benz Energy and Fraunhofer IVI.

Corporate fleets drive EV demand as operating costs drop up to 50 percent

"The project focused on upgrading existing fast-charging infrastructure based on combined charging to the megawatt system. The higher charging power poses new challenges for power electronics, the contact system and grid connection capacity," says Stefan Reichert of Fraunhofer ISE, who coordinated the project.

Second-life EV batteries as buffer

A central element is the integration of second-life EV batteries as buffer storage. In the demonstrated setup, a grid connection of 500 kW was sufficient to support charging power of more than 1 MW, with the additional capacity supplied by the storage system. This configuration reduces peak load on the grid while maintaining high charging output.



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The project team at Fraunhofer ISE with the demonstrator system for megawatt charging

The system is built around a common DC bus linking the AC grid, storage and charging output, enabling flexible power flows and load balancing. Crucially, it also supports the integration of on-site PV, with solar generation either used directly for charging or stored for later use.

Fraunhofer ISE pushes tandem efficiency beyond 34 percent

At the component level, the galvanically isolated DC/DC converter is based on a series resonant topology and operates at switching frequencies of up to 200 kHz. This allows inductive components such as transformers to be designed more compactly, contributing to a reported power density of 9 kW/l alongside peak efficiencies of 99.26%.

Modular and scalable

The modular design allows up to four 250 kW units to be connected in parallel, enabling scalable configurations depending on site requirements. The system is designed to cover a wide range of charging voltages and vehicle types while ensuring compatibility with both CCS and MCS standards.

Testing at Fraunhofer ISE's facilities in Freiburg included commissioning of the full MCS charging system and buffer storage. Using modular DC/DC converters (developed by Motion Control & Power Electronics), the battery, AC grid and charging output were linked via a common DC bus. Once again, the setup demonstrated charging power of more than 1 MW with a 500 kW grid connection, with the remaining capacity supplied by the storage system. Trials across varying charging durations and storage sizes indicated consistently high transmission efficiencies from grid to vehicle battery. (TF)

Solar Investors Guide #5 – Solarised parking and charging

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