PRESS RELEASE

Fraunhofer ISE Goes with Medium Voltage for Resource Efficiency in PV Plants

Enormous quantities of raw materials are required for the conversion of the energy system, for example, in the form of copper and aluminum cables to connect renewable generators to the grid. One promising approach to save raw materials is to move from the low to the medium-voltage level in renewable energy power plants. The Fraunhofer Institute for Solar Energy Systems ISE sees a huge potential for savings with higher system voltages, especially in large PV power plants. The institute is planning first pilot power plants with this technology and is aiming for a broad market launch together with industry. To kick-off its new research topic "Medium Voltage – A Resource-Efficient Way to Interconnect", Fraunhofer ISE will be presenting the world's first medium-voltage PV string inverter and a medium-voltage battery inverter at the Smarter E trade fair in Munich (June 19-21).

Around 73 terawatts of photovoltaic capacity alone must be additionally installed worldwide by 2050. This will lead to an increasingly large demand for raw materials: According to the International Energy Agency's "Global Critical Minerals Outlook 2024", copper demand will exceed the announced supply from 2025 on.
“Increasing the voltage of the system can help lessen this demand, since the corresponding decrease in the system’s current can lead to considerable savings in raw materials," explains Andreas Hensel, group manager for High Power Electronics and System Technology at Fraunhofer ISE.

For example, increasing the output voltage from 800 V_{AC} to 1,500 V_{AC} results in 75 percent savings in the cable cross-section with the same power. Also, it is generally easier to lay and connect smaller cable cross-sections, thereby reducing the installation costs. "Now that PV module costs have fallen by 90 percent since 2010 due to technological progress and economies of scale, installation and balance-of-system components have become the biggest levers for savings," says Andreas Hensel.
The step from low to medium voltage can also increase the power output of the subsystems: At an output voltage of 1,500 V, 10 to 12 MVA are already possible in one transformer instead of the 3 to 5 MVA per transformer that are still common today. Thus, less transformers and switchgear are needed for power plants with medium voltage interconnections. This reduces both the construction and installation costs.

Contact us
Claudia Hanisch M. A. | Communication | Phone +49 761 4588-5448 | claudia.hanisch@ise.fraunhofer.de
Christian Schoener | Power Electronics and Grid Integration | Phone +49 761 4588-2078 | christian.schoener@ise.fraunhofer.de
Fraunhofer Institute for Solar Energy Systems ISE | Heidenhofstraße 2 | 79110 Freiburg | www.ise.fraunhofer.de

The technological course has been set

The move to medium voltage (MV) was first made possible by the development of high voltage silicon carbide (SiC) components with high switching speeds. SiC components up to 3.3 kV are now available on the market. In 2023, Fraunhofer ISE developed the world's first medium-voltage photovoltaic (MS-PV) string inverter in the "MS-LeiKra" project and successfully put it into operation on the grid. The two-stage inverter has an output voltage of 1,500 V_{AC} at a power of 250 kVA. "We have demonstrated that the technological course has been set for the transition to medium voltage. Due to the hugely rising demand for raw materials, we are convinced that the question is no longer whether the medium voltage technology will be introduced, but rather who will be the first players in this promising market," explains Christian Schoener, project manager of Medium Voltage at Fraunhofer ISE. A first photovoltaic pilot system based on the MS-PV string inverter is currently being planned.

Overcoming obstacles together

During a MS-PV workshop in April, a European consortium was formed consisting of representatives from all areas of trade involved in large-scale PV power plants. The consortium will jointly work on setting down the technological and normative requirements necessary for the leap into the medium voltage technology. "As a powerful consortium that is open to additional participants, we can tackle the existing hurdles together and achieve optimization throughout the entire power plant," says Christian Schöner.
Utility-scale PV power plants are just the beginning: Charging infrastructure, industrial grids, large heat pumps, battery storage systems, electrolyzers and wind turbines are also interesting areas of application for the lower medium-voltage level. Higher system voltages enable considerable material, cost and space savings and open up completely new system architectures for renewable hybrid power plants, whose individual components are interconnected via the medium voltage.

LINKs: Medium voltage website: https://www.ise.fraunhofer.de/en/key-topics/medium-voltage.html

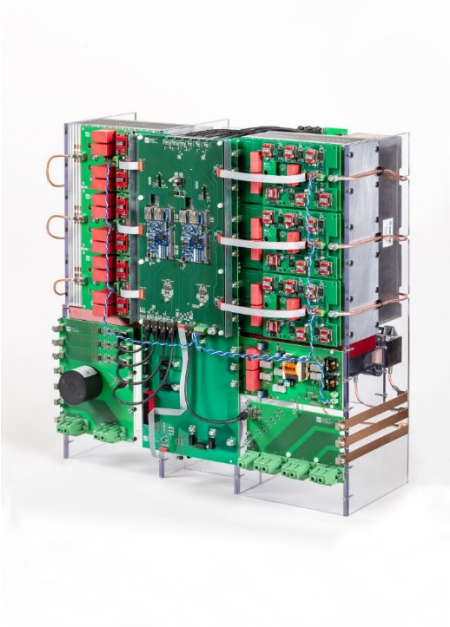
Project page MS-LeiKra: https://www.ise.fraunhofer.de/en/research-projects/ms-leikra.html

Project page SiC MS-Bat: https://www.ise.fraunhofer.de/en/research-projects/sic-msbat.html

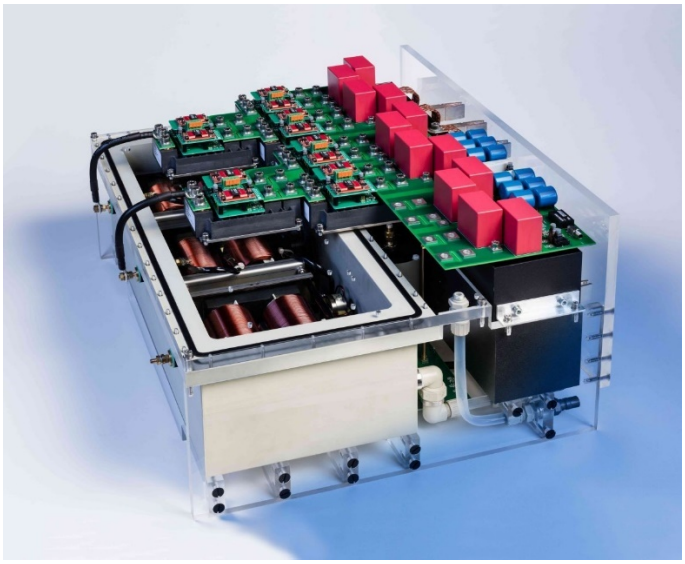
Website Fraunhofer ISE- Intersolar
https://www.ise.fraunhofer.de/en/events-and-trade-fairs/intersolar-europe.html

For a PV string inverter with 250 kVA, increasing the output voltage from 800 V_{AC} to 1,500 V_{AC} reduces the cable cross-section by 75 percent. © Fraunhofer ISE

Representatives from all trades involved in a large-scale PV power plant discussed the transition from the low-voltage to the medium-voltage level at Fraunhofer ISE on April 10, 2024.
© Fraunhofer ISE



In the "MS-LeiKra" project, Fraunhofer ISE developed and demonstrated the world's first PV string inverter in the medium-voltage range. © Fraunhofer ISE



Highly compact medium-voltage inverter with SiC power modules for large-scale storage and distribution grids, developed in the "SiC-MSBat" project. © Fraunhofer ISE