



CASE STUDY /

Ansys + SuperGrid Institute

“Simulation tools such as from Ansys are embedded in our design culture. With the multiphysics simulation that Ansys provides, we can now do things which we would not have thought possible before, allowing us to gain valuable time in the design process and avoid going through multiple prototype phases. The benefit of using Ansys while developing new technologies is that it really allows us to test a lot of concepts in a short period of time.”

Benhur Zolett

Power Electronics R&D Engineer / SuperGrid Institute

SuperGrid Institute Uses Ansys' Solutions to Develop Power Electronics Technologies for Future Power Grids

European leader in high voltage (HV) and medium voltage (MV) direct current (DC) technologies, SuperGrid Institute develops and tests innovative technology solutions for electrical networks including integration of distributed energy resources, such as renewable generation, electric vehicles (EVs) and energy storage systems. SuperGrid Institute's mission is to develop and promote direct current (DC) technologies to meet these upcoming challenges. Efficient AC/DC and DC/DC power electronics converters are important building blocks for future electric grids and SuperGrid Institute uses Ansys to facilitate the development process for these converters.

/ Challenge

The climate crisis and ambition to achieve net zero emissions by 2050 are a prominent focus for society. Introduction of DC distribution can help to achieve these goals by allowing easier integration of the electric vehicle charging infrastructure, low-emission CO2 generators like wind and solar farms, and energy storage within the existing electrical power system. Compact and efficient DC/DC medium-voltage power converter technologies are key to realize DC distribution and a focus of the Power Electronics & Converters program within SuperGrid Institute.

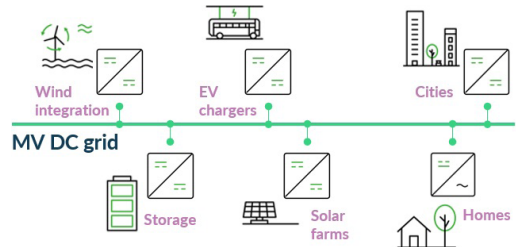
The company works in the early stages of product and technology development. Prior to working with Ansys, SuperGrid Institute used electric simulation software and validation through prototyping. While addressing innovative technologies, such as silicon carbide devices and their integration within the converters, multiple prototyping made developments more challenging and time consuming. It became crucial for SuperGrid Institute to be able to assess numerous concepts in a short period of time, studying the technical feasibility as well as economic viability. Ansys provides effective tools allowing SuperGrid Institute to achieve these objectives.

"The innovative nature of our work means that most of the time we work on products which do not exist in the marketplace," said Konstantin Verzhinin, R&D Engineer at SuperGrid Institute. "To be successful we need to take into account, not only electrical, but also mechanical and thermal consideration. Coupled engineering simulations with Ansys allow us to have much better understanding of the system in a holistic approach before prototyping activities."

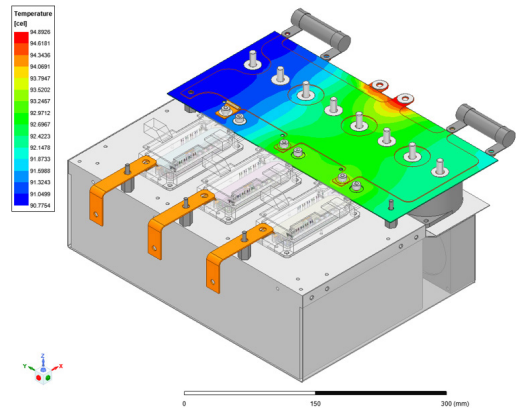
/ Engineering Solution

In 2014, SuperGrid Institute developed an isolated DC-DC power converter to connect low-voltage DC loads, such as EV chargers, to a low-voltage DC network (LVDC). For MVDC, the company adopted a cascaded topology with individual blocks of 100 kW using medium-frequency transformers and silicon carbide (SiC) power modules. The development of this converter required a simulation process to meet the complex criteria points. A multiphysics simulation was required beyond the initial level of electric challenges, alongside the inclusion of mechanical constraints and the ability to simulate the power density of power modules, temperature control, and any issues with the semiconductor.

SuperGrid Institute initially chose the Ansys Mechanical and Ansys Electronics solutions to build a dedicated multiphysics simulation workflow for its power converters. The workflow eventually became key to the daily activities of validating calculations, connecting data paths and troubleshooting of existing solutions.



General applications overview (future MVDC grid).



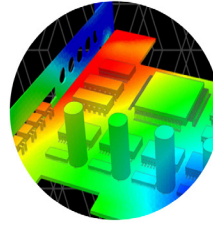
DC-DC Converter Simulation.



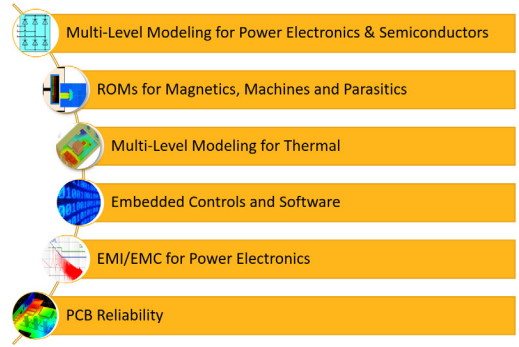
Benhur Zolett - Power Electronics R&D Engineer at SuperGrid Institute.

Ansys software solution suite features an easy data-exchange solution allowing for accelerated development with emphasis on an engineering-based solution.

Using Ansys Q3D Extractor, Ansys Maxwell 3D and Ansys Twin Builder, SuperGrid Institute can efficiently design and simulate power converters thanks to the nonlinear and linear solvers. Ansys Icepak helps with thermal management of the electronic components. The Ansys integrated electronics tools, such as workflow automation, help SuperGrid Institute solve the most pertinent thermal, electrical, and mechanical issues. On the user interface, teams can customize and automate solutions for any structural mechanics problems and parameterize them to analyze numerous design scenarios.



Ansys provides multiscale, multidomain and multiphysics simulation for power electronic systems.



/ Benefits

By testing concepts in different settings in a virtual environment, SuperGrid Institute's experts can shortlist solutions to implement and progress further, saving valuable time in the design process. The intuitive and customizable features across the user interface provided by Ansys within the finite element analysis (FEA) software means that the engineering team can also get accurate answers quickly. The main benefits include:

- Estimated 50 to 70 percent in time response reduction to a specific customer need
- Faster troubleshooting time
- Safely explore high-voltage equipment in a virtual environment
- Access to a dedicated Ansys support team

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Ansys offers an intuitive and unified platform to provide the SuperGrid Institute team a perfect match with their engineering needs. The recent tech updates ([Ansys R2, 2021](#)) on the Ansys Electronics Desktop have significantly improved the simulation technology and the computing power to enable reimagined product design and development.

/ About SuperGrid Institute

SuperGrid Institute, a European leader in HV & MV DC technologies, is an independent research and innovation centre, dedicated to the development of technologies for the future power transmission system. The company supports its clients in the development of electric power systems that aim at increasing energy efficiency and the integration of renewable resources, drawing on industrial and academic expertise and an array of added-value test platforms.

Among our five research and development programmes, our Power electronics & converters research department focuses on developing power electronics technologies that meet the requirements of the future DC grid. Our research covers innovative topologies and control systems which enable us to build highly efficient MVDC and HVDC power converters, notably for use in DC/DC conversion.

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