Electric Vehicles - Key to Energy Transition

Charging infrastructure for electric vehicles will be the key factor for ensuring a smooth transition to e-mobility. It is here, that five technologies will play a vital role in the EV charging infrastructure: smart charging (including vehicle-to-grid V2G technology), charging of EVs from photovoltaic panels, (ultra)fast charging, contactless charging and on-road charging of EVs. With the use of smart charging, the EV charging power and direction can be continuously controlled. Smart charging of EVs can provide several benefits to the EV owner and to the providers of the EV charging infrastructure like reduced peak demand on the grid and reduced cost.

In order to ensure that the use of electric vehicles results in net zero CO_2 emissions, it is important that the charging infrastructure derives all/majority of its power from renewable energy sources. It is here that the falling costs of photovoltaic panels (PV) over the years and the ease of integrating into the distribution network play a key role. Workplaces like office buildings and industrial areas are ideal to facilitate solar EV charging where the rooftops and car parks can be installed with PV panels. There are several additional advantages of charging EVs from photovoltaic panels: EV battery can be used as an energy storage for the PV and reduced energy and peak power demand on the grid as the EV charging power is locally generated from PV.

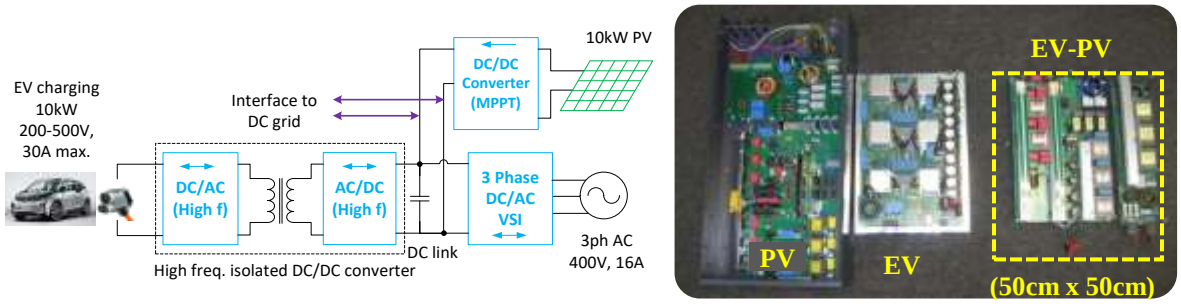

Figure 1:Left: Topology of power converter; Right: 10kW prototype of SiC based converter developed with PRE (Power Research Electronics) compared to a conventional PV inverter and EV charger of 10kW

With respect to (ultra)fast charging, new EVs are designed to withstand high power and for the EU market new standards are being developed with 350 kW charging. Research on what is the fast charger architecture and power electronic components which gives the most competitive advantage considering, the product development (cost, manufacturing, operability, compactness, power efficiency, etc) is conducted. New research question is how to maximize the utilization of installed power of the EV charger. Therefore a concept of a multiport, flexible and intelligent fast charger which features multiple output charging spots through the implementation of multiplexing techniques, scheduling and simultaneous charging is developed (see Figure 2).

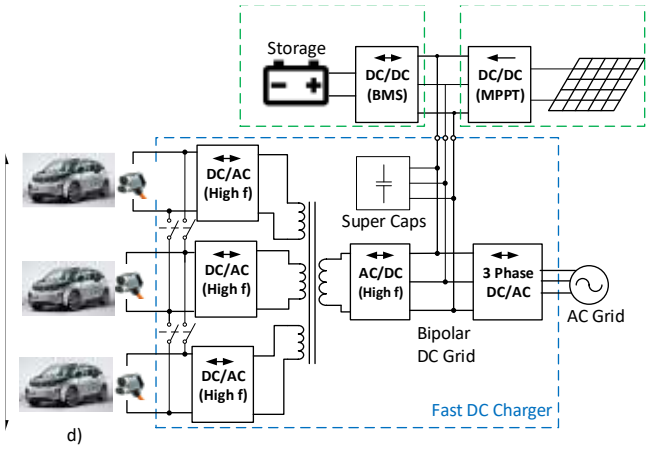

Figure 2:Modular multiport fast DC charger for simultaneous charging of multiple EVs

Contactless charging of EVs using Inductive Power Transfer (IPT) and on road charging is a technology that is increasingly becoming acceptable as an important feature of autonomous charging and key element enabling autonomous driving of EVs. This technology uses electromagnetic energy transfer between loosely coupled charge-pads which are placed with an air-gap in between. A block diagram of such a system is shown in Figure 3.

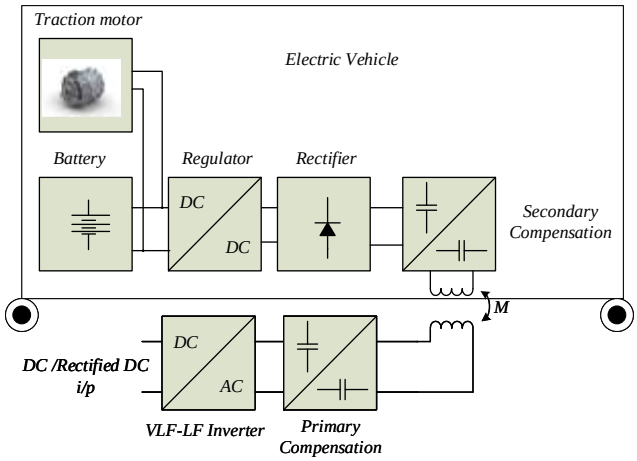

Figure 3: Block diagram of an EV IPT based system highlighting the various power conversion stages.