Electric vehicle integration in a real-time market

This project is rooted in the EDISON project, which dealt with Electrical Vehicle (EV) integration into the existing power grid, as well as with the infrastructure needed to facilitate the ever increasing penetration of fluctuating renewable energy resources like e.g. wind turbines. In the EDISON project, the EV is introduced as an energy buffer used to store excess energy produced at off-peak hours, while at the same time potentially benefiting the consumer by offering cheaper charging. This role as a buffer, predominantly used for delayed charging, also known as “smart charging”, can also be used for ancillary services to help stabilize the grid at critical periods, e.g. by providing near instant up- or down regulation. The initial goal of this project is to develop the components for a simulation platform for large scale EV integration studies. By interfacing the EV simulation with an externally simulated model of the power grid, it is be possible, in real-time, to simulate the impact of EV charging and help to identify bottlenecks in the system. In EDISON the vehicles are aggregated using an entity called a Virtual Power Plant (VPP); a central server monitoring and controlling the distributed energy resources registered with it, in order to make them appear as a single producer in the eyes of the market. Although the concept of a VPP is used within the EcoGrid EU project, the idea of more individual control is introduced through a new proposed real-time electricity market, where the consumers will have direct access to the current price. As opposed to the hourly spot-price market of today, the real-time market see price updates as often as every couple of minutes. To allow the individual resources to react to these changes, independent of each other, so called “smart controllers” are needed at the device level. In order for this market to work, however, the proper ICT network- and server-infrastructure has to be developed. The primary goal of this PhD project, has been to investigate the scope of this ICT infrastructure, required to realise price-signal based charging of electric vehicles, in accordance with the EcoGrid EU market.