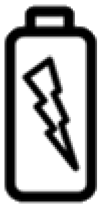
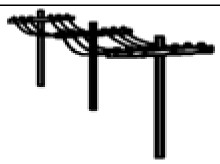
Use of facilities for EV integration

	**Battery technology** The battery is the most valuable component of an EV. It is valuable both in terms of the monetary upfront cost and in the context of the opportunities it offers in relation to the power grid. The focuses of this study are on the charging and discharging efficiency, thermal degradation and optimal usage relating to battery lifetime. These studies require comprehensive battery models as well as physical experimental facilities for real life testing.
	**Smart EV utilization concepts and markets** 'Utilization concepts' covers the various value-adding services that the electric vehicle can offer to external stakeholders. These can roughly be divided into the following: **Smart charging** - Where the charging of an EV battery is delayed or advanced in time based on energy costs, grid constraints or renewable contents (e.g. wind-power). **Energy backup** - Where the EV stores energy that is delivered back to the power grid or household at some later point in time. **Ancillary services** – Where the EV, as a fast response resource, reacts with charging and discharging operations to meet the balancing needs of the power system. **Distribution grid services** - Where the EV will reduce its charging power at certain periods in time to respect the capacity constraints of the distribution grid. To test the above concepts a series of prediction and optimization methods needs to be implemented. Also, the integration into existing and future power markets must be explored.
	**Grid impact** The investigation on how the added load of future EV fleets will influence the power system in terms of grid congestion. The degree of grid congestion is dependent on a number of factors including local grid topology, penetration- and distribution of EVs as well as charging management procedures. The main goal is the prevention of equipment overloading and the assessment of the need for grid reinforcement. The study uses virtual EV fleets and simulated grid models with household and EV load profiles, in order to test different scenarios based on the existing grid topology.

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<td>EV Communication
This study investigates the technologies, protocols and standards that will connect the EV to the charging infrastructure and other external entities. The type and formatting of data is investigated as well as all protocols spanning the OSI stack that will carry it over the net-works. This study include proof-of-concept implementation in will be linked to the ongoing EV communication standardization process.
Part of this study is also the cyber security that needs to be implemented to secure confidentiality, integrity and availability in EV communication.</td>
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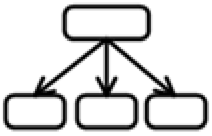
<td></td>
<td>Control design
By ‘control design’ is meant the mechanism used to influence the EV’s behaviour and inter-face it with power system and market. Two main such designs are investigated
Centralized control - In which a single entity (a fleet operator) directly controls the behaviour of a group of electric vehicles.
Distributed control - In which the EV behaves as an autonomous and intelligent agent. The use of price signals falls into this category.
Developed software systems are used to test the various designs.

EV integration assets related to PowerLab.dk

The following assets are presently part of PowerLab.dk to help facilitate the above studies.</td>
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