

Load as a Resource: Demand Response and Electric Vehicles

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In a not-so-distant future, it is expected that large fleets of electrical vehicles (EVs) are to be integrated into electric power systems, representing a new type of load which will add up to the already growing demand of electricity. Moreover, EV loads will be connected to low and medium voltage networks that were originally not conceived to handle such type of demand. It is therefore expected that the demand induced by the EVs will impact the power system at both system and local level.

EVs are equipped with a battery that enables them to act as micro-storage devices, as opposed to conventional demand,. Alongside with this change in the transportation sector and consequently in the electricity demand, the advent of Smart Grid technologies is expected to enable a higher degree of controllability to the loads.. The combined characteristics of control and storage will enable a granular EVs-demand side response, that can be used to support the power system in the daily operation and to potentially reduce/ postpone the need for additional generation and network reinforcement. This, however, requires the definition of strategies and requirements for the control of EV demand and unlock the potential flexibility services that it can provide.

The different aspects that need to be considered at the stage of defining EVs control strategies and the requirements for its deployment are manifold:

- Which are the flexibility services that can be provided by the EVs and to whom?
- What is the economic and environmental benefit to the electric power system and to the social welfare obtained from these services?
- What are the technology requirements for both the EVs and the electric power and related systems, that will facilitate the use of this flexibility to support the electric power system operation and planning?
- What are the needs in terms of market and regulatory frameworks to facilitate the deployment of this flexibility and its economic reward?

Addressing these questions requires an important research effort, that involves different fields ranging from electric power system, economics, regulation, technology development and social sciences.

As part of this research efforts, the focus of this presentation will be to present the work developed in terms of:

- identification of the impacts on the operation of different parts of the electricity supply chain and of the opportunities that can emerge from the large scale deployment of EVs in terms of using this new demand to support the electric power system;
- development of alternative control strategies and analysis of its potential benefits both at system and local level, in order to anticipate the needs for technological, market and regulatory evolution, as the penetration of EVs in the systems increase. To this end, different solutions are presented in terms of technical and commercial interactions and analysis of the performance of these strategies using models and simulation tools will be presented.
- to share results of a set of illustrative case studies, based on European power systems and distribution networks, performed by academic and power industry partners as part of the European cooperative research project G4V .

Finally, some conclusions in terms of benefits from and challenges for adopting different type of control strategies will be drawn and needs for additional research to support the large scale integration of electric vehicles in the electricity systems are identified.