Decentralized Charging Protocol for Plug-in Electric Vehicles

Tech ID: 29884 / UC Case 2015-030-0

BRIEF DESCRIPTION

Plug-in vehicles (PEVs) have drawn interest from government, automakers, and the public due to potential for reduced environmental impact. UCI researchers have developed a decentralized charging protocol for PEVs that results in improved stability in power grid demand.

SUGGESTED USES

• Procedure to coordinate the charging of individual plug-in electric vehicles with the operation of the electric grid

ADVANTAGES

• Smooth fluctuations in overnight electricity demand
• Lower cost for utility and user
• Reduced emissions from intermittent power generation
• Minimizes calculation and communication between a PEV and grid operator

FULL DESCRIPTION

One of the hurdles for large deployment of PEVs is the shortage of charging infrastructure. Studies into the development of such infrastructure have shown that the majority of charging activities occur at home with the current PEV characteristics and charging rates, due to the cheap night time residential electricity and the long dwelling time needed. Furthermore, charging time strategy has been showed to have the most significant impact on charging cost reduction. At the same time, power grid operation requires electricity demand and generation to be balanced at all times. Peaks in demand require the use of intermittent power generation techniques which are costly and more harmful to the environment while demand valleys waste power.
UCI researchers have developed a charging protocol to coordinate the charging of individual PEVs with the operation of the power grid. An electricity cost projection, derived from anticipated demand, is broadcasted by the grid operator. Each individual vehicle decides on an optimal charging profile for the night, which is sent back to the grid operator for the purpose of updating the cost projection. The proposed protocol can fill the overnight electricity demand valley without incurring additional peaks. Further, by using the gap between current load and a target load to guide the cost signal, the target load can be approached in an efficient manner. Adoption of the charging protocol can potentially reduce the peak demand and power losses on the electric grid, mitigate the burden caused by the intermittent renewable power and lower the cost and emissions from the power generation.

STATE OF DEVELOPMENT

The charging protocol has shown good performance in simulations to level overnight electricity demand while minimizing money cost for the user.

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OTHER INFORMATION

CATEGORIZED AS

- **Computer**
  - Software
- **Energy**
  - Other
  - Storage/Battery
- **Transportation**
  - Automotive

RELATED CASES

2015-030-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,065,520	09/04/2018	2015-030

RELATED MATERIALS

» Zhang, L.; Jabbari, F.; Brown, T.; Samuelsen, S. Coordinating plug-in electric vehicle charging with electric grid: Valley filling and target load following. Journal of Power Sources 2014, 267, 584–597.

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