REFLEX PhD Candidate

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PHD THESIS

Title

Electric vehicle fleets in the local energy system under consideration of the integration of renewable energy sources and uncertainty

Abstract

Electric vehicles (EV) are one promising technology towards an improved sustainable and green transportation sector, especially when charged with electricity from renewable energy sources (RES). However, the fluctuation generation of RES as well as the changing driving patterns of EVs have the offset of an uncertain nature which make it hard to schedule the charging processes optimal.

This PhD elaborates several methods (simulation, optimization and stochastic programming) to schedule the charging process of three different EV fleets at a common charging infrastructure under uncertainty. In the setting of a car park use case, several restrictions are taken into consideration when the load shift potential of the EV fleets are evaluated – cost-wise with respect to charging-cost minimization as well as maximal utilization of generated photovoltaic (PV) for charging. A Latin hypercube based sample average approximation method is used to solve the underlying two-stage stochastic mixed-integer optimization problem efficiently. Moreover, the characteristics of the three EV fleets are models with a non-parametric probability density function (kernel density estimation) to reflect the arrival time, departure time and distance covered through the energy demand more accurately.

The benefits of reduced charging costs, even when uncertainties are considered are shown as well as an increased utilization of the PV when optimized and simpler heuristics are compared. Moreover, results indicate that the commuter fleet has the highest potential to utilize generated PV for charging which also ends up in the lowest overall charging costs of all the three EV fleets. Implications for business model concepts for a car park operator interacting as an aggregator are drawn. Moreover, a conceptual framework to enhance this demand side flexibility of EV customers with incentives through diverse service designs are outlined.

This project has received funding from the European Union's Horizon 2020 research and innovation programme [GA-No. 691685].

PROFESSIONAL EXPERIENCE

since 04/2017	Research Associate at the Chair of Energy Economics, Institute for Industrial Production, Karlsruhe Institute of Technology (Karlsruhe, Germany)
08/2015 – 11/2015	Research stay at Lawrence Berkeley National Laboratory (Berkeley, CA, USA)
02/2013 – 05/2017	Research Associate at the Energy Solution Center e. V. (Karlsruhe, Germany)
10/2011 – 11/2011	Intern at the Federal Ministry of Economics and Technology (Berlin, Germany)
03/2011 – 08/2011	Intern at Siemens Industry, Drive Technologies (Norwood, Ohio, USA)
10/2010 – 02/2011, 04/2008 – 08/2009	Student assistant at the Dresden University of Technology (Dresden, Germany)

EDUCATION

10/2016 – 09/2012	Studies of Industrial Engineering at the Dresden University of Technology (Dresden, Germany) Degree: Diploma (Dipl.-Wi.-Ing.)
09/2009 – 06/2010	Studies of Economics and Finance at Heriot-Watt University (Edinburgh, Scotland) Degree: Bachelor of Arts with distinction

RESEARCH INTERESTS

- Electric Mobility, Energy System Modelling, Stochastic Programming, System Dynamics

PUBLICATIONS AND CONFERENCE PRESENTATIONS

Seddig, K.; Jochem, P.; Fichtner, W. (2017): Integrating renewable energy sources by electric vehicle fleets under uncertainty, Energy

Seddig, K.; Jochem, P.; Fichtner, W. (2017): A Framework for Electric Mobility Services for a Car Park, Proceedings of Karlsruhe Service Summit, Karlsruhe, Germany

Seddig, K.; Jochem, P.; Fichtner, W. (2017): The Impacts of Load Management of Electric Vehicles Fleets under Uncertainty, Proceedings of IFORS 2017, Quebec, Canada

Seddig, K.; Jochem, P.; Fichtner, W. (2016): The impact of electric vehicle fleets on the integration of renewable energy sources and CO2 emissions under uncertainty, 14th World Conference on Transport Research, Shanghai, China.

Seddig, K.; Salah, F.; Schnug, S.; Frank, M. (2015): Dezentrales Lastmanagement von E-Flotten unter Berücksichtigung der Erzeugungs- und Netzverfügbarkeit, *ETG-Fachtagung - Von Smart Grids zu Smart Markets*, VDE VERLAG GmbH, Kassel, Germany.

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Seddig, K.; Jochem, P.; Fichtner, W. (2014): Fleets of electric vehicles as adjustable loads –Facilitating the integration of electricity generation by renewable energy sources, in proceedings of IAEE International Conference, New York, USA.

Seddig, K.; Jochem, P.; Fichtner, W. (2014): Nutzung von elektromobilen Flotten zur Lastverschiebung, in proceedings of Symposium Energieinnovation, Graz, Austria.

Seddig, K.; Jochem, P.; Fichtner, W. (2014): An Agent-based Simulation Approach for Scheduling the Charging Process of Electric Vehicles in Fleets, Conference of the International Federation of Operational Research Societies (IFORS), Barcelona, Spain.

Seddig (2013): Integrated Fleet and Charge Management, EIT ICT Labs Smart Energy Summer School, Paris, France.

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