REFLEX PhD Candidate

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PHD THESIS

Title

Life cycle environmental assessment of European power systems considering the impacts of electric vehicles integration

Abstract

With the introduction of electric vehicles (EV) the hope is expressed to reduce carbon emissions and by this the share of mobility at total carbon emissions. However, the development of EV brings forth impacts on the power systems, e.g., additional generation of electricity by power plants, and an additional load on distribution grid. A market penetration with EV could be seen as an additional policy measure to achieve the European Climate and Energy policy goals, by transforming the amongst others the energy system the mitigation strategies sees a reduction of the greenhouse gas (GHG) emissions by 80 to 95 % below 1990 levels by 2050.

Energy system optimization models (ESOM) are widely used to identify possible transformation paths of the energy system at minimized system costs and given specific environmental policies. Generally the later takes only carbon emissions into account. However, the transition of the energy system will have additional environmental impacts, for example metal depletion. In order to expand the scope, life cycle assessment (LCA) is conducted to evaluate other environmental impacts along with carbon emissions from life-cycle thinking by linking ESOM and LCA models.

However, up to now, rare studies have considered the potential influence of EV integration on the life cycle environmental impacts on the power systems. This study aims at filling the gap. Additionally, considering the challenges of linking LCA and ESOM approaches, e.g., different system boundaries, different assumptions and database, etc., this study would dedicate to overcome the challenges mentioned above and develop a general framework to analyze life cycle environmental impacts of future energy systems. This framework will be used in the study.

To achieve the motivation, three work packages are defined: firstly, modification of PERSEUS, an European power system model in this study as a use case for ESOM with EV charging information considering different charging plans (controlled and uncontrolled unidirectional charging); secondly, drawing a general framework of linking LCA and ESOM for the environmental analysis of future energy systems; thirdly, applying this framework to the modified PERSEUS model, and analyze the life cycle environmental impacts of future European power systems with EV integration. Besides the benefits of involvement in an international working

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team, REFLEX project brings the framework conditions for the transportation scenarios as well as data exchange related to electric vehicles.

EDUCATION

since 07/2015	Doctoral Student at Karlsruhe Institute of Technology, Institute for Technology Assessment and Systems Analysis (KIT-ITAS)
2012 – 2015	M.Sc. - Master's Program of Infrastructure Planning (MIP), University of Stuttgart, Germany
2008 – 2012	B.Sc. - Environmental Science, Beijing Normal University (BNU), China

RESEARCH INTERESTS

- Life cycle assessment
- Technological assessment
- Renewable energies
- Energy system analysis

PUBLICATIONS AND CONFERENCE PRESENTATIONS

Xu, L., Resources, Conservation & Recycling (2017), http://dx.doi.org/10.1016/j.resconrec.2017.06.014

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