Simultation-based Approach for Investigating the Impact of Electric Vehicles on Power Grids

The large-scale introduction of plug-in electric vehicles (PEV) may pose challenges to power system operators by causing grid congestion or voltage fluctuations. This work presents a simulation-based approach for investigating the impact of transport electrification on power grids. The framework consists of an agent-based traffic simulation which is coupled with a power system simulation through the IEEE Standard High Level Architecture. As detailed power grid information is often unavailable, the framework further contains a method for synthesizing power networks from tempo-spatially resolved demand data. Using a high-performance computing infrastructure, the approach allows simulating the traffic and power system on the scale of a megacity faster than real-time. An application to the example of Singapore shows that grid congestion and voltage drops are observed on the low voltage level while the high and medium voltage grid remain unaffected. The presented framework may facilitate infrastructure decisions and support the development of smart charging strategies minimizing power grid impact.

Index Terms--- Power grid synthesis, power flow simulation, plug-in electric vehicle, grid congestion, power grid impact
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