PEV storage in multi-bus scheduling problems

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Abstract-

Modeling electricity storage to address challenges and opportunities of its applications for smart grids requires inter-temporal equalities to keep track of energy content over time. Prevalently, these constraints present crucial modeling elements as to what extent energy storage applications can enhance future electric power systems’ sustainability, reliability, and efficiency. This paper presents a novel and improvedmixed-integer linear problem (MILP) formulation for energy storage of plug-in (hybrid) electric vehicles (PEVs) for reserves in power system models. It is based on insights from the field of System Dynamics, in which complex interactions between different elements are studied by means of feedback loops as well as stocks, flows and co-flows. Generalized to a multi-bus system, this formulation includes improvements in the energy balance and surpasses shortcomings in the way existing literature deals with reserve constraints. Tested on the IEEE 14-bus system with realistic PEV mobility patterns, the deterministic results show changes in the scheduling of the units, often referred to as unit commitment (UC).

Index Terms- Direct load control, mixed-integer linear programming (MILP), multi-bus unit-commitment (UC), plug-in electric vehicles (PEVs), reserves.

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