Design Planning of Charging Infrastructure Using an Agent-Based Digital Twin

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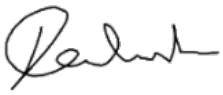

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[i] See: https://www.tue.nl/en/our-university/about-the-university/organization/integrity/scientific-integrity/
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ABSTRACT:

This paper concerns the design planning of charging infrastructure for electric distribution trucks by modeling an agent-based simulation model otherwise known as an agent- based digital twin. Due to the stochastic design variables such as the number of trucks in a fleet, the number of charge points, the capacity of Battery Energy Storage (BES), and grid capacity being involved in the model, Monte Carlo experiments are performed to estimate the probable outcomes while varying the design variables. In particular, we first start with building an agent-based digital twin with the inputs and requirements obtained from the stakeholders namely Albert Heijn (AH), TNO, and Heliox. Secondly, we perform three different Monte Carlo experiments to predict the waiting time of the trucks to charge, BES capacity, and power curves while varying the design variables within specific bounds. The novelty of this paper lies in predicting the outcomes of different scenarios by varying the design variables using an agent-based digital twin. Our results show that for a fleet of 50 e-trucks at a charging station at least 9x180 kW charge points are required to keep the waiting time less than 10 minutes. Secondly, utilizing a stationary BES at the charging station can buffer the energy flow between an electric vehicle and the grid, lowering the maximum necessary grid power.