Evaluating the feasibility of Circular Charging Ecosystems (CCEs) for transport operators

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Abstract:
The electrification of freight transport has widely been identified as viable solution to minimize the sectors CO2 emissions, noise and pollution. Yet earlier research has indicated that such a transition would not only entail a switch to alternative fuels sources, i.e., electricity, but also lead to extensive changes in relationships between business actors in the transport and logistics industry (Klitkou et al., 2015), alter existing business models (Tongur & Engwall, 2014) and require the diffusion of a multitude of different innovations (Sovacool et al., 2020) as well as complementary technologies (Andersen & Markard, 2020).

These potentially profound changes in existing business practices have left incumbent actors, specifically freight haulers, with many uncertainties about future transition pathways, which in turn has resulted in a slow adoption of electric vehicles outside of funded demonstration projects, especially in the heavy commercial vehicle section (Melander & Nyquist-Magnusson, 2022). To bridge existing knowledge gaps and resolve uncertainties, we present a study that investigates the development efforts necessary to establish circular charging ecosystems at the depots of regional logistic companies. Such circular charging ecosystems (CCEs) are comprised of energy hubs including photovoltaics and second-life battery storage and in combination with autonomous static charging platforms at the depots could enable transport operators to charge electric trucks with their own climate-neutral electricity independent of price fluctuations.

The aim thus is to identify business model, technology and system challenges of how logistic companies can transition to electrification more resource efficiently and cost effectively through circular charging solutions to evaluate their potential to accelerate the transition the electrified road freight transport. Our results analyse the business case and financing models of circular charging solutions for freight haulers including total cost of ownership and potential for added revenue streams as well as sharing technology investments between multiple freight haulers. Additionally, an in-depth analysis of the technological requirements and system operability of such circular charging ecosystems is presented, and we discuss how current daily business practices for local and regional freight transport such as traffic planning, vehicle routes and scheduling might be affected.

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