Techno-economic assessment of public charging infrastructure: A European Comparison

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Introduction and Motivation

In order to achieve the climate protection goals of the European Green Deal, the expansion of public charging infrastructure is seen as one key element of the road transportation's transition. Although public charging infrastructure has expanded in recent years, a European-wide coverage remains insufficient. One key enabler in reaching the goals set out in the recently introduced Alternative Fuels Infrastructure Regulation could be a higher transparency on the financial attractiveness of public charging infrastructure. Previous studies lack a comprehensive economic feasibility analysis of different configurations of public charging infrastructure across European countries (e.g., Mortimer et al. 2021; Lanz et al. 2022) and a consideration of technical disruptions, such as the transition of grid infrastructure systems from Alternating Current (AC) to Direct Current (DC) microgrids (Pires et al. 2023). To close this research gap, our study attempts to answer the following research questions:

1. *How do the economics of public charging infrastructure vary depending on the countries, charging capacities, number of charging points per charging station and grid system from a CPO's perspective?*
2. *How do changes in the most influential parameters affect profitability from the charging point operators (CPO's) perspective?*

Applied Method

For answering these questions, we determine the amount of electricity required to reach the break-even points based on a techno-economic net present value model from a CPO's perspective. Among others, we include the capital expenditures (Capex) of charging stations, transformers etc. and operating expenditures (Opex) of electricity as well as revenues for the electricity sold. Our calculations vary according to the considered countries (European Economic Area), charging capacities (11 kW, 22 kW, 50 kW, 150 kW and 300 kW), number of installed charging points (one to eight per charging station) and the grid system (AC grid and DC grid).

Results

Overall, our results show that the economics of public charging infrastructure vary between countries considerably (see Figure 1). We also outline the DC grid's economic attractiveness compared to the currently prevailing AC grid system, especially for higher charging capacities and an increasing number of charging points per charging station. Our sensitivity analyses indicate that the break-even points are particularly influenced and sensitive to alterations in electricity revenues and costs in a non-linear manner as well as Capex. The latter is especially evident for higher charging capacities and DC grid system architectures. However, the DC grid system, appears to be resilient to these changes.

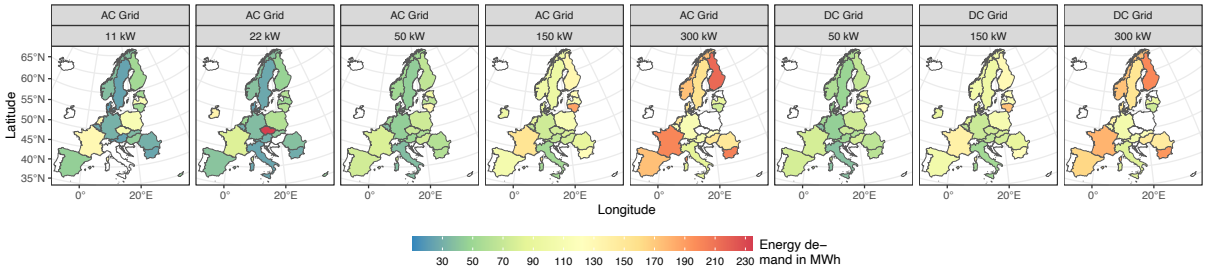

Fig. 1: Break-even points across countries, charging capacities and grid systems for two charging points. Note: Blank countries indicate either missing values or that a solution with the iterative calculation could not be found or that the utilization exceeded 100%.

Conclusions

Besides implications for potential investors regarding their decision-making process for investments in charging infrastructure, our study highlights several implications for policymakers. Policy initiatives need to address the lack of data transparency, support charging infrastructure manufacturers in their innovation and cost-reduction efforts, and a redesign of country-specific subsidies. The latter in particular relates to the Capex of DC grid infrastructures, a minimum amount of charging points and operating expenditures subsidies in countries where deployment is lagging behind.

References

Lanz, Lukas; Noll, Bessie; Schmidt, Tobias S.; Steffen, Bjarne (2022): Comparing the levelized cost of electric vehicle charging options in Europe. In: Nature communications 13 (1), S. 5277. DOI: 10.1038/s41467-022-32835-7.

Mortimer, B. J.; Bach, A. D.; Hecht, C.; Sauer, D. U.; Doncker, R. W. de (2021): Public charging infrastructure in Germany-a utilization and profitability analysis. In: Journal of Modern Power Systems and Clean Energy PP (99), S. 1–10.

Pires, Vitor Fernão; Pires, Armando; Cordeiro, Armando (2023): DC Microgrids: Benefits, Architectures, Perspectives and Challenges. In: Energies 16 (3), S. 1217. DOI: 10.3390/en16031217.