The secret life of e-scooter batteries

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Shared mobility has recently become a B€ industry with ~260 million e-scooter rides taken in Europe 2024 alone. Actors such as Lime, Dott, and Voi have operated shared e-scooter (SES) & e-bike fleets for >7 years, and with these businesses becoming profitable, use is likely to further expand. Given this, it is relevant to consider ways of benchmarking SES battery performance, just as for any other electric vehicles. The automotive industry and customers benefit from standardised usage profiles, such as the Worldwide Harmonized Light-Duty Vehicles Test Procedure (WLTP), but at present no such profiles exist for SES. Furthermore, little is known about SES-specific battery ageing, partly due to lack of understanding of operating conditions, including representative load profiles, arguably having a significant impact on lifetime [1].

Here we approach the challenge of identifying SES battery usage and load cycle, relevant for both lifetime testing and performance benchmarking, by using high frequency voltage, current, and temperature data collected from 10 thousand commercial SES both during rides (> 15 million) and standby (>3 months accumulated operation). This way we can identify fleetwide distributions in C-rates, temperatures, rest times, and state-of-charge windows traversed, using the battery information format (BIF) [2]. Combining all above, we can tentatively give recommendations for representative test conditions and power profiles, similar to WLTP etc., enabling accurate lab-testing of ETW batteries and future vehicle improvements.

[1] Dynamic cycling enhances battery lifetime., Nat Energy 10, 172–180 (2025).

[2] The battery information format (BIF)[...] , J. Power Sources, 652, 2025.