

Charged for Change?

What does it take to make bidirectional charging attractive?

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ABSTRACT

The ongoing technical development of charging technologies has a need to incorporate the electric vehicle (EV) user's perspective. Therefore, a survey which aimed to (1) provide a representative overview of current charging behaviour and (2) assess user attitudes toward Vehicle-to-Everything (V2X) charging technologies, was conducted. The study focused on the technologies smart charging, Vehicle-to-Home (V2H), Vehicle-to-Building (V2B), and Vehicle-to-Grid (V2G). Results indicate that most users charge their EVs several times a week, primarily at home, with a significant share charging at night. Cost savings emerged as the key driver for charging decisions, with users more willing to adjust charging time than location. The survey also revealed varying acceptance levels of V2X technologies. More participants expressed willingness to adopt smart charging or V2H, rather than V2B or V2G. The insights provide valuable input for designing incentives and policies to enhance user acceptance of V2X technologies.

Keywords: EV Charging Behaviour, Smart Charging, Bidirectional Charging, User Acceptance.



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1 INTRODUCTION

Technical development of V2X charging is ongoing, having the need to involve the EV drivers' perspectives. Reviews focusing on EV adoption show the relevance of topics like charging infrastructure, charging time, and financial incentives for EVs (e.g., Anastasiadou & Gavanis, 2022; Stockkamp et al., 2021). Further studies provided insights on EV users' charging behaviour (e.g., Jabeen et al., 2013) while others analysed the process of how EV drivers develop their range preferences (Franke & Krems, 2013).

While many critical aspects were already investigated, it is essential to generate findings which can inform the ongoing technical development processes. The conducted survey has two major goals. First, to better understand EV drivers charging behaviour. Second, to learn about EV drivers' opinions and attitudes about V2X technologies, if these would be acceptable for them, and under which conditions they were willing to use them.

2 METHODS

The online survey was conducted between October 2024 and February 2025. Participants were required to drive an EV or to plan to do so soon. Depending on whether participants already drive an EV, different versions of the survey were presented. The survey was administered using LimeSurvey. In the beginning of the survey, participants' socio-demographic and economic backgrounds were collected. Followed by this, the survey asked about EV ownership and typical charging habits. Participants were also asked to evaluate statements about their charging behaviour using a Likert scale, indicating their level of agreement or disagreement. The survey further explored when they typically initiate and end a charging session. The last part of the survey was about their attitudes regarding the mentioned V2X technologies. The survey sample consists of a total of 516 participants (397 male, 113 female, 6 non-binary). A total of 453 participants drove an EV at the time of participation.

3 RESULTS

The analysis of charging behaviour shows that half of the EV drivers charge their electric vehicle several times a week (50.3%) and mainly at their own charging station at home (67.5%). In addition, 41.5% state that they mainly charge their electric vehicle at night (00:00-05:00), while 25.4% state that this varies. Only 11.3% charge their electric car in the evening (17:00-00:00). The survey on their charging habits showed that cost savings are the most important aspect of charging (90% agree). They are also more willing to change the time of charging (77%) than the location (50%) if more favourable charging conditions are available. The reason for this is that EV drivers are interested in having the shortest possible walking distance (74%) and minimising the time required for charging (67%). The survey also showed that maintaining a certain minimum amount of state of charge (SoC) seems to be more important (87%) than financial aspects such as the salary on their account (13%) or finding a favourable charging option (56%). Finally, the condition of the battery plays a major role in users' decision to stop charging. It is more important to conserve the battery (77%) or to have enough SoC for the next planned journeys (86%) than to have a fully charged battery (38%).

Analysing the survey data shows that there is a clear difference in the willingness to use innovative charging technologies. While over 65% of participants would be willing to use smart charging or vehicle-to-home (V2H). Out of the participants only 38% would use vehicle-to-building (V2B) and only 33% would use vehicle-to-grid (V2G). In contrast, the number of participants who reject V2B or V2G is more than twice as high. In addition, the number of people who would only use this technology under certain conditions is quite similar. The main reasons against V2B and V2G are concerns about battery degradation (41% for V2B and 40% for V2G) and uncertainty about whether the SoC will be high enough when they want to start their next journey (33% for V2B and 46% for V2G). When asked about the necessary compensation for discharging, the price reduction when charging and how far they would let their car discharge, the median answers were similar between V2B and V2G. For discharging, the median is 30 c/kWh, for price reduction 50% and for discharging 50% of the SoC.

4 OUTLOOK

The presented survey findings show insights into EV driver's charging behaviour and their willingness to use V2X. The survey data will be further analysed also considering differences across European countries. Further, the findings will be an input to a digital twin developed as part of the European research project XL-Connect.

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