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Reducing Battery Degradation with Vehicle-to-Grid Operations

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Under considerable concern for our environment and other drawbacks of using ICE vehicles, we can observe that electric vehicles (EVs) are becoming popular worldwide. Complementary to EVs, another emerging technology is Vehicle-to-Grid (V2G). V2G can make it easy to connect your EV to the power grid. This can help support electricity where people face crises and empower valuable services, including load levelling and frequency regulation. V2G is being demanded, especially where the standard form of electricity is unavailable or prohibitively expensive [1-2]. The best part of V2G technology is not only getting charging support for a car to run, but it can store power to send back to the grid every time the car is linked to the grid at rest mode. Apprehensions about battery degradation, an inherent battery property that occurs in both running and resting states, are critical barriers to V2G deployment [1]. In the resting (or storing) mode, the capacity loss is referred to as calendar ageing, which denotes the capacity fade's reliance on resting or storage circumstances and is unaffected by charge throughput. Inversely, the cycle ageing factor will be included, which often happens when the battery is connected to electricity. The capacity will reduce, explaining the effects of charging rates, depth-of-discharge, charge throughput, and battery temperature on cycle conditions. Theoretically, as the charged cycle's numbers increase, the battery life is decreased. Hence, to minimise excessive ageing through V2G activities, the level and amount of V2G operations should be calculated and optimised as precisely as feasible [3-4]. According to the literature, calendar ageing can be more prevalent than cycling ageing, especially when the magnitude of applied C-rates and DoD is modest [5].

According to Amamra *et al.* [6], an optimised bidirectional V2G procedure is based on a convoy of electric vehicles (EVs) connected to a distributed power supply via a charging station network. The system might react to real-time EV usage data and determine what changes are needed to enable both frequency and voltage regulation while minimising battery degradation and optimising battery performance. Moreover, while the EV is parked, various smart charge strategies have been devised, which generate charging plans to reduce charging costs and battery degradation. [7-8]

Talking about the contribution to Moxie Energy Group, it is a great project. Most things are according to the plan of the project. The above describes a little bit about the V2G techniques and different aspects of battery ageing. Hopefully, looking forward to learning more.

I plan to conduct,

- "A survey of algorithms for distributed charging control of electric vehicles in smart grid" [9]
- "A review on the key issues of the lithium-ion battery degradation among the whole life cycle" [10]
- "Impact analysis of V2G services on EV battery degradation A review" [4]

Much research is particularly required for this project. Given the innovation behind V2G, a study concerning how to reduce the ageing of the battery will be a challenge, at least in a way that will be useful

for the Moxie Energy Group. With the help of my supervisor, we can build, to some extent, a framework to help solve the problems. The type of battery ageing is not specified by the Moxie Energy Group, adding to the challenge, as specifications vary from company to company and battery to battery.

Nevertheless, I have experience in MATLAB, developed during my bachelor's degree, which will help me better understand the scope of the problem. In terms of experience, I do not have any within the Moxie Energy Group. Still, I will work to apply the skills I am learning through my academic activities to do my part in the global effort against climate change.

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