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Electric Vehicles within the landscape of the energy sector

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The world is embracing electric vehicles (EVs). The number of countries, regional governments and cities that have set dates to ban internal combustion engine vehicles is rapidly growing. Underlying this momentum is the recognition that electrifying transport is a critical lever to improve air quality, reduce greenhouse gas emissions, and transition from fossil fuels. The increased uptake of EVs can lead to a contributing factor to the increased electricity demand during peak times, which further contributes to an imbalance between the grid's peak and off-peak demand.

However, by using smart, holistic, management of the integration of EVs, there can be a decrease of the difference between the base load and peak load demand on the grid thereby ultimately increasing the efficiency of power distribution across the grid network. This can be achieved by not only controlling the timing of energy to the vehicle during charging, but also to utilise the EV as an energy source to the grid through Vehicle-2-Grid (V2G) capabilities. The V2G technology enables EVs to discharge energy from the vehicle's battery pack into the grid network enabling fleets of EVs to improve the electricity landscape significantly and potentially provide the opportunity for additional revenue generation for EV owners through ancillary services to the grid. In the residential case, this would be in the form of behind-the-meter services.

The growth of EVs within the market will also result in retired battery packs from EVs that reach their end of first life due to capacity losses for mobility usage. The lithium-ion battery packs used within mobility applications are considered to have reached their end of first-life when the state-of-health (SoH) has reached 80% of original capacity. Although no longer fit for mobility applications due to the decrease in available vehicle range, the battery pack still has potential capacity left that can be utilised across stationary applications.

The uYilo smart-grid ecosystem project focuses on the integration of electric vehicles into a micro-grid environment with embedded generation that includes solar photovoltaic, as well as energy storage systems in the form of second life electric vehicle batteries utilized within stationary storage. The distribution network consists of multiple AC and DC chargers for EVs as well as demonstration of V2G. IEC 61850 is the smart grid communication network implemented for remote monitoring and control of the facility.