Smart grids can help electric vehicles tick

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As per the National Electric Mobility Mission Plan (NEMMP 2020), India's transport sector accounts for one-third of the country's crude oil consumption, out of which road transport guzzles more than 80%. Going forward, this is set to expand as the country focuses on improving its road and railway transit network, as per the US Energy Information Administration (EIA) statistics.

Two factors – green house gas (GHG) emissions and unstable oil prices – could act as key drivers for moving away from petroleum-based transportation. Energy consumption by the urban transport sector is likely to increase considerably in the coming decades. This will not only adversely affect the quality of life in cities but also increase dependency on oil imports, thus threatening our energy security.

Keeping this in view, India aims to reduce its GHG emissions intensity by 20-25% below 2005 levels by 2020 along with the addition of renewable capacity as per the recent climate action plan submitted by India to the UN Framework Convention on Climate Change (UNFCCC).

While several states in India continue to face high energy and peak-time power deficits along with unreliable supply, the demand for electricity is growing consistently. Under NEMMP 2020, India envisages a deployment of 6-7 million Electric Vehicles (EVs) by 2020. Considering the possibility of increased EV penetration in the coming years, it is critical to evaluate its impact on the electricity grid. Is the present grid ready to handle the additional load demand from the planned fleet of EVs?

Having a large population dependent on public transportation shift to electric buses would enable India to move towards a clean and sustainable transport system. Further, there is more volatility in fuel prices as compared to electricity prices.

electricity. While the price of diesel is currently low, there is no guarantee that this will continue in the future due to market dynamics and other pricing externalities. Hence, with a more stable and regulated electricity tariff structure, it may be fiscally more prudent to adopt EVs.

While conventional vehicles run on fossil fuels burned in the internal combustion engine, EVs use electricity for charging their battery. EVs can be either fully powered by battery (pure EV) or have a combination of battery and fossil fuel as the source of energy (hybrid EV). The size of the battery is the largest in pure EVs since it is the only source of power, and it gets smaller as the fossil fuel component (petrol, diesel or CNG) in the hybrid EV increases.

Despite the battery being the most expensive component, a pure EV is a cleaner solution since it produces zero local pollution. However, larger the share of pure EV in the future road transport mix, greater will be the impact on electricity utilities as a considerable amount of power will be needed to charge large-scale public electric transport systems.

Charging vs utility conflict

Large-scale EV integration into the grid brings forth several aspects in the context of load smoothening, optimised utilisation of base load power plants, and innovative opportunities like vehicles serving as distributed storage resources in the vehicle-to-grid electricity flow scenario. However, with increased EV adoption, utilities could face challenges in determining when their customers would plug-in to charge the battery, thereby causing stress on the grid.

If the number of EVs is low, the grid may be able to absorb the power required for charging these vehicles. The time of charging could be controlled since the travel time would temporally be separated from the time of battery charging. However, increased penetration of EV bus fleets, especially during peak load hours may result in additional stress on the distribution network.

Hence, before EVs are adopted on a large scale, a detailed analysis is needed to estimate the local electricity and grid requirements. The analyses could include (but not be limited to) study of grid supply, forecasted local demand growth, available power evacuation capacity, peak demand of utility, EV charging schedules, optimum number and locations of the charging stations, and EV driving pattern/routes and fleet economics.

Managing EV charging time is a key aspect for consideration in terms of the added load that the grid will have to handle. One solution could be to schedule the charging time of EV such that the vehicles are charged during off-peak hours of the utility when the demand is low.

Smart grid systems could be deployed for enabling utilities to monitor and analyse real-time information – charging pattern of EVs along with its implication on the grid. This way, utilities could make informed decisions, especially during adverse situations such as transformer

A synergy between smart grid infrastructure and EVs could enable utilities to work more effectively by managing the charging schedule, informing state transport agencies on EV charging status and keeping track of billing data through smart communication systems.

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