

Emerging E-Bus Charging Technologies: Opportunities And Challenges

By **Sadhana Raju Shenvekar** - 10th November 2020



Electric bus (e-bus) technology hit the Indian market in recent years as a solution to the environmental concerns posed by conventional fuel buses. However, large-scale adoption of e-buses is a non-starter due to the lack of an enabling ecosystem. Planning and technology selection are crucial to maximise the utilisation of e-buses, which will in turn lower upfront capital costs, while minimising the adverse effects on existing public transport operations.

In India, depot-based plug-in charging is the common practice. In fact, only plug-in charging is eligible for subsidy under the FAME II scheme. Though depot charging has many advantages, a single charging technology option would not be able to meet the requirements of a city comprehensively. Therefore, exploring new charging options is inevitable to electrify a wide range of bus routes in India.

Alternative charging options

Battery swapping, opportunity charging, and trolleybuses are the currently available alternative options to depot charging.

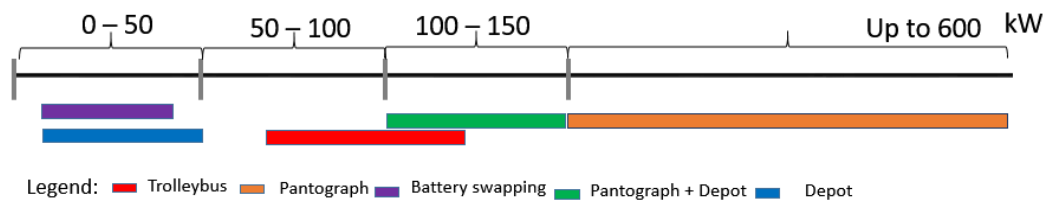
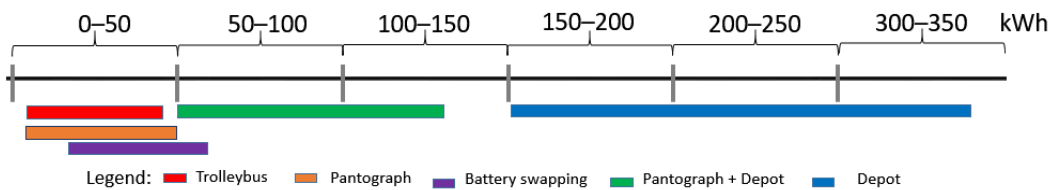
In battery swapping, a fully or partially depleted battery will be replaced by a charged battery. An extremely quick turnaround time (<10 min) is the key advantage of battery swapping. However, this option would require a large land area at the swapping station.

Opportunity charging is the process by which a considerable amount of energy is replenished in short bursts. This is mainly done by high-powered charging using pantographs. A large number of e-buses in European cities deploy the pantograph-charging technology and a combination of pantograph and depot charging.

A battery-assisted trolleybus uses overhead wires to draw power while moving. An on-board battery in the trolleybus gets charged while traversing under the wires, allowing buses to operate even when disconnected from the wires.

Technology characteristics

The Center for Study of Science, Technology and Policy conducted a market review to assess the viability of the available technologies. The results are presented in the figures.



The battery capacity range (Figure 1) shows that battery swapping, pantograph charging, and trolleybuses require relatively smaller batteries. While depot charging demands batteries of sizes in the range of 150–350 kWh, the peak power (Figure 2) requirement for it is relatively low (<100 kW). On the other hand, pantograph charging requires higher power depending on the size of the battery (>150 kW up to 600 kW) used in e-buses.

Opportunities and challenges

The choice of technology would largely depend on the characteristics of public transit operations and the nature of investments.

Trolleybuses can serve shorter routes (trip lengths <30 km), are suitable in wide roads (>45 m), and require a higher capital investment. Pantograph charging can be recommended for routes with trip lengths of up to 30 km. This technology is suitable when depots are small (<2 acres of land) but the road width is sufficient (>30 m) to accommodate a charging bay. Battery swapping can be adopted for routes with 40 km or less trip length from large depots (>5 acres of land). A combination of pantograph and plug-in charging at depots can be considered for routes with longer trip lengths (>30 km). This technology requires infrastructure to be installed at depots and bus bays en route. Hence, suitable for e-buses plying on routes with wider roads (>30 m). However, installing pantograph charging is more expensive when compared to battery swapping. Adopting a combination of these technologies might be feasible as the length of bus routes vary widely in cities.

Despite these challenges, the emerging e-bus charging technologies provide opportunities to deploy alternative battery charging options that would expand electric mobility in India and accelerate the transition to clean and sustainable energy.

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