E-Move Series: A Planning Tool for E-Buses

This article is the first in a two-article series on why planning tools are vital for effective electric-bus deployment — a significant step towards cleaner public mobility.

By Aswathy K P and Spurthi Ravuri

Electric buses (e-buses) offer a more efficient, cleaner, and quieter alternative to the diesel buses currently run in Indian cities. The country has a target of deploying 5,595 e-buses by 2024 (sanctioned under the Faster Adoption and Manufacturing of Electric Vehicles scheme [FAME]). According to a 2020 report by the Department of Heavy Industry (GoI) and Rocky Mountain Institute, these buses will, over their lifetime, travel almost three billion kilometres without tailpipe emissions, saving around 12 lakh tons of GHG emissions and 55 lakh barrels of imported fuel.

However, though the benefits are immense, achieving this won't be easy as it involves a major transition, given that the operations of e-buses are quite different from those of their diesel-based counterparts. While a diesel bus can cover around 750 kilometres on a full tank, with an average mileage of 3.5 kilometres per litre, an e-bus can operate for only around 200–250 kilometres on a 250 kWh battery (which is the full battery capacity), covering 0.8–1 kilometre per kWh. Also, while it takes hardly 30 minutes to fill the fuel tank of diesel buses, charging the e-bus batteries takes 4–5 hours (using the prevalent mode of charging viz. slow charger). These differences give rise to several challenges that the public bus transport operators have to address for deploying e-buses, such as identifying the optimal location for setting up the charging infrastructure; shortlisting the feasible routes to ply e-buses; selecting cost-effective and efficient charging technologies, etc.

Clearly, efficient deployment of e-buses involves planning that is far more complex than the one required for traditional operations, as multiple factors (like bus-route characteristics, e-bus specifications, charger specifications, and grid specifications) have to be considered.

Further, as e-buses are still nascent in India, the operators are not familiar with them. As they struggle to answer the many new questions that come along (like: Which routes would be best suited for running e-buses? Should they consider overnight charging or intermittent charging? How many fast and slow chargers would be required? What would be the energy consumed, and how much they would cost?), the e-bus deployment challenge intensifies.

Due to such lack of clarity, and the complex nature of planning involved, the initial attempts to deploy e-buses by state transport undertakings (STUs) have failed. In some instances, the e-buses got discharged during operations (as witnessed in the inter-city operations in Kerala), while in others, the STUs did not find the total cost of ownership of the e-buses feasible for undertaking deployment (as seen in the case of Bangalore Metropolitan Transport Corporation, Karnataka).

These challenges warrant the use of mathematical/simulation tools in planning the deployment of e-buses. Several tools, like ebusplan, EVOPT, CACTUS, etc., have been employed globally to address specific deployment concerns — from route selection to infrastructure planning and cost-benefit analysis. Such tools take a systematic approach for optimising the design of e-bus fleet operations, considering dynamic features like network characteristics, e-bus characteristics (battery size, energy consumption, etc.), charging infrastructure capacity, and financial support/liability. To illustrate, a planning tool can shortlist the eligible bus routes by analysing the features of conventional bus routes (i.e. trip pattern, trip length, halt duration, etc.) and comparing them with the requirements of an e-bus route (i.e. typical range of the bus, energy consumption, etc.), to determine the suitability of these routes for electrification.

The use of such tools would enable STUs to make informed decisions that are backed by evidence, thereby increasing the possibility of the success of e-bus deployment. Further, by helping them assess their plans, develop strong request for proposals (RFPs), and monitor the performance of the e-buses efficiently, these tools can avoid operational failures and avert losses caused due to poor planning. This would improve overall cost-effectiveness, making the transition beneficial for all stakeholders.

In the next article, we will talk about a planning tool developed by CSTEP to aid in large-scale deployment of e-buses for transitioning to green public transport.