

Opinion: Second life of batteries

Enabling circular economy through the second use of batteries can reduce the total cost of batteries in e-buses

8 June 2021

With the Government of India's (GOI's) renewed focus on sustainable development and improving the quality of air in the recent budget, cities in India have started integrating electric buses (e-buses) into their fleets. Around 1,000 e-buses are in service at the moment, and nearly 6,500 e-buses are expected to be deployed across the country by 2022. The high purchase cost of batteries, though, is proving to be a major deterrent to the large-scale adoption of e-buses.

Batteries contribute a major share (40–50 per cent) to the upfront purchase cost of e-buses. Cities planning on e-bus fleets such as Bengaluru, Mumbai, and Ahmedabad are looking at a battery capacity range that would be sufficient to run an average trip length of 200–220 km per day. This calls for larger battery sizes (greater than 250 kWh), leading to higher investments. Presently, the cost of a battery pack ranges from USD 137 to USD 320/kWh (INR 10,000 to INR 24,000/kWh) in the global market.

The Government of India has floated schemes, such as the Faster Adoption and Manufacturing of Hybrid and EV (FAME) II, for supporting state transport undertakings (STUs) and operators to bear the first purchase of batteries in e-buses. However, an e-bus would require battery replacements at least two to three times in its lifetime. This could turn out to be an additional liability for the operators.

Battery life

Ageing of batteries is the main reason behind battery replacements. According to global standards set by the United States Advanced Battery Consortium (USABC), a battery is said to reach its end of life when it reaches 80 per cent of its initial capacity. Ideally, at this stage, the battery has to be replaced with a new one.

The main factors that contribute to battery ageing are temperature, state of charge (SoC), battery usage (topography, congestion, driver behaviour), and rate of charging. Among these, temperature is a critical factor as it has an exponential effect on battery degradation. The best performance of lithium-ion batteries (the most popular battery type at the moment) is said to be between 25°C and 27°C. This means that, in most Indian cities, these batteries would be operated in non-optimal temperatures, hastening their degradation.

Battery life can be prolonged by avoiding full charge as it accelerates capacity fading. The SoC of an e-bus battery could be kept between 20 per cent and 80 per cent — or the level needed to complete daily trips — for optimal performance. Also, the use of flash charging or ultra-fast charging should also be minimised as it may hasten battery ageing.

Second use of replaced batteries

Retired batteries can be installed in renewable energy (RE) applications. The second life of batteries will be particularly useful in the current scenario where RE penetration is increasing. The RE targets specified by GOI are 175 GW and 450 GW for 2022 and 2030, respectively. To allow the seamless integration of renewables and to provide grid stability, we require energy storage systems in our power grids. The retired batteries (20% degraded batteries) from the heavy vehicles have a remaining capacity of 80%. These batteries can be brought back to a re-purposing centre, thoroughly graded based on their capacity, and then used in RE parks before being recycled.

Currently, there is a policy vacuum on the second use of replaced batteries. This creates a twofold issue: the overall increase in the total cost of ownership (TCO) of e-buses and environmental concerns. Therefore, the optimal solution would be to reuse batteries in the grid once they reach their end of life in e-buses before they are recycled.

The advantage of reusing e-bus batteries is that they have a large capacity and STUs would have bought them in bulk initially. When e-bus operators replace the batteries, they would get sufficient resale value as they would be reselling the batteries in bulk. As a result, the TCO of the e-buses would reduce considerably. To enable this supply chain successfully, we need to ensure that batteries in e-buses are used with care and battery degradation is kept in check.

As India is in the nascent stage of cleaner energy transition in transport and RE applications, this is the right time to explore the opportunities of a 'circular economy' through the second use of batteries.

[This piece was authored by Ammu Susanna Jacob and Aswathy K P. The authors work at the Center for Study of Science, Technology and Policy (CSTEP)]