PROCEEDINGS FROM TRAINING PROGRAM ON DEPLOYMENT STRATEGIES FOR ELECTRIC BUSES 8-9 JULY 2019, NEW DELHI

Key takeaways from UITP training program on deployment strategies for electric buses
Indian cities are pursuing ambitious electric bus deployment targets to reduce the emissions and improve efficiency of transport systems. Government of India (GoI) has already adopted initiatives like Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) to strengthen these goals.

Transformation of public transport systems, particularly bus systems from Internal Combustion Engines (ICE) vehicles to electric propulsion is important as it has the potential to convert higher passenger-km to be environment friendly. Furthermore, the high daily vehicle utilisation of bus services also helps maximise the operational cost saving benefits from electric vehicles thereby the shorter pay-back period among other electric vehicles.

Appreciating these factors, some cities have already initiated electric bus roll-out, while many others are at different stages of planning and implementation. Further, the phase II of FAME scheme has been launched with the target of deploying 7,000 electric buses over the next three years. Recently, Department of Heavy Industries (DHI) has called an expression of interest for from states and cities to avail the subsidy under FAME II for deployment of 5,000 electric buses. The list of cities selected to be funded under the scheme will be announced soon.

In this context, cities are now faced with challenges in identifying context specific deployment strategies for electric buses covering vehicle technology alternatives, incentive schemes and procurement models for electric buses. To support cities in addressing some of these issues, UITP India organized **a two- day training program on "Deployment strategies for electric buses" in New Delhi between 8-9 July 2019.**

The training brought together about 60 participants, representing 40 organizing comprising of State Transport Undertakings (STUs), Original Equipment Manufacturers (OEMs), private bus operators, other representatives from the industry and think tanks. Indian and international experts on the topic of e-buses and the associated ecosystem delivered training on wide range of topics for e-bus deployment.

The objective of the training was to enhance the understanding among participants on the technicalities of e-bus deployment and various procurement methods for e-buses. The program covered the following topics:

- Panel discussion 1: Fiscal incentives for electric buses
- Panel discussion 2: Expectations from FAME-II
- Session I: Technology evaluation for electric bus
- Session II: Charging infrastructure and depot management for e-bus deployment
- Session III: Bus contracting in India
- Session IV: Tender process for e-buses

Key takeaways

The key takeaways from the training are summarised here as recommendations to FAME II at the National level and to inform deployment at the State and City levels.

Inputs for effective implementation of FAME-II scheme

- **Need for a holistic deployment strategy**: Deploying electric buses (e-buses) will be a paradigm change in procurement, operations and fleet management as compared to the existing diesel and Compressed Natural Gas (CNG) based fleets. However, the procurement efforts of e-buses have so far followed the traditional least cost bidding based approaches used for conventional vehicles leading to cancellation of many tenders post invitation for bids. FAME II should ensure that cities carry out the required technical and financial analysis while defining their procurement strategy
- **Creating the right ecosystem**: The FAME-II subsidy for buses is designed as an Operational Expenditure (Opex) and charging infrastructure incentive by Government of India (GoI). Additionally, cities deploying e-buses under the scheme need to be plan for building the right ecosystem for the scheme to succeed and ensure the depot electricity infrastructure, quality of power supply, pricing mechanisms and the required viability gap funding before going ahead with procurement. GoI shall ensure that the cities are prepared with such plans before releasing the incentives
- **State level institutional measures**: GoI should appoint a state-level counterpart to assist Department of Heavy Industries (DHI) in rolling out FAME II to support e-bus deployment across the State and to create state level capacity on e-bus services and infrastructure deployment
- **State and City level funding to complement FAME II subsidy**: FAME II mandates OPEX model bus operations but is structured as a capital subsidy of 40% of the capital cost subject to an upper cap of INR 55 lakhs. Since it is recognised that public bus services make operational losses the State and City level Governments should commit long-term funding to sustain e-bus operations to ensure that the e-buses aren't grounded due to OPEX losses, as observed during the JNNURM scheme of the Ministry of Housing and Urban Affairs (MoHUA). For eg. in Shenzhen, China 67% of the operational costs of e-buses are supported by the local Governments
- **Identifying appropriate range and assured-km:** State Transport Undertakings (STUs), operators and Original Equipment Manufacturers (OEMs) need to plan for the daily vehicle-km of range specified in the contracts with care. While mandating higher daily assured km of vehicle utilization ensures faster payback and lower bids it may not necessarily fit into the existing operational conditions in the city. Hence a detailed service planning analysis for the entire contract duration needs to be taken up before finalizing these Service Level Agreements (SLAs).
- **Provisions on energy efficiency**: Energy efficiency performance of buses is a function of their operational conditions like level of congestion, driving behaviour etc. which need to be taken care of while defining the Service Level Agreements (SLAs) of the contract.
- **Need for Total Cost of Ownership (TCO) analysis**: STUs operating intercity operations may derive lower per-km bids due to higher vehicle utilization. But the limitations in vehicle range may lead to requirement of more buses to meet the service levels of conventional buses thereby increasing the overall cost of operations of the route. Therefore, STUs need to carry out TCO analysis comprising of various technological and operational alternatives before identifying the suitable specifications for their operations
- **Including electricity Distribution Companies (DISCOMs) in developing the implementation plan**: The role of DISCOMs is quite crucial for the electrification of buses since they need to create the suitable infrastructure and ensure quality power supply at attractive prices. Therefore, DHI should mandate a e-bus steering committee at the State/ City levels which involves discoms and other key stakeholders while preparing the deployment plan.

Inputs for State and City level initiatives needed for e-buses

- **Focusing on 'electric mobility' not just 'electric vehicles'**: Many states and cities have launched their 'Electric Vehicle (EV)' policies focusing in increasing the share of EVs in the market rather than developing 'electric mobility policies' that go beyond just vehicles and integrate EVs into their overall planning for mobility (charging infrastructure, financing etc.) The cities should plan for electric mobility in an integrated manner.
- **Viewing electric buses as a transformational initiative**: Experience from Shenzhen suggest that electrification of buses is a way to transform the entire public transports services to an advanced system with better passenger comfort and reliability along with technological improvement. Indian cities should also adopt a similar approach as opposed to a piecemeal project implementation approach to electrification
- **Including e-buses as a part of the long-term vision for the bus services**: States and Cities need to have a long-term vision for their bus based public transport system and plan for a large scale electrification of these buses. The various e-bus procurements that the take up-through FAME or independently need to be placed within this this overall framework to ensure that the immediate deployments lead to larger overall benefits to the public transport system. Various aspects of e-bus deployment including number of buses, likely demand, depots and charging infrastructure needs to be analyzed in detail before calling for tenders for immediate procurement.

Inputs for infrastructure and service planning of e-buses

- Cities need to carry out detailed alternative analysis to identify the specific depots and routes for deployment of electric buses
- **Approach for depot selection**
    - Identification of the depots from where e-buses will ply needs to be part of the initial planning exercise
    - Selection of the right depot ensures focused investments and implementation efforts for charging and electricity infrastructure, thereby reducing the overall cost of implementation
    - Development of new depots or converting entire depots into electric depots is advised as a better approach for initial deployment rather than operating electric and diesel buses together from the same depots. This is because of the varied service schedules, charging schedules and vehicle maintenance routines of electric buses compared to conventional buses
    - The key criteria for selection of depots includes electricity and charging infrastructure costs, location of depots to minimise dead mileage, number of buses operating from the depot, capacity of the depot and estimated power load

- **Approach for route selection**
    - The choice for routes within the depot selected for e-bus operations has significant implications on the energy consumption, range and payback period for the buses
    - The energy consumption and estimated range of electric buses are dependent on issues like use of air conditioning and passenger loading. It is estimated that an empty and a fully loaded buses are likely to have a differential energy consumption of up to 13%, thereby reducing the average range significantly.
    - The key criteria for route selection are:

        - Balancing need for daily vehicle utilisation/ range with replacement ratio i.e. the extra buses required to provide the current service after factoring trips lost due to top-up charging
        - Identifying routes with the maximum of number of buses such that that charging times can be planned in coordination with to their service timetables. Multiple routes with overlapping rest times are likely to cause congestion for charging
        - Earnings per km of the route such that the payback time is shorter
        - Operational feasibility to fit in the charging times within existing service frequencies and vehicle schedules
        - Minimising dead-km i.e distance of terminal points of each route from allocated depots

- **Approach for charging infrastructure planning**
    - Usable energy in a battery is generally only 59.5% of its total rated capacity. Therefore the charging infrastructure and battery size need to be planned such that the replacement ratios are minimised
    - A multi criteria decision making framework based on techno-economic parameters for charging infrastructure selection is required. The following were the parameters suggested
        - Technical parameters
            - Charging time
            - Effectiveness to maintain service headway of a bus route
            - Grid voltage required
            - Area required per EVSE
        - Financial parameters
            - Capital cost per EVSE
            - Cost of electricity for charging a bus by an EVSE
            - Cost of ancillary infrastructure
            - Maintenance cost per EVSE

Inputs for tendering and contracting of e-buses

- Many of the STUs have been reliant on in-house operations for conventional buses. FAME II has initiated the twin transition of moving to e-bus technology and to privatised operations of buses. Therefore, the discussions revolved around building technical capacity STUs to handle the transition

- **Developing a favourable Public Private Participation (PPP) ecosystem:**
    - Private sector participation in city bus services has been tried in India over many decades through various models of nationalization, privatization and corporatization. However, their success has been limited owing to the cities lacking in adequate regulatory and financing frameworks that ensure their viability gap being funded
    - With the FAME II mandating OPEX model of services, it is important that cities learn from the systemic issues that caused the failure of many bus contracts in Indian cities to ensure successful of e-bus deployment
    - The entire ecosystem comprising policy and planning framework, institutional framework, funding mechanism, contracting and regulatory framework needs to be made conducive for opex based city bus services to be sustainable,

irrespective of the fuel type of bus

- **Inputs to Gross Cost Contract (GCC) based operations:**
    - In a GCC contract, the operating risk is completely transferred on to the operator. Therefore, the functional specifications of the GCC contract like service needs, depot needs etc. need to provide some flexibility to the operator while ensuring technical responsibility with the manufacturer
    - The bus contracting agency from the Government need to honour the following obligations in GCC:
        - Provision of depots
        - Provision of quality power and electricity infrastructure for charging
        - Guaranteed on time payments
        - Provide for inflation indexation of manpower and electricity cost
    - India lacks a reliable operator ecosystem for large scale operations. STUs need to work extensively with their GCC operators to ensure that their experience of large scale operations is transferred to the private operator
    - Apprehensions of staff who are traditionally used to in-house operations to move towards GCC needs to be addressed before calling tenders
    - Maintenance of battery is also a responsibility of OEMs in Shenzhen and hence battery replacements are dealt by OEMS. The responsibility of bus body and battery should remain with OEM, to eliminate any technology risks
    - Risk management (division of responsibilities during operation, charging and maintenance and emergency situations) must be addressed within the contract
    - Training and knowledge exchange need to be mandatory. In Shenzhen, even though the OEMs maintain buses they are mandated to train the current staff in maintaining electric buses, thereby addressing twin challenges of handling new technology with existing staff
    - Also, Shenzhen exposes maintenance technicians to bus manufacturing such to improve their technical know-how

- **Suggestions on e-bus tendering process**
    - A three-stage tender procedure through Quality and Cost Based Selection (QCBS) shall be adopted based on quality parameters like warranty, after sales support, fleet availability and energy consumption as well as cost of operations including salvage value
    - Progressive payment terms need to be incorporated to ensure adequate cash flow, provision of an escrow account mechanism and bank guarantee
    - Fines and penalties linked with service level agreement need to be clarified upfront
    - Training and capacity building of the STU staff need to be mandated on the OEM and operator for long-term sustenance of e-bus technology
    - Elaborate functional specifications like service to be provided, operating conditions need to me the focus rather than just technical specifications of the vehicle technology
    - Clarity on the division of responsibilities between the authority and operator is a key feature of successful procurement models
        - In case of outright purchase, trial runs may be mandated and payment may be linked to results of trial runs