



## ANNEXURE-V

### SUMMARY REPORT

# UITP TRAINING PROGRAMME ON DEPLOYMENT STRATEGIES FOR ELECTRIC BUSES

JULY 08-09, 2019 | NEW DELHI

## 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**
  - o Identification of the depots from where e-buses will ply needs to be part of the initial planning exercise
  - o Selection of the right depot ensures focused investments and implementation efforts for charging and electricity infrastructure, thereby reducing the overall cost of implementation
  - o 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 shall be with the 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

- o Also, Shenzhen exposes maintenance technicians to bus manufacturing such to improve their technical know-how

**- Suggestions on e-bus tendering process**

- o 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
- o Progressive payment terms need to be incorporated to ensure adequate cash flow, provision of an escrow account mechanism and bank guarantee
- o Fines and penalties linked with service level agreement need to be clarified upfront
- o 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
- o Elaborate functional specifications like service to be provided, operating conditions need to be the focus rather than just technical specifications of the vehicle technology
- o Clarity on the division of responsibilities between the authority and operator is a key feature of successful procurement models
- o In case of outright purchase, trial runs may be mandated before deployment

## List of Participants

| S No | Name              | Organization      | Designation       |
|------|-------------------|-------------------|-------------------|
| 1    | Ajay Goel         | Sun Mobility      | CEO               |
| 2    | Ajay Srivastava   | DIMTS             |                   |
| 3    | Amit Gupta        | Foton PMI         |                   |
| 4    | Amit Hitkari      | DIMTS             |                   |
| 5    | Arun Thomas       | Sun Mobility      | Head Bus          |
| 6    | Ashish Khanna     | ABB India         | Sales Director    |
| 7    | Aumkar Bargaonkar | CSTEP             | Research Engineer |
| 8    | Avni Mehta        | Shakti Foundation |                   |
| 9    | Basant Bohra      | RSRTC             | Technical Advisor |
| 10   | Bharat B Chawla   | JBM               |                   |
| 11   | C K Goyal         | DIMTS             | VP                |

| S No | Name                  | Organization      | Designation                    |
|------|-----------------------|-------------------|--------------------------------|
| 12   | Chandana Sasidharan   | AEEE              | Senior Research Associate      |
| 13   | Chandrashekhar S      | BMTC              | Divisional Controller          |
| 14   | Chetna Nagpal         | Shakti Foundation |                                |
| 15   | Chinmay Acharya       | Shakti Foundation |                                |
| 16   | Dastagiri Reddy       | ABB               | R&D Engineer                   |
| 17   | Deepak Rajagopal      | LBNL              |                                |
| 18   | Dr. A K Jindal        | Tata Motors       |                                |
| 19   | Dr. P Venkatesh       | Supreme Court     | Advocate                       |
| 20   | G Jaya Rao            | MORTH             | JD, DMU                        |
| 21   | G P Hari              | KMRL              | GM (UT)                        |
| 22   | G V Ravi Verma        | APSRTC            | Chief Mechanical Engineer      |
| 23   | J Manickam            | MTC               | Asst Manager                   |
| 24   | Jagabanta Ningthoujam | RMI               | Senior Assoicate               |
| 25   | Jitendra Jha          | DIMTS             |                                |
| 26   | K Elangovan           | MTC               | Joint Managing Director        |
| 27   | Kailash Chandra Verma | JCTSL             | CFO                            |
| 28   | Laghu Parashar        | GIZ               |                                |
| 29   | M K Sharma            | DTC               | Sr. Manager                    |
| 30   | M L Khatri            | RSRTC             | Consultant Technical           |
| 31   | Manoj Kumar           | DTC               | MD                             |
| 32   | N K Basavaraju        | KSRTC             | CME                            |
| 33   | Nisheeth Srivastava   | KFW               | Sector Specialist Energy       |
| 34   | P S Harsha            | KSRTC             | Director S&V                   |
| 35   | P V Rama Rao          | APSRTC            | Executive Director Engineering |
| 36   | Parag Gohel           | ALSTOM            | Consultant                     |
| 37   | Pascal Saavedra- Lux  | KFW               |                                |

| S No | Name                 | Organization      | Designation                   |
|------|----------------------|-------------------|-------------------------------|
| 38   | Praful Math          | ASRTU             | Asst. Director                |
| 39   | Prashanth Udayakumar | STEER Group       | Assistant Consultant          |
| 40   | R K Jain             | DTC               | DCGM (Transport)              |
| 41   | R K Kasana           | DMRC              | J.G.M                         |
| 42   | Ragavendra D         | Ashok Leyland     | AGM-Sales & Marketing         |
| 43   | Raghav               | Shakti Foundation |                               |
| 44   | Raghunath Rao        | TSRTC             |                               |
| 45   | Rakesh Jain          | DIMTS             |                               |
| 46   | Ramesh H M           | BMTC              | D.C BMTC                      |
| 47   | Ranjit Kumar         | DIMTS             |                               |
| 48   | Rohit Pardeshi       | Prasanna purple   | COO                           |
| 49   | Rupesh Agrawal       |                   |                               |
| 50   | Salim Ahmed          | DMRC              | GM                            |
| 51   | Sanjay Bhatia        | Tata Motors       |                               |
| 52   | Shantanu Gupta       | CSE               | Research Associate            |
| 53   | Shirish Mahendru     | GIZ               | Technical Expert              |
| 54   | Shravani Sharma      | WRI               |                               |
| 55   | Shrinivas Joshi      | MSRTC             | D.C                           |
| 56   | Shyamasis Das        | AEEE              | Principal Research Associate  |
| 57   | Srinivas Chilukuri   | DAIMLER India     | Head Bus - Inst Mktg. and PMG |
| 58   | Sugumar. R           | Surbana Jurong    | Procurement Expert            |
| 59   | Sujit Dolas          | MSRTC             |                               |
| 60   | Sumit Barat          | First Group       | Director                      |
| 61   | Swati Khanna         | KFW               | Sr. Sect specialist           |
| 62   | Tim Dallmann         | ICCT              | Sr. Researcher                |
| 63   | Tim Hoffmann         | GIZ               |                               |





**Annexure-V**  
Deployment strategies for e-buses- Training Summary  
Create enabling mechanism to scale up adoption of E-buses in  
Indian cities'



| S No | Name             | Organization      | Designation |
|------|------------------|-------------------|-------------|
| 64   | V K Gupta        | DTC               | CGM         |
| 65   | Vaibhav V Wakode | MSTRC             | ME (S)      |
| 66   | Varun Atluri     | RAMBOLL           |             |
| 67   | Vatsal Bhardwaj  | DMRC              |             |
| 68   | Vivek Chandran   | Shakti Foundation |             |

## PROGRAM AGENDA

**Day 1: July 08, 2019**

|                        |   |
|------------------------|---|
| <b>9:30 AM</b>         | <b>Registration</b>   |
| <b>10:00- 10:15 AM</b> | <p><b>Welcoming the participants</b></p> <ul style="list-style-type: none"> <li>• Welcome address by Ms. Rupa Nandy, Head of UITP India</li> <li>• Introductory remarks by Mr. C K Goyal, Vice President, DIMTS</li> <li>• Inaugural address by Mr. Chinmaya Acharya, Shakti Foundation</li> </ul>  |
| <b>10:15- 11:15 AM</b> | <p><b>Panel Discussion I: Fiscal Incentives for Electric Buses</b></p> <ul style="list-style-type: none"> <li>• <b>Moderator- Mr. Chinmaya Acharya, Shakti Foundation</b></li> <li>• Panel discussion on fiscal incentives to deploy electric buses at scale <ul style="list-style-type: none"> <li>• Mr. Manoj Kumar, Managing Director, Delhi Transport Corporation</li> <li>• Mr. C K Goyal, Vice President, DIMTS</li> <li>• Ms. Swati Khanna, Sr. Sector Specialist, KfW</li> </ul> </li> </ul> <p>Q&amp;A session with audience</p>   |
| <b>11:15-11:30 AM</b>  | <b>Tea Break</b>  |
| <b>11:30-12:45 PM</b>  | <p><b>Panel Discussion II: Expectations from FAME II</b></p> <ul style="list-style-type: none"> <li>• <b>China's experience of electrification at scale-</b> Mr. Joe Ma, Shenzhen Bus Group</li> <li>• <b>Moderator- Ms. Rupa Nandy, UITP India</b> <ul style="list-style-type: none"> <li>• Mr. G.P Hari, KMRL</li> <li>• Dr. A. K Jindal, Tata Motors</li> <li>• Mr. Ajay Goel, Sun Mobility</li> <li>• Dr P S Harsha Director, KSRTC</li> <li>• P V Rama Rao Executive Director APSRTC</li> <li>• Vaibhav V Wakode MSTRC</li> </ul> </li> </ul> <p>Q&amp;A session with audience</p> |
| <b>1:00-2:00 PM</b>    | <b>Lunch break</b>  |
| <b>2:00-3:15PM</b>     | <b>Session I: Technology evaluation for electric bus implementation</b>   |

|                     |  |
|---------------------|--|
|                     | <ul style="list-style-type: none"> <li>• <i>Planning for transition to electric buses in BMTTC-Ravi Gadepalli &amp; Christy Cheriyan, UITP India</i></li> <li>• <i>Route level energy consumption modelling and Total Cost of Ownership (TCO) assessment – Tim Dallmann, ICCT</i></li> </ul> <p>Q&amp;A session with audience</p>  |
| <b>3:15-3:30PM</b>  | <b>Tea Break</b>   |
| <b>3:30-4:45PM</b>  | <p><b>Session II: Charging infrastructure and depot management for electric bus deployment</b></p> <ul style="list-style-type: none"> <li>• <i>Depot Management in Shenzhen- Mr. Joe Ma, Shenzhen Bus Group</i></li> <li>• <i>Case study on Charging Infrastructure- Dr. Deepak Rajagopal, LBNL</i></li> <li>• <i>Planning for charging infrastructure for intra-city bus fleets-Mr. Shyamasis Das, AEEE</i></li> <li>• <i>Recent innovations in charging technologies– Dr. Dastagiri Reddy, ABB</i></li> </ul> <p>Q&amp;A session with audience</p> |
| <b>4:45-5:00 PM</b> | <b>Tea Break</b>   |
| <b>5:00-5:45PM</b>  | <p><b>Working Group Meeting: UITP-ICCT electric bus working meeting</b></p> <ul style="list-style-type: none"> <li>• <i>UITP-ICCT presentation on electric bus evaluation framework</i></li> <li>• <i>Discussion on roadmap for working group activities</i></li> </ul> <p>Q&amp;A session with audience</p>   |
| <b>5:45-6:00PM</b>  | <b>Concluding Remarks</b>  |
| <b>6:00PM</b>       | <b>End of the day</b>  |

**Day 2: July 09, 2019**

|                      |  |
|----------------------|--|
| <b>09:30AM</b>       | <b>Welcoming the participants &amp; setting agenda for the day</b>   |
| <b>09:45-11:30AM</b> | <p><b>Session III: Bus contracting in India</b></p> <ul style="list-style-type: none"> <li>• <i>Presentation on past experiences of bus contracting in India</i> <ul style="list-style-type: none"> <li>• <i>Presentation by Mr. C K Goyal, DIMTS</i></li> <li>• <i>Presentation by Mr. Laghu Parashar, GIZ</i></li> </ul> </li> </ul> <p><i>Q&amp;A session with audience</i></p> |
| <b>11:30-11:45AM</b> | <b>Tea Break</b>   |
| <b>11:45-1:00PM</b>  | <p><b>Session IV: Tender process for electric buses</b></p> <ul style="list-style-type: none"> <li>• <i>Tendering and contracting for e-buses in China- Mr. Joe Ma, Shenzhen Bus Group</i></li> </ul> <p><i>Q&amp;A session with audience</i></p>  |
| <b>1:00-2:00PM</b>   | <b>Lunch break</b>   |
| <b>2:00-4:00PM</b>   | <p><b>Session IV: Tender process for electric buses</b></p> <ul style="list-style-type: none"> <li>• <i>Presentation on UITP tender structure document- UITP India</i></li> <li>• <i>Open house discussion on key takeaways from the program</i></li> </ul>  |
| <b>4:00PM</b>        | <b>Tea Break and End of Training</b>   |