SUMMARY REPORT

UITP TRAINING PROGRAMME ON PLANNING AND PROCUREMENT OF E-BUSES

FEBRUARY 11-12, 2019 | BANGALORE

EXECUTIVE SUMMARY

Indian cities are pursuing ambitious electric bus deployment targets to reduce the emissions and improve efficiency of transport systems. Some cities have already initiated electric bus roll-out through the FAME I scheme, while many others are at different stages of planning and implementation. However, cities are facing challenges in identifying context specific solutions on the vehicle technology alternatives, incentive schemes and procurement models for electric buses.

In this regard, International Association of Urban Transport (UITP), supported by Association of State Road Transport Undertaking (ASRTU) and Shakti Sustainable Energy Foundation (SSEF) organised a training program on 'Planning and Procurement of Electric Buses in Bangalore on February 11and 12, 2019.

The training programme brought together more than 60 participants representing 30 organisations comprising of State Transport Undertakings, Special Purpose Vehicles (SPVs) managing city buses, manufacturers, think-tanks and consultants. Indian and International experts with extensive experience in electric bus sector delivered lectures on a wide range of planning and procurement issues.

There were 7 technical sessions and 2 workshops chaired under the panel of Mr. Jen Fongers (Fongers Folio B. V., Netherlands), Dr.Ray Minjares (ICCT), Dr. Nikit Abhyankar (LBNL) and Mr. C K Goyal (DIMTS) to cover the following topics on

- Different configurations of electric buses (Buses, Charging infrastructure, Battery, Battery management system)
- Components of charging infrastructure and its guidelines for installation
- Types of procurement of electric buses and tender structure
- Techno economic analysis of electric buses
- The challenges and opportunities faced during implementation of electric buses in Delhi

A National level working group on 'Electric buses for India' was launched on the sidelines of the UITP training program on 'Planning and procurement of electric buses. The working group includes key Government officials promoting electric mobility throughout India, representatives of State Road Transport Undertakings (SRTUs), professionals from academia and think-tanks promoting electric mobility. The working group will act as a knowledge sharing platform for various city bus agencies including but not limited to energy performance of implemented electric buses, exchanging notes on tendering structures and their bids and meet periodically to advance other opportunities. As a first step, the group agreed to exchange information with each other on the performance of the electric buses inducted through the FAME I scheme. The next working group meeting will be focused on specific opportunities like tendering operations, planning, charging infrastructure etc. which will help accelerate e-bus deployments across India.

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INTRODUCTION

India is at a critical juncture in its infrastructure, energy and mobility developments, which makes the nation possible to take a different path for Sustainable Mobility. Government of India has identified "Shared, Electric and Connected Mobility" as a solution that could produce many benefits globally and domestically. Further, the National Electric Mobility Mission Plan (NEMMP) laid down ambitious goals of 6-7 Million electric vehicles by 2020 and 175 GW of Renewable Energy by 2020. To strengthen these targets, India has already adopted initiatives like Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME-I) for deployment of electric vehicles in India.

Bus based city transport are the mainstay of public transport in India. Bus transport system is an effective alternative to various modes of transport in urban and rural areas. The strengthening of bus transport is crucial to induce sustainable and cleaner transportation. Electrification of bus based public transport has invited much attention in recent years when FAME-I scheme has re-launched with a focus on e-buses, e-taxis and e-autos in December 2017.

Further, various Indian cities are pursuing ambitious electric bus deployment targets to reduce the emissions and improve efficiency of transport systems. Some cities have already initiated electric bus roll-out through the FAME I scheme, while many others are at different stages of planning and implementation. However, cities are facing challenges in identifying context specific solutions on the vehicle technology alternatives, incentive schemes and procurement models for electric buses.

In this regard, International Association of Urban Transport (UITP), supported by Association of State Road Transport Undertaking (ASRTU) and Shakti Sustainable Energy Foundation (SSEF) organised a training program on 'Planning and Procurement of Electric Buses in Bangalore on February 11and 12, 2019.

"Many confusions exist among the authorities for the implementation of electric buses regarding technology of electric buses, procurement methods (outright method or Gross contract) and other financial aspects"

Sri. D C Thammanna, Minister of Transport, Government of Karnataka

The training programme brought together more than 60 participants representing 30 organisations comprising of State Transport Undertakings, Special Purpose Vehicles (SPVs) managing city buses, manufacturers, think-tanks and consultants. Indian and International experts with extensive experience in electric bus sector delivered lectures on a wide range of planning and procurement issues.

The program began with Welcome note by Dr. N V Prasad, Managing Director of BMTC. Honourable Minister of Transport, Government of Karnataka, Shri D C Thammanna inaugurated the program. The inaugural address was given by Shri N A Haris, Chairman, BMTC followed by introductory remarks from Capt Ratnaparkhi, Executive Director ASRTU and Ms. Rupa Nandy, Head of UITP India.

The trained comprised of 7 technical sessions and 2 workshops chaired under the panel of Mr. Jen Fongers (Fongers Folio B. V., Netherlands), Dr.Ray Minjares (ICCT), Dr. Nikit Abhyankar (LBNL) and Mr. C K Goyal (DIMTS) to cover the following topics:

- Different configurations of electric buses (Buses, Charging infrastructure, Battery, Battery management system)
- Components of charging infrastructure and its guidelines for installation
- Types of procurement of electric buses and tender structure
- Techno economic analysis of electric buses
- The challenges and opportunities faced during implementation of electric buses in Delhi

The detailed agenda of sessions is attached in Annexure-I.

OVERVIEW OF SESSIONS

Electric Bus Technology: Different configurations and innovations and various case studies across the world

Electric buses have a great potential in improving the air quality in comparison to diesel buses as e-buses can shift the emissions from multiple moving vehicles to a single point source like power plant. In comparison to Internal Combustion Engine (ICE) vehicles, e-buses are more efficient with limited emission, lower energy consumption by degenerative breaking as well as longer life cycles. The different forms of e-buses operational in the world includes, battery run buses, hybrid bus (battery as well as diesel), plug-in hybrid bus, trolley bus and fuel cell buses. Each type of e-bus has its own on advantages and disadvantages

and the selection of a particular driveline depends on various factors including power requirements, operating distance, environmental considerations as well as legislations. However, the major challenge in deployment of e-buses is the additional requirement of infrastructure and new strategies to support this robust technology.

The three configurations of e-buses are serial hybrid, parallel hybrid and split hybrid. While a serial configuration is more efficient for low speed operations, parallel configuration is efficient when speed of operation is high. In a serial configuration, the ICE runs a generator to produce electrical energy which is then either delivered directly to the electric motor or sent to the energy storage system for later use. In the parallel hybrid configuration of buses, traction at the wheels are delivered by either the electric motor, engine or both. The split hybrid configuration combines both the serial hybrid and parallel hybrid configurations.

"Government of India should take steps to set up more Manufacturing unit for electric buses in India to strengthen the new technology"

Sri. N A Haris, Chairman, BMTC

Yutong(China), BYD(China), ABVolvo(Sweden), Proterra (USA), VDL(Netherlands) and Solaris(Poland) are some of the e-bus manufacturers around the world. London while deployment of 12 m buses procured from BYD preferred depot charging whereas Netherlands adopted a combination of opportunity and depot charging with the support from the indigenous manufacturer VDL. In India, Tata Motors and Goldstone BYD were the low cost bidders for the supply and deployment of e-buses under the FAME-I scheme among most of the cities.

Battery and Charging Infrastructure: Methods, Guidelines and Specifications

Battery: Parameters, Technology and Battery Management system

Electric buses use high energy density batteries to accommodate automotive light weight requirements. The key performance parameters to be considered for the e-buses are specific energy, specific power, safety, lifespan and cost. The two types of batteries used in e-buses are Lithium ion and Nickel Manganese Cobalt (NMC) batteries. The NMC batteries are fast charging and are more efficient. However, NMC batteries are costlier than Lithium-ion batteries. The specifications on the batteries are given in Table 1.

Table 1 Different Types of Batteries for electric bus

Type of Charging	Type of battery	Main features
Slow Charging	Lithium-Ion-Phosphate	Excellent safety and long lifespan but moderate specific energy and elevated self-Discharge

	Lithium –Metal polymer	High energy density and safety of use due to limited sensitivity to temperature variation
Fast Charging	Lithium-Nickel-manganese-cobalt (NMC)	Good overall performance and excels on specific energy.
	Lithum –Titanium-Phosphate	Excels in safety, low-temperature performance and life span.

The functionality of each battery system is dependent on an optimal temperature, voltage and structural conditions, which are maintained by a battery management system (BMS). The major components of a battery management system (BMS) include sensors, actuators and controllers to detect and control. The BMS also includes an embedded software network that estimates and manages the battery's State of Charge (SoC), On-Board Diagnosis (OBD), battery safety control/alarm, battery operating parameters, battery equalization (to maintain consistency between all cells within a module), information storage and thermal management.

Charging Infrastructure: Types, Specifications and guidelines

Charging is the conversion of electrical energy to chemical energy which provides power to EVs as a result of chemical reactions. There are mainly two types of charging:

Conductive Charging:

- Conductive charging requires a physical connection between the EV and chargers at the charging station, and power supply from grid.

Inductive charging:

- Inductive charging uses an electromagnetic field to enable the exchange of energy between the EV and the charging station.

Conductive charging is the most popular option historically for accessing grid electricity for various charging applications and the studies have shown that grid impact of bus charging is manageable. The depot charging and opportunity charging are two operating strategies for charging electric buses. For city buses, opportunity charging has been identified as a suitable operational strategy. It entails charging the bus during its scheduled idle time at a few stations along the route. Frequent charging allows for a smaller battery to be used. However, it requires high power, which increases the price of the charger. Even though the charging infrastructure requirement is higher for the opportunity charging, more buses can share the same charger.

"The cost for making the charging station interoperable comes around only five percent of total cost and hence it is not a big issue of concern "

Mr. Nikit Abhayankar,LBNL

The development of a robust charging infrastructure network is considered as key requirement for large-scale transition to electric buses. Specifications and guidelines are required to ensure the optimal distribution and supply of the power for the electric bus deployment. GoI has issued charging infrastructure guidelines in December 2018 and the key points of these guidelines are given in the Table 2.

Table 2 GoI Guidelines for Charging infrastructure

Charger Type	Connectors	Rated Voltage
Fast	CCS (min 50 kW)	200-1000V
	CHAdeMO (min 50 kW)	200-1000V
	Type 2 AC (min 22 kW)	380-480V
Slow/Moderate	Bharat DC-001 (15 kW)	72-200V
	Bharat AC-001 (10kW)	230V

The key suggestions for charging infrastructure are:

- At least one Public charging Station (PCS) in a 3km x 3km grid, and one PCS to be set up every 25 km on both sides of highways/road
- Setting up of Public Charging Stations (PCS) will be a de-licensed activity as long as they meet the performance standards and protocols
- Every State Government shall nominate a nodal agency for setting up the initial infrastructure. State DISCOM shall generally be the Nodal agency.

Guidelines for Procurement of Electric Buses: Purchase models, Life Cycle Cost Analysis and Tender Structure

Types of Purchase Model: Gross Cost Contract and Outright Purchase Contract

For procurement of electric buses in Indian Cities under FAME-I scheme, the cities had option of either a Gross Cost contract (GCC) or an outright purchase business model. The Gross Cost Contract is a service level agreement where the transport authority leases buses from the OEMs for a certain period for operations under a certain level of services and quality standards. In GCC, the transport authority takes the revenue risk, plans overall services, manages the contract for Level of Service (LOS) and quality, and is ultimately responsible for customer service. This is suitable if transport authorities desires to keep technology risk low as there is no upfront capital cost for this purchase model. GCC requires Key Performance Indicators (KPIs) and will need close monitoring by the transport authority for effective operations. Whereas in outright purchase contract, the transport authorities procure the electric buses and operate with warranty and maintenance from

the operators. This involves a higher technology risk to the public transport authority and may become a sunk cost when the technology becomes obsolete.

While Lucknow, Kolkata, Jammu and Guwahati has opted for an outright purchase for e-bus procurement, Bengaluru, Hyderabad, Mumbai, Ahmedabad and Jaipur has chosen GCC. For outright purchase, cities invited separate tenders for buses and charging infrastructure. However, for cities which opted GCC, tenders were invited as bundled which included capital cost, operations, maintenance and labor. Some of the invited tenders also included cost of electricity and charging infrastructure.

Life Cycle Costs and Key performance indicators (KPIs)

The Life cycle cost (LCC) analysis is very important in decision making of Gross Cost Contract. LCC is defined as sum of all costs associated with products or systems during its life cycle, calculated at present time. It includes acquisition costs, ancillary acquisition cost, utilization cost, maintenance cost and end of life costs. LCC along with Interest rate, infrastructure costs for service life time, operational costs and fixed utility costs makes Total Cost of Ownership.

Key Performance Indicators (KPIs) are set by authorities for close monitoring of the services offered by OEMs. These have to be defined during the procurement phase. KPIs include performance parameters for operation and maintenance, spare parts, consumable parts, manpower performances etc.

Tender Structure: Tendering, Commissioning, Sorting and Evaluation

During this session, UITP introduced guidelines to improve the efficiency of e-bus tendering process and to harmonize the tendering specifications across cities in India. The document gives a detailed description for structure of tender document and describes the key factors to be included in tender offer by the OEM to the purchaser.

Accordingly, a tender document shall include overall operational requirements. Broadly, the tender document shall provide following information:

- The reason for the expansion or introduction of the new services, location of the services, number of buses, type for operations, number of buses, total purchase etc.
- The purchaser should notify the bidder if more legal entities are involved.
- The tender procedures with an interactive approach to counter proposals.
- Detailed timetable with fixed and provisional schedules for the implementation of process, starting from tender publishing date to delivery schedule.
- The legal requirements and standards of the vehicles and infrastructure to be procured
- A clause specifying minimum vehicle requirement
- Financial and economic conditions along with payment timetables, financial guarantees and penalties

- Emphasis for the training programs by the operator for the personnel's involved in the service
- A maintenance documentation after the sales

Further, while submitting the document, list of the company related information should be submitted. Chapters describing functional and technical specifications should also be included in the tender submission. Tender evaluation is yet another important step in the procurement of e-buses. The different factors to be considered for evaluation must be ranked based on their relative importance prior evaluation. Prior agreement, a limited number of visits to the manufacturer's plants should be agreed on between the supplier and the purchaser. The manufacturer shall be allowed to choose the most feasible technical solution, taking into account technology development, manufacturing and operation cost. The costs to be calculated for life cycle cost evaluation were also given in the manual discussed during the session.

Techno Economic Analysis of Electric Buses

India's shift towards electric vehicle is both an energy and economic savings opportunity with a positive impact on environment. Given current utilization trends, nearly 70% of the fuel imported is utilized in mobility sector. Therefore any impact on the oil consumption will affect oil import which will also influence the GDP of the country. In contrast, the cost of the battery of electric bus, a major component of determining the cost of bus, has reduced by 80% of their cost in 2010s. During the initial phases of deployment of e-buses, countries like China, USA, Europe cities had given major portion of subsidies for batteries because of the high upfront cost of batteries. The last five years had witnessed a change in this situation and there has been scaling up in the purchase of batteries which triggered the reduction in cost by 70-80%. For example, providing more subsidies for setting up manufacturing unit for battery has increased the number of local manufacturers in China, thus reducing the cost of battery which in turn had an impact on the electric vehicle segment in China. Now, China has almost transformed all of its intercity buses to electric bus. Furthermore, China has recently limited granting subsidies to electric buses of long range beyond 150km.

"Scaling the manufacturing battery to larger volume will essentially reduce the cost of electric bus "

Mr. Ray Minjares, ICCT

In India, Department of heavy industries (DHI) allocated nearly 400Cr INR as subsidy for transport undertakings and special purpose vehicles for procuring electric buses under FAME scheme. 11 cities called tender under this scheme either as GCC or as outright purchase contract. While significant cost variations were observed in per km cost of cities with Gross Cost contract, outright purchase cost seems to be harmonized. Therefore, harmonization of bidding criteria is essential across the cities. Moreover, formation of a central nodal agency for determining the operational parameters and other specification across the cities will help to reduce uncertainties in the bidding process.

Accordingly, an evaluation of total cost of ownership (TCO) for e-bus and diesel bus was performed based on DHI Guidelines and specifications to observe that the TCO for electric bus is cheaper compared to that of diesel with lesser payback period of 2-3 years. It was also found that the cost per charge per km or network up gradation is low for e-buses.

Challenges Faced and Proposed Solutions for The Implementation of 1,000 Electric Buses in Delhi

Delhi Government has planned to induct 1000 low floor electric 12 m buses under its cluster bus scheme. Under cluster scheme of bus operations, the bus routes in Delhi was divided into different clusters and each cluster will be operated by both private operators and Delhi Transport Corporation (DTC) based on a unified timetable.

Even though introduction of electric buses is a good gesture for improving public transportation, DTC faced many challenges. One of the challenges was the uncertainty regarding the choice of technology; whether electric or Hydrogen fuel cell bus technology needs to be adopted. However, both the technologies has its own pros and cons. After multiple deliberations and studies, it was concluded that e-buses are a more feasible solution.

Secondly, the allocation of charging infrastructure in terms of selection of depot charging or opportunity charging for electric vehicles was a major challenge. Further, the gross vehicular weight, which includes the weight of vehicle, weight of battery and passenger weight is higher for electric vehicle. The passenger carrying capacity is reduced due to additional load on batteries. In India the, safe axle load 19T for air suspension vehicle. Therefore, optimization of power requirement for charging these additional electric bus was one of the major challenge. Though many techno-feasible solutions are available, selection of a particular solution is the major task which prompted the need to prepare a detailed project report identifying the operational characteristics of the city.

Further, Delhi Integrated Multi Modal Transit System (DIMTS) opted a GCC model procurement since e-bus is a newer technology and both operators as well as authorities are in a learning phase. GCC model gives more flexibility for the manufactures along with full technical responsibility since the focus of transport authority is more on the functional requirements. Moreover, GCC model gives responsibility and ownership for the bus operators. Some provision for authorities regarding the depots, power load and on-time payment should be guaranteed in the contract. The authorities shall take responsibility of manpower and electric cost in the contract.

Accordingly, a comprehensive planning was done which identified routes for the operation of electric buses. The capacity of bus depots was studied and the feasibility of depots by identifying the least distance from the power utilities (DISSCOM in case of Delhi) was performed. The routes were mapped from the depots to the terminals and the route with least dead mileage are adopted. Node points in the route which comes within 5km of depots or terminal are designated for opportunity charging. The size of the depot is

taken to be a minimum for 100 buses for the economy of bus. In a cluster, high or medium routes are considered for the deployment of buses with a minimum of 10 buses in each route. A feasibility assessment study is undertaken with two options for operations i.e; depot charging and combination of depot plus opportunity charging. It was identified that upfront cost is more for depot charging since it requires heavy batteries whereas for depot and opportunity charging, though the cost of bus is lower, it requires more complex design and less flexible operations.

RECOMMENDATIONS FOR PHASE II OF FAME SCHEME

Two sessions were conducted where participants actively involved and discussed the pits and falls of FAME-I scheme. These were brainstorming sessions under the panel of Mr. Jen Fongers (Fongers Folio B. V., Netherlands), Dr.Ray Minjares (ICCT), Dr. Nikit Abhyankar (LBNL) and Mr. C K Goyal (DIMTS), in which higher officials from different State Transport Undertakings, Bus manufacturers, representatives from various think tanks, Indian and International experts in Electric bus technology etc. were present. The key recommendations from this session are as follows:

- **City selection**: The level of pollution in the city and previous efforts towards implementing electric buses should be considered for subsidy allocation

- **Subsidy criteria:** The energy efficiency of the bus/ battery needs to be a key parameter along with the **size of the battery in deciding the quantum of subsidy**

- FAME II should also allocate a certain amount of **subsidy for research, development and innovations** for the electric bus technology in addition to the implementation subsidies

- Various **Public Sector Undertakings (PSU) can play an active role in providing infrastructure for electric bus deployment**. For example, NTPC limited (India) is currently supporting Bhopal Smart City Limited to provide charging infrastructure.

- Government of India may provide capital subsidy for fixed assets like buses, charging infrastructure etc. while the **State Governments can provide reciprocal subsidies** through lower tariff on electricity to reduce operating cost of the electric buses

- In addition to the upfront capital subsidy, making **low interest financing** available to cities are likely to scale up electric bus deployment sooner

- The **charging infrastructure** should ideally be developed as **an interoperable system** across bus manufacturers. However, the cost of switching between charging infrastructure may not be very high.

LAUNCH OF WORKING GROUP

A National level working group on '**Electric buses for India'** was launched on the sidelines of the UITP training program on 'Planning and procurement of electric buses' .The working group comprises of various bus agencies across India as the key members with invited private members like manufacturers, NGOs etc. on a need-basis periodically. The group constitution and its framework is modeled based on the 'Zero Emission Bus Resource Alliance (ZEBRA) formed in USA and Chile. The ZEBRA alliance forms a venue for various operators to come-together to share best practices and key learning's from their electric bus efforts.

State Transport Undertakings (STUs) and Special Purpose Vehicles (SPVs) operating buses across various states in India have shown active interest in being part of the working group. As a first step, the group will focus on the current implementation of electric buses across the country and their performance evaluation. A comparative analysis will be developed and shared at the National, State and City levels to inform the technology choices for upcoming electric bus tenders.

The working group will act as a knowledge sharing platform for various city bus agencies including but not limited to energy performance of implemented electric buses, exchanging notes on tendering structures and their bids and meet periodically to advance other opportunities. As a first step, the group agreed to exchange information with each other on the performance of the electric buses inducted through the FAME I scheme. The next working group meeting will be focused on specific opportunities like tendering, operations. planning, charging infrastructure etc. which will help to accelerate e-bus deployments across India.

KEY TAKEAWAYS

The key takeaways for further action from the training program are:

- Gross Cost Contract model is the preferred model for the deployment of electric buses since it is an emerging technology in India which requires time to learn and develop protocols and strategies for the successful implementation
- In FAME I scheme, the selection of cities for the scheme was primarily based on population of city. The level of pollution in the city and the previous efforts taken by the city towards the implementation of electric buses should also be considered while city selection.
- The efficiency of battery shall also be a criterion for bid evaluation in addition to size of vehicle (standard size (12m) or midi (9m)), air conditioning, battery and range requirements
- Certain amount of subsidy may be allocated for research, development and innovations in electric bus technology during FAME II scheme to enhance the customized manufacturing of electric buses and its components to Indian conditions.
- Public Sector Undertakings (PSU) can play an active role in providing infrastructure for electric bus deployment. For example, NTPC limited (India) is currently supporting Bhopal Smart City to provide charging infrastructure.
- The Government of India (GoI) may provide capital subsidy for fixed assets like buses, charging infrastructure etc. while the State Governments can provide reciprocal subsidies through lower tariff on electricity to reduce operating cost of the electric buses. Further, in addition to the upfront capital subsidy, making low interest financing available to cities is likely to scale up electric bus deployment.
- The charging infrastructure should ideally be developed as an interoperable system across bus manufacturers. The cost of switching between charging infra technologies may not be very high.
- Scaling up of purchase of electric bus will eventually reduce the cost of the electric buses. For example, provision of more subsidies for purchase, popularized the electric bus market in China which scaled the volume of electric buses in China as well as reduced the cost.
- Minor investment will be sufficient to manage the grid impact on power distribution systems due to extra power load required for the operation of electric buses.
- The depot charging and opportunity charging are two operating strategies for charging electric buses. For city buses, opportunity charging has been identified as a suitable operational strategy.

- The development of a robust charging infrastructure network is widely considered a key requirement for a large-scale transition to electric mobility. Government of India has issued guideline and specifications for charging infrastructure to ensure the optimal distribution and supply of the power for the electric buses in December 2018.

- Significant variations were found among the bidding criteria across the cities during the phase I of FAME scheme, hence formulation of a central nodal agency for determining the operational parameters and other specifications is the need of the hour to harmonize the bidding criteria across the cities.

APPENDIX-I: Agenda of the Program

Day 1 - 11 Feb 2019

9.00	**Registration and introduction to the course**
10.00	**Inaugural Ceremony** Introductory remarks by Ms. Rupa Nandy, Head of UITP India Welcome address by Dr. N V Prasad, MD, BMTC Introductory remarks by Capt. Ratnaparkhi, ED, ASRTU Inaugural address by Sri N A Haris, Chairman, BMTC Keynote address by Sri. D C Thammanna, Minister of Transport, Government of Karnataka
11.00	Coffee break
11.30	**Session 1: Introduction: International market overview of electric buses and charging infrastructure** Electric buses contribute in making public transport network competitive and our cities more sustainable. What are the drivers and barriers when it comes to the choice of technology? This session will give an overview of configurations and developments of e-buses in the market. What are the possibilities, looking to auxiliaries and related technologies used in electric busses, both the drive-line and the installation of different systems for charging and belonging infrastructure, which have consequence for the operation. Including some (European) practical examples of implementation. *[Jen FONGERS, Senior Advisor Bus., Fongers Folio B.V., Netherlands]*
13.00	Lunch

14.00	**Session 2: Electric buses in Indian cities- Learnings from the FAME I scheme** The session will present findings from the evolution of the Indian electric bus market so far. This will include a review of the incentives offered under the FAME scheme and its comparision with International electric bus incentive programs. Outcomes of the procurement process followed by cities as a part of the FAME I scheme will also be presented *[Ravi GADEPALLI, UITP + Nikit Abhayankar, LBNL]*
15.00	**Session 3: Transition to e-Buses- Evaluating other low-emission alternatives** This session will give an overview of the global low-emission bus technology evolution. The comparative evaluation of electric buses against other low-emission alternatives like Bharat Stage (BS) VI, Compressed Natural Gas (CNG) and Hybrid electric buses will be presented. *[Ray MINJARES, International Council on Clean Transportation (ICCT)]*
16.00	Coffee break
16.30	**Session 4: Workshop on recommendations for FAME II**
17.30	**End of the day**

Day 2 - 12 Feb 2018

09:30	**Session 5: LCC, Procurement and Tender Procedure of electric buses** To understand the Life Cycle Cost of the investment is vital for decision making. There are also procurement principles. A Tender procedure, advised by UITP, will be presented in order to get an organised procurement process. The key features of an electric bus tender and contract documents, methods for technology evaluation and key Service Level Agreements (SLA) needed will be discussed *[Jen FONGERS, Senior Advisor Bus., Fongers Folio B.V., Netherlands]*
11.00	Coffee break

11.30	**Session 6: Implementation challenges: The impact on service planning and electricity grid infrastructure** From line management and maintenance to training of personnel, driving and safety, the operations of a fully electric bus system differs substantially from that of a traditional bus system. The importance of studying the initial operational needs are key to successfully introducing electric buses. International examples will be presented to explain impact on operation of electric fleets. India specific research on the impact of electric bus charging infrastructure on the electricity infrastructure of a city and its implications will be discussed. *[Nikit Abhayankar, LBNL + Ray MINJARES, ICCT]*
13.00	Lunch
14.00	**Session 7: Action plan for implementing electric buses in India** Delhi has embarked on an ambitious plan of inducting 1,000 electric buses. Implementing such large scale electrification of bus fleets will require implementation of wide-ranging reforms. This session will focus on the challenges being faced and potential solutions for the Delhi plan. *[C K Goyal, DIMTS (proposed, TBC)]*
15.00	Parallel Workshops: - Tendering and Procurement - Impact on service planning and operations - Investments in electricity grid infrastructure
16.00	Coffee break
16.30	**Launch of 'Working group on Soot Free Buses in India'**
17.30	**End of the day**

APPENDIX-II: List of Participants

SI	NAME	Designation	Organization	Type of Organization	Address
1	K M Sharana Basavaraj	Divisional Mechanical Engineer	Karnataka State Road Transport Organization	STU	KSRTC Central Office Bangalore
2	B. L Venkatesh Murthy	Divisional Mechanical Engineer	Karnataka State Road Transport Organization	STU	KSRTC ,Mysore City Transport Division, Mysore
3	Sujaya Rathi	Consultant			
4	Gohel Parag	Director-Sales& Business, eBus	Alstom Group	Consultant	601-B,6th Floor-1,Konnectus,Bhavbuti Marg, Near Minto Bridge
5	Kishore Kumar .S		Mytrah Energy (India) Private Limited	Consultant	Qcity, Gachiboli
6	Arun Joy	Head-R&D	Kondody Autokraft Private Limited	OEM	Kondody Autocraft Private Limited,kottayam
7	Sugumar	Procurement Engineer	Surbana Jurong	Consultant	MES College ,Malleshwaram West
8	Arun Thomas		SUN Mobility	Consultant	5, 1st cross, 2nd Main road, Behind Graphite Mahadevpura Post, Doddanakundi Industrial Area 2, Phase 1, Doddanekkundi
9	Amith Pathak		SUN Mobility	Consultants	5, 1st cross, 2nd Main road, Behind Graphite Mahadevpura Post, Doddanakundi Industrial Area 2, Phase 1, Doddanekkundi
10	A Ramakrishna		APSRTC	STU	Beside APSRTC Bus Depot, Nagarajupeta, Kadapa, Andhra Pradesh 516001
11	G Selvan	D.M (Operations)	Metropolitan Transport Corporation (MTC) Limited, Chennai	STU	Metropolitan Transport Corporation (MTC) Limited, Chennai
12	S Natarajan	D.M (Tech&Corp)	Metropolitan Transport Corporation (MTC) Limited, Chennai	STU	Metropolitan Transport Corporation (MTC) Limited, Chennai

13	N.Ganesh kanna	A.M (purchase)	Metropolitan Transport Corporation (MTC) Limited, Chennai	STU	Metropolitan Transport Corporation (MTC) Limited, Chennai
14	Vishwanathan Iyer	Senior Management		Private	
15	Joseph Ciby	Dy.General Manager(Procurement)	Kochi Metro Rail limited	Metro SPV	8th Floor, Revenue Tower, Park Avenue, Kochi - 682 011, India
16	Arun Thomas		Kochi Metro Rail limited	Metro SPV	9th Floor, Revenue Tower, Park Avenue, Kochi - 682 011, India
17	Vivek Vaidyanathan		CSTEP	Think Tank	Papanna Layout, Nagashettyhalli, RMV 2nd Stage
18	Varun Raturi		CSTEP	Think Tank	Papanna Layout, Nagashettyhalli, RMV 2nd Stage
19	Aswathy K P		CSTEP	Think Tank	Papanna Layout, Nagashettyhalli, RMV 2nd Stage
20	Ananthalakshmi		CSTEP	Think Tank	Papanna Layout, Nagashettyhalli, RMV 2nd Stage
21	Spruthi Ravuri		CSTEP	Think Tank	Papanna Layout, Nagashettyhalli, RMV 2nd Stage
22	Ananya	Senior Research Associate	CSE India	NGO	Tughlakabad Institutional Area, Vayusenabad, Near Batra Hospital
23	Krishnam	VE	Eicher Truck & Buses	OEM	
24	Vaibhav Wakode	Executive Director	MSRTC	STU	Maharashtra Vahatuk Bhavan, Dr. Anandrao Nair Marg
25	Shrinvas Joshi	Executive Director	MSRTC	STU	Maharashtra Vahatuk Bhavan, Dr. Anandrao Nair Marg
26	Shakeel Ahammed	Dy.General Manager	DTC	STU	Office at Subash Palace Depot
27	B.P Nigam	Dy.General Manager	DTC	STU	Office at I.P Estate
28	Shamanth	Technical head	DULT	STU	TTMC Block,Fourth Floor,Shanthinagar Busstand
29	Siva Subramanya	Senior Transport Planner	DULT	STU	TTMC Block,Fourth Floor,Shanthinagar Busstand
30	Shilpa Kharwal		WRI	NGO	2nd Floor, No. 93/2, G Towers, South End Road, Basavanagudi,

31	Kriti Venkat		WRI	NGO	2nd Floor, No. 93/2, G Towers, South End Road, Basavanagudi,
32	Parveen Kumar		WRI		2nd Floor, No. 93/2, G Towers, South End Road, Basavanagudi,
33	Sai Ratnam Chaitanya		ITDP		Govindarajapuram, Nehru Nagar, Adyar, Chennai
34	Anuj Dhole		ITDP		Govindarajapuram, Nehru Nagar, Adyar, Chennai
35	Devadanam	DVM	TSRTC		TSRTC Bus bhavan
36	Ravi	Works Manager	TSRTC		TSRTC Bus bhavan
37	Vivek Chandran		Shakti Foundation		The Capital Court, 104B, 4th Floor 38Munirka Phase III
38	S D Sarole	Assistant Director	ASRTU		ASRTU Bhavan
39	M.Trinath Babu	Director	ASRTU		ASRTU Bhavan
40	V.Ratnaparkhi	Executive Director	ASRTU		ASRTU Bhavan
41	Manish Chaube	Manager (Technical)	Bhopal Muncipal Corporation		Bhopal City Link Limited under Bhopal Municipal Corporation
42	Chetan Prabhu	Manager(Depot)	Kadamba Road Transport		Kadamba Road Transport Corporation Limited
43	Roque Louis	Manager(Depot)	Kadamba Road Transport		Kadamba Road Transport Corporation Limited
44	R K Kasana	JGM	DMRC		Metro bhawan,4th floor,B Wing
45	Vatsal Bhardwaj		DMRC		Metro bhawan,4th floor,B Wing
46	Shweta Singh	ARM	UPSRTC		Tehri Kothi ,MG Marg
47	K.V.Manjunath		BMTC		BMTC Central Office,Shanthinagar