

› TRAINING REPORT

PLANNING, FINANCING AND PERFORMANCE EVALUATION OF ELECTRIC BUSES

JULY | 2022



International Association of Public Transport (UITP)
Rue Sainte-Marie, 6 | B-1080 Brussels | Belgium

Tel: +32 2 673 61 00
info@uitp.org
www.uitp.org

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INTRODUCTION

UITP India, supported by Association of State Road Transport Undertakings (ASRTU) conducted a one-day training programme on Planning, Financing and Performance Evaluation of Electric Buses in New Delhi, India on 14 July 2022. The event was an in-person training programme and was successfully attended by more than 60 participants representing 17 State Transport Undertakings (STUs), 3 Original Equipment Manufacturers (OEMs), and other Non-profit organisations.

The training programme had 13 key national and international speakers and trainers joining in-person and sharing their knowledge on key topics, namely planning for transition to electric buses, financial planning of electric buses, contracting and

performance management of electric buses and discussion on other key enablers for electric buses. The training also had an interactive session with Operations Manager of Waterloo Garage, London – UK's first all-electric bus garage.

The training programme was kicked off by the opening remarks by Rupa Nandy, Head of UITP India, followed by T. Surya Kiran, Executive Director, ASRTU highlighting the importance of electric buses in future of public transport in India. He further expressed confidence that the training programme will provide an opportunity for an insightful and interesting discussion for the State Transport Undertakings (STUs) and other stakeholders attending the training programme.



KEY SESSION OUTCOMES

The sessions from the report focused on topics relating to planning for transition to electric buses, planning and design of charging infrastructure, financial planning of electric buses, total cost of ownership models, contracting and performance evaluation of electric buses, Delhi experience of depot infrastructure development, schedule optimisation from ICE to Electric buses, and strategic approach to electric bus projects and partnerships.

SESSION I: PLANNING FOR TRANSITION TO ELECTRIC BUSES

Route-level analysis framework for Electric Buses: Bangalore Case Study

1. Ravi Gadepalli and Divyanka Dhok, UITP India, presented the route level analysis framework for electric buses, taking a case of BMTC and KKRTC, i.e., an urban and a suburban transport undertaking. It was emphasised on the need of dynamic service planning and approach to be used for electric bus planning along with the Total Cost of Ownership (TCO). The presentation explained the considerations STUs must take before procurement of e-buses, such as

diesel replacement ratio, charging strategy required for determining-bus TCO and others.

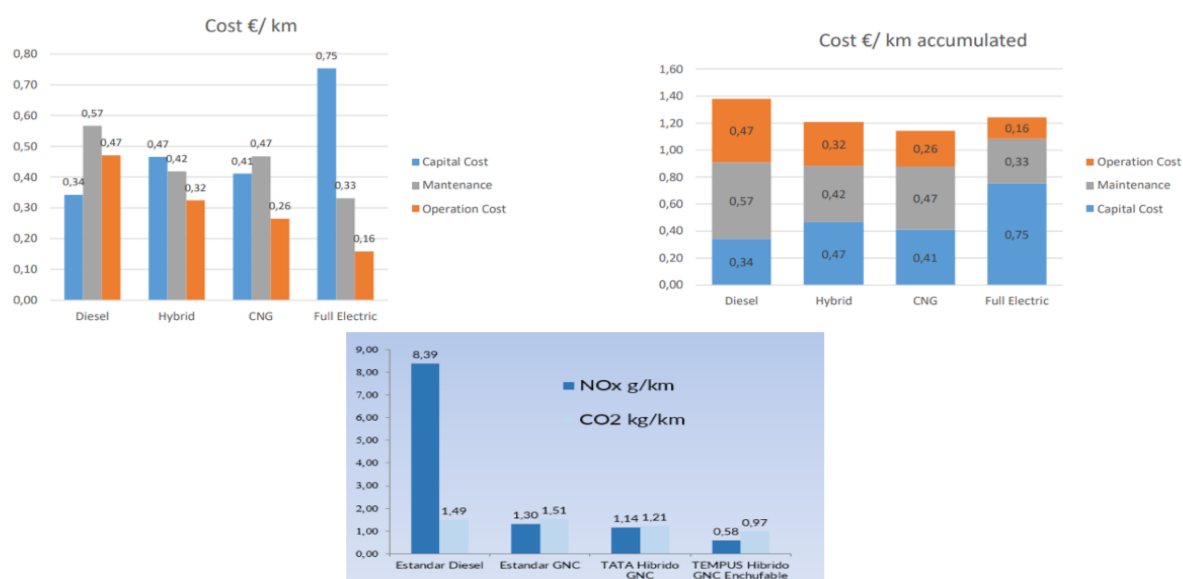
2. Taking a case of BMTC Bangalore, the presentation highlighted the planning process for route procurement, which included identifying technical specifications for buses required, depot selection and then route selection.
3. For KKRTC, a different route selection methodology was used for long distance buses. This was done using an excel based model, analysing each route and trips based on selected criteria by the STU. The model helps in different scenario analysis, in order to help create conducive supporting environment for e-bus deployment in rural and intercity market.



Planning for transition to electric buses – planning and design of charging infrastructure

1. Iván López de la Casa, Head of Electrical Infrastructure Department, EMT Madrid – a company 100% owned by Madrid City Council, operates, and manages the whole network of public urban buses, providing other public mobility services such as e-bike sharing system called BiciMAD, and the cable car system in city of Madrid.

> TCO IN EMT MADRID





2. EMT has already done a full transition of bus fleet from Diesel to CNG buses and is now transitioning to electric buses. Currently electric bus fleet of EMT is 179 and it is planning to have 254 e-buses by end of 2022, with 16 bus lines 100% electric. The long-range target is to have approximately 34% of electric bus fleet by year 2027.

3. The presentation highlighted demand, route length, schedule, depot-head distance, charging system, climate, length of buses, bid specifications, tendering, and service requirements as key considerations for route and bus planning.
4. The presentation also included charging infrastructure evolution for electric buses from induction opportunity charging, wired charging, inverted pantograph, and finally to smart charging and new depots as well as total cost operative analysis.

European approach towards 100% Zero-Emission Bus Targets

1. Flavio Grazian, Project Manager – Knowledge & Innovation, UITP gave a brief introduction on European Union approach and European Clean Bus Deployment Initiative to support transition to cleaner

➤ Electric Buses: not all about the vehicle

A system approach is needed

- Following elements need to be considered
 - Strategy
 - Funding
 - Infrastructure
 - Vehicle
 - Operations
 - Synergies

Bus Mode system approach

Operational context, costs and technical performances set the characteristics of the system elements

UITP

Source: EBSF project



transport. European Union Clean Vehicles Directive aims to have 32.5% of public procured buses to be zero emission buses in different member states by 2030.

2. The presentation highlighted that a systems approach is needed for the introduction of electric buses with following key elements– strategy, funding, infrastructure, vehicle, operations and synergies. The Zero Emission Urban Bus System (ZeEUS) project aims to bring the electrification of buses at the heart of urban bus network.

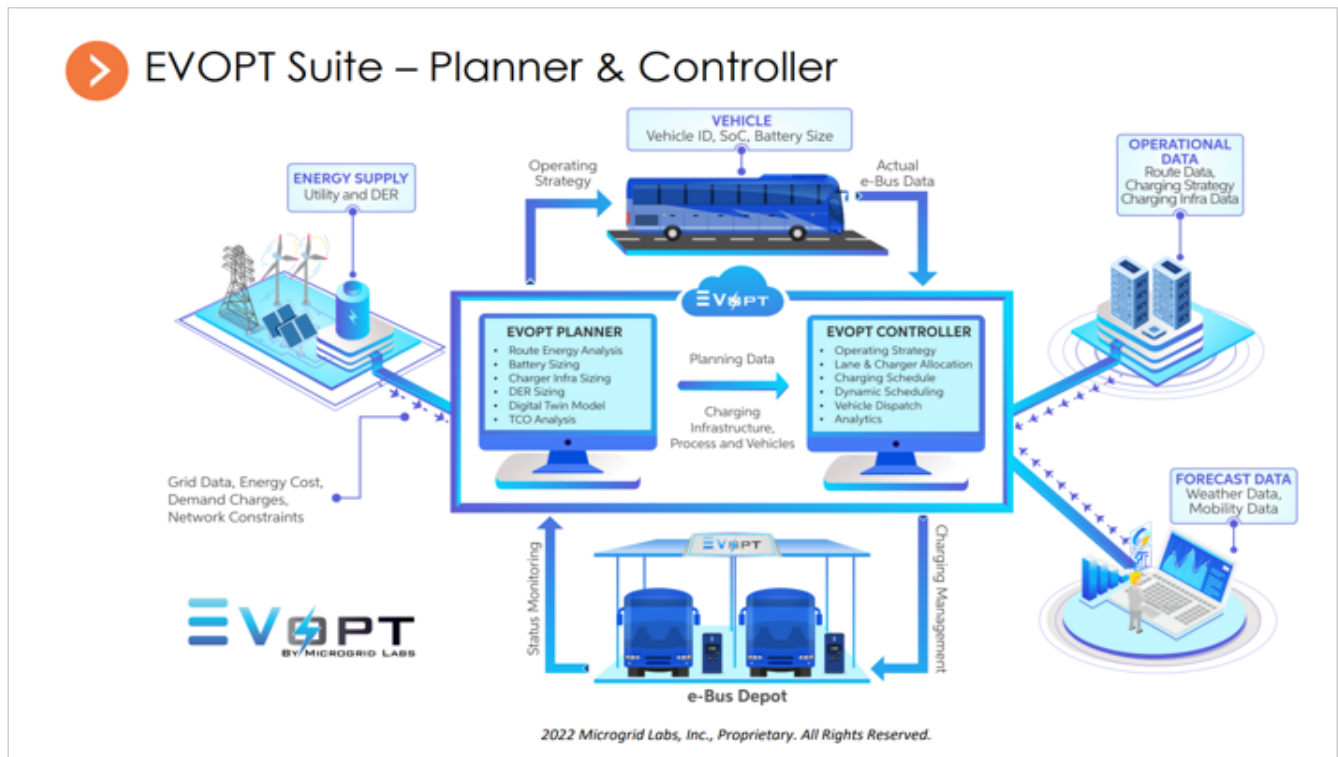
3. Five major challenges were highlighted in the introduction of electric buses – high upfront cost, new operational requirements, new ways of procurement and contracts, standardisation or interoperability, and reinforcing cooperation between member states.
4. Clean Bus Europe Platform, the European Commission initiative for clean bus deployment in European Member States from 2019-2023 seeks to bring to-

gether network of stakeholders related to clean bus deployment together, adopting a twinning approach of learning from experienced as well as learning cities, and building a network of knowledge on technologies related to E-Bus.

5. Introduction of e-buses is a golden opportunity to rethink and revamp the current public transportation system globally.

Initial transitioning to electric buses

1. Lalit Chauhan and Sam Joy, Microgrid Labs comprehensively explained how battery electronic bus needs building a new ecosystem. It includes planning and design, and operations which further incorporates duty cycle, power quality, ridership figures, depot space, weather profile, charging strategy, real-time optimisation, dynamic rescheduling, and monitoring and control.



2. EVOPT Suite developed by microgrid labs includes EVOPT Planner and EVOPT Controller. It works on model-based system design and in pre-implementation phase includes plan, design and simulate. This helps to de-risk the project through modelling and simulation.
3. The post-implementation phase includes building, deploying and operating. EVOPT software helps in the transition planning process which includes intervention at five key stages i.e., Route Analysis, Fleet Sizing, Charging Infrastructure Sizing, Energy Infrastructure Sizing, and Financial Modeling.



SESSION II: FINANCING ELECTRIC BUSES

Bus and Fleet level Financial Modelling: Case Study of Karnataka

1. **Ravi Gadepalli** presented strategies STUs could take up to improve the bus and fleet level financial undertakings STUs could use for electric buses. The presentation explained the need of service improvement, and the total cost of ownership STUs would face for diesel and electric buses with utilisation rates of 300km/day or 350 km/day, showcasing a clear advantage of electric bus adoption.
2. The presentation showcased UITP's fleet level financial model which includes physical and financial performance inputs & long term fleet procurement inputs from STUs. The output estimates the fleet level financial requirement, present value (PV) of capital expenditure, of operational expenditure financing cost, and STU's total TCO, under different business models, giving STUs different scenario analysis. The presentation discussed the restraints in financing and thus recommended measures such as National level financial support for CAPEX, enabling financial lease, payment guarantee mechanisms among other measures.
3. **Divyanka Dhok** later showcased the model to the participants.

Develop electric bus projects for financing

1. **Mohit Ganeriwala**, Senior Operations Officer, Asia Pacific Urban Infrastructure, International Finance Corporation presented about the approach IFC is taking towards developing electric bus projects for financing. The presentation explained how IFC could give value addition to the cities by offering technical, financial (bankability) and institutional support to cities. This includes tailored advisory services, provide and support green/blue loans and sustainability linked

loans, fixed interest rates, commercial finance without sovereign guarantee, long term support among many others.

2. With electric proposals gaining traction and new concessions being bid, IFC has focused on developing a toolkit to accelerate the transition to cleaner vehicles. This helps cities in 7 steps starting from project preliminary support to implementation.

SESSION III: KEY ENABLERS FOR ELECTRIC BUSES

Delhi experience of depot infrastructure development and service changes to meet electric bus needs

1. **CK Goyal**, Senior Vice President, DIMTS briefly explained the reform journey of public transport in Delhi and emphasising on the approach for planning and procurement of Electric Vehicles by Public Transport Authorities (PTAs)/State Transport Undertakings (STUs). The presentation emphasised that project structure must mirror the technical and operational challenges and the GCC (OPEX Model) helps to transfer risk on the operator.



2. Key terms and conditions of bid document (RFP) were discussed such as e-bus specification, amount of upfront capital subsidy, assured kilometer per bus per annum and charging time between shift changeovers. Learnings from the Shenzhen case study such as induction of charging infrastructure, and route category-wise charging strategy was also discussed.
3. The presentation discussed the need to analyse service schedules using so-called energy balancing calculation, grid load assessment at bus depot and presented on the scope of opportunity charging using case study of Delhi.

> Government Contractual Obligations

OPEX MODEL (Development of eco-system for operation of Buses (Electric):

- Provision of depots with supporting infrastructure.



- Provision of power load (for electric buses).



- Formation of economic unit of depots/routes for open bidding.



Schedule optimisation during transition from ICE to electric buses

- Hen Twito, Head Global Presales, Optibus Ltd, a software company providing planning and scheduling solutions introduced the services provided by the company. Optibus is an end-to-end platform with management of planning, scheduling, rostering operations, and passenger systems for STUs. They have focused on helping cities in diesel to electric transition and overcoming various operational and e-bus challenges cities face.
- Through examples, the presentation discussed on how Optibus could help cities transition to e-buses in phases, ensuring optimal solutions with mixed fleet, in peak hour time, and charging options for cities.
- The presentation also discussed examples of use cases and demonstrated the software efficiency in real time.



e-Bus scheduling software

- Build and optimize an e-Bus or mixed-fleet schedule** that includes trips and charging events, to get full value out of your electrical miles and reduce peak vehicle requirements
- Make adjustments** (add charging events, move trips) to fine-tune the schedule
- Define your preferences** for batteries, chargers, vehicle types, and see validations to make sure your schedule complies
- Use optimization** and schedule adjustments to account for battery discharge profiles and charger locations and capacity
- Get automatic alerts** for insufficient battery power and preference violations
- See KPIs and stats** showing energy consumption



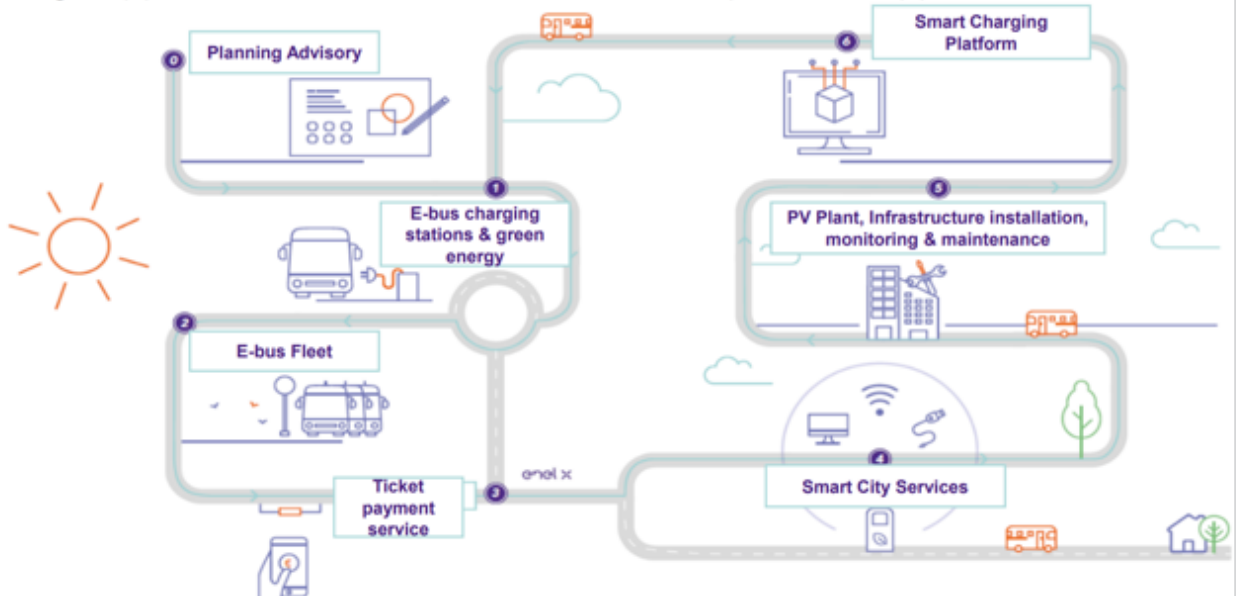
Strategic approach to electric bus projects and partnerships

1. **Lomoro Federico**, from EnelX gave an overview of the company that brings a comprehensive value proposition to cities through partnership. It includes project design and implementation, optimisation of energy costs and monetise asset flexibility.
2. The company takes a strategic approach to electrification with end to end modular approach, with tailored response to client's needs. The presentation showcased this using several global references. EnelX also focuses on depot electrification, giving different commercial approach options to the cities.



> Strategic approach to electrification

A strategic approach to an end to end service and fully modular approach



INTERACTIVE SESSION

Hema Russell, Operations Manager of Waterloo Garage, London – UK's first all-electric bus garage in an interactive session with the participants, gave the electric bus operations management perspective from an operator's point of view. With the favourable GCC contract for procurement of electric buses, the cities work in tandem with the operators. The discussion points included the issues faced by operators, support needed from city authorities or STUs for the operator, data and asset management, route decision and many others.





SESSION IV: CONTRACTING AND PERFORMANCE MANAGEMENT OF ELECTRIC BUSES

Performance evaluation of electric buses in Indian cities

The performance evaluation of electric buses in India was presented by Ravi Gadepalli. It was an interactive session with the participants focussing on the monitoring of performance of electric buses to inform future decisions. UITP in its study has taken up this evaluation exercise in 7 Indian cities. The discussion included assessing the current practises in the cities and sensitising the participants about the good practices. The performance evaluation forms the key basis for future decision making for the authorities for the optimum route selection, contract negotiation based on city requirements and better service provisions.



VALEDICTORY SESSION

The one-day training programme was successfully completed with active participation and discussions among the participants. R R K Kishore, Director Technical, AS-RTU gave the concluding remarks thanking UITP India Team and all the State Transport Undertaking members who participated in the training programme and had insightful discussions. He requested all the STU members to focus on data maintenance and at the same time share across each other to learn and actively participate in the electrification of bus system in India. Lastly, mementos and participation certificate were presented to the trainers and participants by Sylvain Haon, Senior Director - Strategy, UITP Brussels.

This is an official Report of UITP, the International Association of Public Transport. UITP has more than 1,800 member companies in 100 countries throughout the world and represents the interests of key players in this sector. Its membership includes transport authorities, operators, both private and public, in all modes of collective passenger transport, and the industry. UITP addresses the economic, technical, organisation and management aspects of passenger transport, as well as the development of policy for mobility and public transport worldwide.

This Report was prepared by UITP India.



Rue Sainte-Marie 6, B-1080 Brussels, Belgium | Tel +32 (0)2 673 61 00 | Fax +32 (0)2 660 10 72 | info@uitp.org | www.uitp.org

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