

Source: West Bengal Transport Corporation, India.

INDIA: TRANSITION TO ELECTRIC VEHICLES PUTS KOLKATA ON THE ROAD TO CLEAN TRANSPORT

Decarbonizing transport is critical to achieving the world's climate change goals, as well as being a key component of a sustainable, livable, and energy-efficient city. The transport sector currently accounts for nearly 25 percent of direct CO₂ emissions from fuel combustion, with road vehicles contributing nearly 75 percent of this share. Actively working to promote and electrify public transport in Kolkata, two of ESMAP's strategic objectives—reducing emissions and creating more livable cities—have been achieved, and through ESMAP support has led to the success of the World Bank's first electric vehicle project in India.

FROM A FRONT-RUNNER CITY IN ELECTRIC TRANSPORT TO ONE OF THE MOST POLLUTED

With the advent of the electricity-driven tram in 1902, Kolkata was one of the first cities in India to introduce an electricity-run public transportation system. Yet, as the city expanded over the years, the lion's share of public transportation moved from electric-based trams to emissions-producing buses, three-wheelers, and cars. According to the World Health Organization, Kolkata is currently the 20th most populated city in the world, and it ranks as the second most polluted in India. According to a 2018 study by India's Center for Science and Environment, Kolkata ranked seven out of the top ten megacities in terms of total particulate emissions from urban commuting.

GETTING TO A CLEAN PUBLIC TRANSPORTATION SYSTEM THROUGH ESMAP SUPPORT

Such environmental concerns prompted the West Bengal Transport Corporation (WBTC), the state-owned enterprise (SOE) in charge of Kolkata's state government-owned bus, tram, and ferry services, to consider a clean public transportation system. WBTC had numerous challenges, including the lack of staff and technical skills to conduct a feasibility study for electric

vehicles (EVs), and thus reached out to the World Bank for assistance.

With the help of an ESMAP grant of \$250,000, the World Bank supported Kolkata's EV transition in two phases. Phase One identified viable business models for public transportation (buses, three-wheelers, and ferries) to transition to electric mobility without a huge investment in infrastructure upgrades or subsidies. The analysis included the following:

- Review of the existing public transport infrastructure for all modes of transportation, including assessment of all existing routes with the help of geographic information system mapping, plus selection of the best possible routes for electrification of public transportation.
- Assessment of pollution in the city and identification of high-polluting corridors.
- Assessment of electrical infrastructure in terms of electrical network and evaluation of the headroom availability of distribution transformers in selected areas during a particular day to analyze whether a particular distribution transformer has sufficient capacity during different time slots to support the envisaged charging requirement.
- Calculation of total cost of ownership (TCO) for all modes of transportation, considering both tangible and ancillary benefits, like cost savings through fuel

costs, O&M costs, and benefits realized in terms of lower fuel imports, energy security, and grid reliability.

A detailed implementation roadmap was developed based on the study in terms of short-, medium-, and long-term strategies, encompassing various factors such as policy and tariff design, business models for EV operations, charging standards, vehicle grid integration, and social and environmental considerations. Based on the findings and recommendations from the study, WBTC chose to carry out the electrification of public transportation and procured 80 electric buses from Tata Motors (40 12-meter buses and 40 9-meter buses) under the Adoption and Manufacture of Hybrid and Electric Vehicles (FAME I) scheme of the government of India. Additionally, nine bus depots and nine bus terminals were identified to cater to the operation of the electric buses.

To support the WBTC's initiative to deploy and operate the electric buses, the ESMAP grant also allowed WBTC to hire an experienced adviser with international experience who carried out the following activities:

- Provided recommendations on the technical specifications of the electric buses and charging stations to be procured by WBTC under FAME I.

- Assessed the civil and electrical infrastructure in order to identify infrastructure gaps; charted out recommendations to facilitate both the implementation of charging stations and the operation of the electric buses.

With the success of Phase One and with 80 buses in operation, WBTC decided to expand its operation into Phase Two under the government's new FAME II scheme. Under this phase, the ESMAP grant allowed WBTC to procure consultants to help prepare Expression of Interests (EOIs) to procure electric buses for five additional cities in the state of West Bengal. These EOIs were submitted to the Department of Heavy Industries to receive subsidies under FAME II, and 50 additional 12-meter buses have been procured and an operator is being selected to procure 100 9-meter buses.

KEY OUTCOMES AND LOOKING FORWARD

As WBTC embarks on a journey to reduce greenhouse gas emissions and convert their fleet to all electric, the fleet requires route analyses, bus battery sizing, charging infrastructure, and upgrades to electrical infrastructure. ESMAP is supporting the transition and adoption of EVs by conducting preliminary analyses, including modeling the charging process based on the operation data, quantifying the electrical demands, assessing the impact on the electrical network, and optimizing the size of the charging infrastructure. The cash-strapped transport corporation has been looking at different financial models to bring in electric buses in Kolkata. The price of an electric bus is about three-and-a-half times that of a diesel bus, which means a payback period of eight years compared to four years for a diesel bus. Based on the operational parameters in Kolkata, buses with smaller battery capacity—125 kWh for 9-meter buses and 188 kWh for 12-meter buses (NMC battery)—were procured, which reduced the capital expenditures significantly and allowed scaling up.

The TCO comes out to be Indian Rupee (INR) 45–50/km while the TCO for diesel buses has been found to be INR 37/km, considering the capital cost of INR 85 lacs for an AC diesel bus. On the operational side, battery-operated electric buses are 50 percent cheaper than diesel as per the operational data from Kolkata (INR 15/km for electric buses, INR 30/km for diesel buses).



Source: Gerald Ollivier/World Bank. Getting around in Kolkata has taken on many forms over the years, from electric trams introduced in 1902 (left), to emissions-producing buses and cars like the iconic ambassador cars based on the Morris Oxford series III model (middle), to electric buses by TATA motors (right) that are now one of the types of EVs in operation as India moves to decarbonize transport.

“The World Bank’s successful technical support for Kolkata’s EV buses created an ecosystem that went beyond the deployment of E-buses and leveraged \$150 million, the largest private investment in EV infrastructure.”

—Debashis Sen, Chairman and Managing Director, Housing Infrastructure Development Corporation (HIDCO) and Additional Chief Secretary, Government of West Bengal

Key outcomes of the project were optimizing the battery size based on the requirements, utilizing the existing transformer to cater to the charging station requirement, optimizing the electrical connectivity requirement to reduce the connectivity cost, and considering on-demand charges.

The modeling also includes recommendations for installing solar photovoltaics (PV), battery energy storage systems, and electric vehicle charging infrastructure required to support the charging requirements of the electric fleet. This includes identifying the type, number, capability, and location of the chargers, and the charging schedule to optimize the operation of the fleet. Through the project, participating WBTC staff developed awareness and skills for operating the EV fleet. They improved their capacity to plan, deploy, manage, and monitor the fleet and verify fuel savings.



With ESMAP support, the project also benefitted from tapping into a network of international knowledge partners and influencers. Global knowledge partnerships were established with both Transport for London and the University of California, Berkeley, which helped to achieve remarkable success in incorporating global best practices to improve the design of the operation.

THE END OF DIESEL BUSES AND WINNING THE PRESTIGIOUS C40 AWARD

Going forward, the government of West Bengal has decided not to receive any new diesel buses in Kolkata and to procure only compressed natural gas-based and electric buses hereafter. The pilot demonstrated that replacing 5 percent of the conventional bus fleet with electric buses will result in an expected CO₂ emissions reduction of 3,094 tons per year, taking into consideration daily round trips of 100 km per bus and an emission factor of 1.19 kg CO₂ emissions/km per bus. By 2030, the government plans to have increased the city fleet to 5,000 e-buses, which is expected to reduce cumulative CO₂ emissions by 782,560 tons. Under this scenario, the government would set up 241 EV charging stations across the city under the Kolkata Metropolitan Area.

These efforts by the city government led Kolkata to become the first city in India to win the prestigious C40 Cities Bloomberg Philanthropies Award in 2019 for its Low Carbon Commute Transition as part of its ambitious climate change mitigation action plan. Since then, there has been much scaling up and knowledge exchange with other cities in India on how they can create programs similar to the Kolkata urban transport project.

IFC-FUNDED LITHIUM URBAN TECHNOLOGIES SETS UP IN KOLKATA

As a result of attracting government interest when showcasing their product at the March 2020 EV forum in Kolkata, India's largest EV fleet operator—Lithium Urban Technologies—set up operations in Kolkata. Lithium, an International Finance Corporation (IFC)-funded entity, launched their transportation service on September 16, 2020. Lithium's CEO and co-founder Ashwin Mahesh said: *"The World Bank-supported EV project gave us the confidence for a large-scale rollout in West Bengal."*

Lithium plans to roll out 1,000 EVs in Kolkata in the next 2–3 years, and along with Urban Technologies, as well as Fourth Partner Energy, in collaboration with the Housing Infrastructure Development Corporation,



will set up what will become India's largest EV public charging station at New Town, Kolkata, under the new brand Powerbunk. This public-private partnership is expected to create more than 3,000 direct and indirect jobs in the state of Kolkata.

ESMAP MISSION

The Energy Sector Management Assistance Program (ESMAP) is a partnership between the World Bank and 19 partners to help low- and middle-income countries reduce poverty and boost growth through sustainable energy solutions. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector. Through the World Bank Group (WBG), ESMAP works to accelerate the energy transition required to achieve Sustainable Development Goal 7 (SDG7) to ensure access to affordable, reliable, sustainable, and modern energy for all. It helps to shape WBG strategies and programs to achieve the WBG Climate Action Plan targets.