case study

Electrification of Public Transport Systems

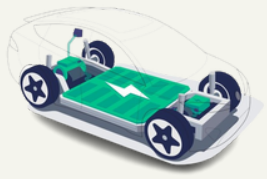
www.eintrusts.com

Introduction

Public transport systems encompass a variety of shared transportation services accessible to the general public. These include buses, autorickshaws, taxis, ride-sharing platforms such as Ola and Uber, as well as rail-based systems like local trains, metro rails, and monorails.

The electrification of public transport systems involves the transition from vehicles powered by fossil fuels to those powered by electricity. This shift includes both light-duty electric vehicles (such as two-wheelers and three-wheelers) and heavy-duty electric vehicles (such as electric cars and buses).

Types of Electric Vehicles



Battery Electric Vehicles (BEV's) are vehicles that run entirely on electricity stored in an onboard rechargeable battery pack.

Plug-in Hybrid Electric Vehicles (PHEVs) are a type of hybrid vehicle that combines an internal combustion engine (ICE) with an electric motor and a rechargeable battery.

Hydrogen Fuel Cell Electric Buses (FCEBs) are public transit vehicles powered by hydrogen fuel cells that generate electricity through an electrochemical reaction between hydrogen and oxygen.

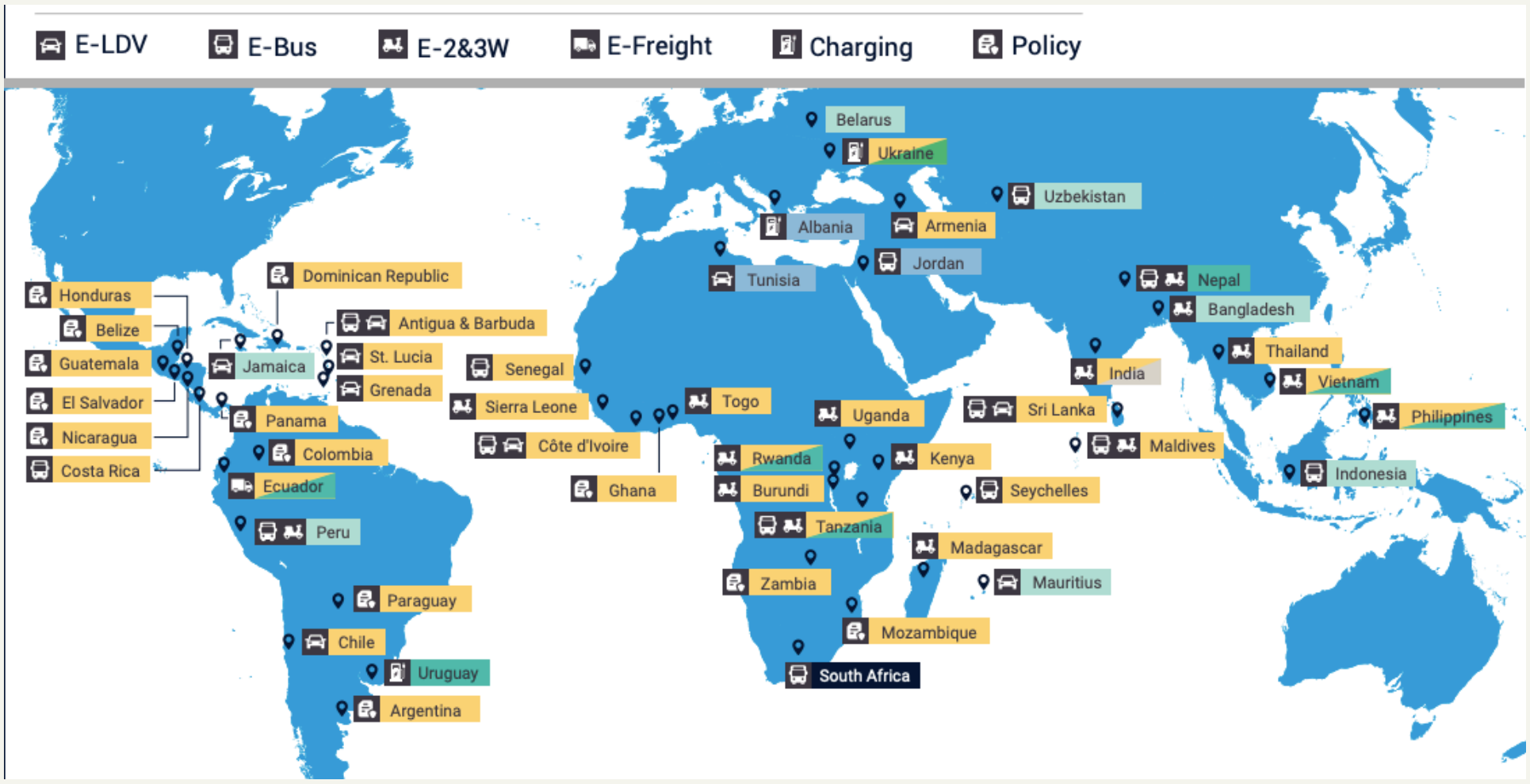
Globally, the adoption of electric vehicles (EVs) has seen significant growth. According to the Global EV Outlook 2024, electric car sales reached nearly 14 million units in 2023. In the same year, India, China, and ASEAN countries collectively sold 19 million, 17 million, and 14 million electric two- and three-wheelers, respectively. Additionally, the global market for electric buses saw nearly 50,000 units sold in 2023.

In India, the government has been actively promoting the electrification of the transport sector through initiatives such as the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) scheme, which facilitates the adoption of electric vehicles. By the end of 2023, over 759,182 electric vehicles had been registered in India, and the country had established approximately 1,800 charging stations. The electric bus market in India also witnessed significant growth in 2023, with 2,632 electric buses sold throughout the year. Furthermore, 380 electric vehicle manufacturing units are currently operational in the country, indicating a growing capacity for EV production.

Global examples of electric mobility

According to the Global EV Outlook 2024, here are **some notable targets:**

- India and Indonesia: Purchase subsidies have been introduced to accelerate electrification, with specific targets for transitioning the 2/3-wheeler fleet to electric.
- Dominican Republic: Aims to have 5% of the private motorcycle fleet electrified by 2030.
- United Kingdom: The second iteration of the Zero Emission Bus Programme provides GBP 129 million (USD 160 million) to support electric bus deployment in the coming years.



- Chile: Plans to achieve 100% zero-emission vehicle sales for public transport by 2035.
- Colombia: Aim for 100% zero-emission bus sales by 2035.
- Chinese Taipei: Committed to fully electrifying the urban bus fleet by 2030.
- Ecuador: Targets 100% of new public transport vehicles to be electric by 2025.
- Israel: Plans for all new municipal buses to be electric by 2025.

Implemented Global cities Initiatives:

- Shenzhen, China: Full electrification of public buses was achieved in 2017.
- Bogotá, Colombia: The largest electric bus fleet in Latin America since 2022.
- Santiago, Chile: Established the Red Mobility Electric Bus Network in 2019.
- Moscow, Russia: Deployed electric buses citywide since 2018.
- Paris, France: RATP's Bus2025 Electrification Program began in 2022.
- Los Angeles, United States: Ongoing zero-emission bus deployment under LA Metro since 2020.

Shenzhen, China: Full electrification of public buses achieved in 2017

Shenzhen, located in southern China with a population of over 12 million, is a thriving economic hub often called China’s Silicon Valley. Rapid urbanization also caused congestion, highlighting the urgent need for sustainable public transport solutions. Shenzhen's shift to full electrification addressed these challenges, setting a global example for clean mobility.

Shenzhen's public transportation system is primarily composed of buses, metro, and taxis, which make up 41.7%, 48.1%, and 9.9% of total transportation, respectively. The Shenzhen Bus Group (SZBG) currently operates 6,000 fully electric buses and 5,000 electric taxis. With a total of 16,000 electric buses across the city, Shenzhen aims to electrify its entire taxi fleet in the near future.

Infrastructure

- 1,707 charging terminals across 104 stations with 150 kW and 180 kW DC fast chargers.
- Most buses charged overnight with a daily range of 190 km and a battery capacity of 250 km.
- Subsidies: 600 RMB/kW for DC chargers and 300 RMB/kW for large AC chargers.
- Charging infrastructure owned by private providers, with investments recovered in 5-6 years.
- Compact terminals with up to 4 charging plugs optimize space and labor.

Environmental Benefits

The electrification of public transport brings significant environmental advantages, including reduced noise and air pollution.

Pollutant	Diesel Bus (g/100 km)	Electric Bus (g/100 km)	Emission reduction after bus electrification (gCO2/100 km)
CO_2 (Use Phase)	85,529.50	0	85,529.50
Fuel Production CO_2	23,573.60	47,838.42	-24,264.80
Battery Production CO_2	Not Applicable	9,388.64	-9,388.64
Total GHG	109,103.10	57,227.06	51,876.04

Policy Support

- Significant central and local government subsidies reduce upfront costs of electric buses and infrastructure.
- Grants, tax rebates, and reduced electricity tariffs incentivize operators.
- Stringent air quality standards and emissions regulations promote cleaner technologies.
- Collaboration among the government, bus manufacturers (e.g., BYD), and energy providers ensures cohesive deployment.

Delhi's DTC and Cluster Schemes

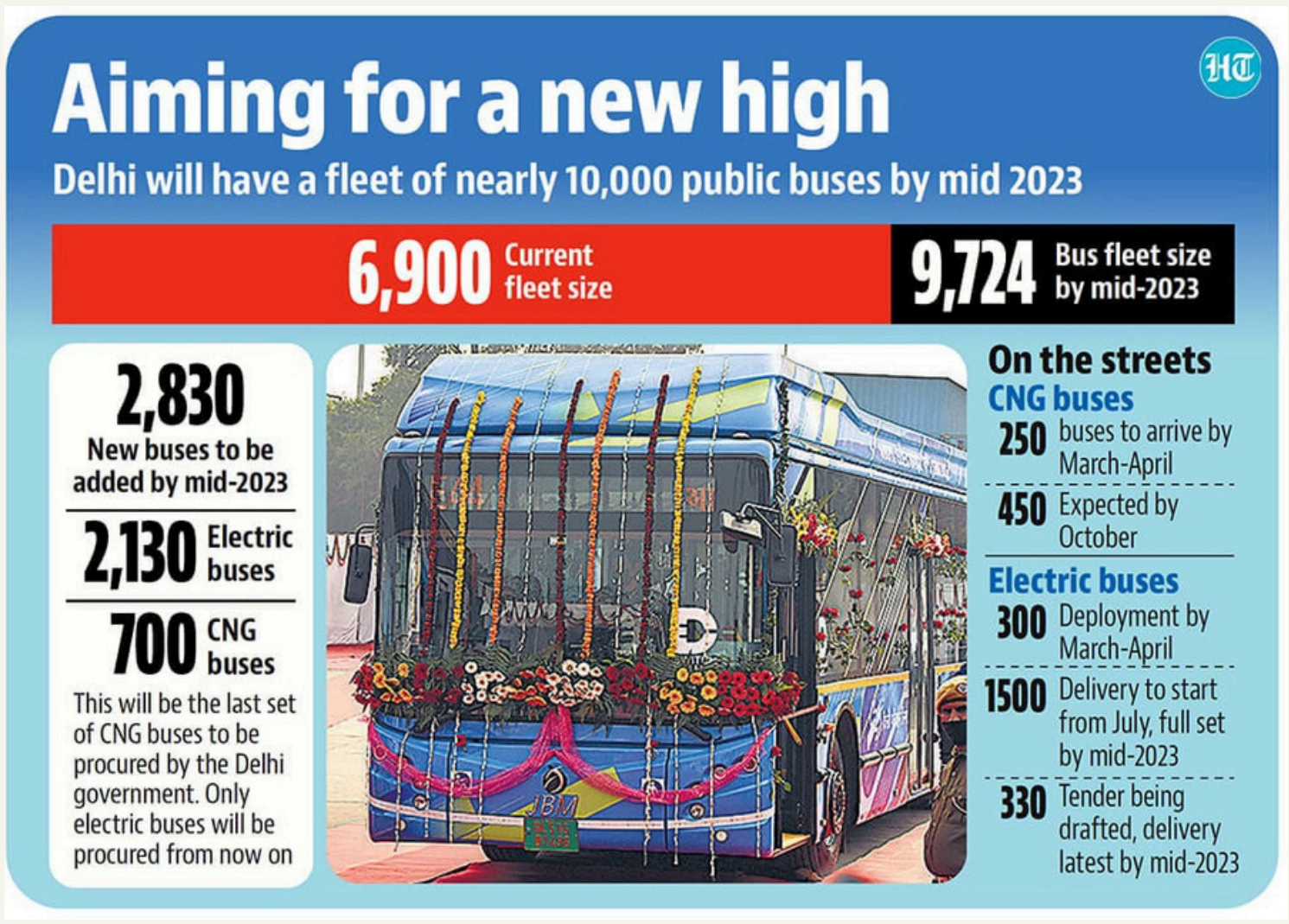
Delhi operates one of the largest fleets of electric buses in India, significantly improving urban mobility while addressing severe air pollution issues. Delhi operates 7,683 buses in total, with 1,970 electric buses (1,570 under DTC and 400 under the Cluster Scheme) as of 2024.

Infrastructure

- 1,919 charging stations and 2,452 charging points as of November 2024.
- 232 battery-swapping stations as per the Switch Delhi website.

Environmental benefits

- Since 2022, the electric bus fleet has traveled over 112 million kilometers, reducing CO_2 emissions by an estimated 91,000 tonnes.
- By 2025, Delhi plans to expand its fleet to 10,480 buses, with 80% (8,280 buses) being electric, targeting an annual CO_2 reduction of 467,000 tonnes.



Policy Support

- FAME-II Subsidies: Covers up to 40% of the upfront cost for electric buses.
- GST Reduction: Reduced GST rates for electric vehicles, from 12% to 5%.
- Electric Vehicle Policy 2020: Incentivizes the adoption of EVs and supports the development of charging infrastructure.

Recommendations

- **Set Clear Targets and Incentives:** Create a clear plan with specific goals for EV adoption. Offer subsidies, tax breaks, and low-interest loans to make EVs more affordable.

- **Provide Financial Support:** Give financial help, such as grants, to lower the initial cost of EVs. Attract private investment by offering tax incentives and using green bonds or carbon credits for funding.

- **Support Local Manufacturing:** Encourage local production of electric vehicles and batteries. Support research and development to make EVs cheaper and more efficient.

- **Use Renewable Energy:** Power charging stations with clean energy like solar or wind. Set up small energy grids near charging stations to ensure a steady power supply.

- **Focus on Busy Routes:** Start with electric buses on popular routes to quickly show the benefits of EVs.

- **Build Partnerships:** Work together with government bodies, private companies, and non-profits to make EV adoption easier and more effective.

- **Create Strong Charging Infrastructure:** Set up charging stations at bus depots, busy areas, and along main routes. Include battery-swapping stations for quicker bus turnaround times and use smart systems to save energy.

- **Connect Different Transport Systems:** Make sure buses, metro trains, and bike-sharing systems work well together. Introduce a single ticket for all types of transport to make it easier for passengers.

- **Use Technology for Efficiency:** Use data and smart technology like AI and IoT to plan bus routes better, track performance, and reduce costs and emissions.

- **Raise Public Awareness:** Run campaigns to teach people about the benefits of electric vehicles, including their environmental impact, cost savings, and available incentives.

Conclusion

The shift to electric public transport, seen in cities like Shenzhen and Delhi, shows how it can drastically cut emissions, reduce fossil fuel use, and improve air quality. However, for cities in developing and underdeveloped nations, challenges like outdated technology, lack of infrastructure, high costs, and limited funding can slow progress.

To tackle these hurdles, we need bold steps—policies that back innovation, subsidies to ease financial burdens, and funding options like low-interest loans. In India, initiatives like Make in India have laid the groundwork for change. Partnering with private companies and setting up local factories for electric vehicles and batteries can make these technologies affordable and accessible.

By blending smart policies, financial support, and local manufacturing, we can clear the roadblocks and drive toward a greener, cleaner future for public transport.

References

- International Energy Agency (IEA). (2023). Global EV Outlook 2023. Retrieved from https://www.iea.org/reports/global-ev-outlook-2023
- NITI Aayog. (n.d.). e-AMRIT: Accelerated e-Mobility Revolution for India's Transportation. Retrieved from https://e-amrit.niti.gov.in/home
- International Energy Agency (IEA). (n.d.). e-Bus Case Study: Shenzhen. Retrieved from https://iea.blob.core.windows.net/assets/db408b53-276c-47d6-8b05-52e53b1208e1/e-bus-case-study-Shenzhen.pdf
- University of North Carolina (UNC) Cleantech. (n.d.). The First and Largest 100 Percent Electric Bus Fleet: Shenzhen Bus Group. Retrieved from https://ie.unc.edu/cleantech-story/the-first-and-largest-100-percent-electric-bus-fleet-shenzhen-bus-group/
- World Bank. (2021). Electrification of Public Transport: A Case Study of the Shenzhen Bus Group. Retrieved from https://documents.worldbank.org/en/publication/documents-reports/documentdetail/708531625052490238/electrification-of-public-transport-a-case-study-of-the-shenzhen-bus-group
- Economic Times. (2023, November 22). Delhi Gets 350 More Electric Buses, Total at 1,650. Retrieved from https://economictimes.indiatimes.com//industry/renewables/delhi-gets-350-more-electric-buses-total-at-1650/articleshow/107681730.cms
- Hindustan Times. (2023, November 21). Delhi Gets 320 More E-buses. Retrieved from https://www.hindustantimes.com/cities/delhi-news/delhi-gets-320-more-ebuses-101722364750159.html
- Delhi Government. (n.d.). EV Charging Stations in Delhi. Retrieved from https://ev.delhi.gov.in/charging_station
- Delhi Planning Department. (n.d.). Chapter 12: Environment. Retrieved from https://delhiplanning.delhi.gov.in/sites/default/files/Planning/chapter_12.pdf