UITP ADVANCING PUBLIC TRANSPORT

KNOWLEDGE BRIEF

ENABLERS AND BARRIERS FOR E-BUS MANUFACTURING SECTOR IN INDIA

MAY | 2025

India's initiative to modernize its public transportation system through the deployment of electric buses represents a critical step toward achieving national sustainable development and climate goals. The Government of India has laid a strong foundation for this transition by introducing robust policy frameworks, financial incentives for both demand and supply side, and enabling regulations that support the growth of the electric bus ecosystem. Despite these progressive measures, the rate of adoption across cities remains slower than anticipated, resulting in delays in the implementation of nationwide deployment targets. A key contributor to this lag is the difficulty Original Equipment Manufacturers (OEMs) face in meeting delivery timelines for electric buses, which affects the overall supply chain and rollout schedules.

This knowledge brief seeks to identify and analyse the key enablers and barriers to electric bus manufacturing in India, drawing on insights from both domestic and international OEMs. It outlines the critical challenges impeding timely supply, and presents recommendations to foster a cohesive, responsive, and resilient manufacturing ecosystem. The insights presented aim to inform and support government stakeholders in refining strategies, optimizing policy interventions, and accelerating the transition to electric public mobility.

Source: https://theprint.in/india/centre-clears-rs-57613-cr-pm-ebus-sewa-scheme-potential-to-be-game-changer-in-transport-sector/1717880/

INTRODUCTION

India is undergoing rapid urbanization, which has significantly increased the demand for efficient and accessible public transportation. Buses serve as a vital mode of transport, offering affordable mobility solutions that connect citizens to employment, education, and essential services. Moreover, the electric bus transport sector contributes meaningfully to the national economy by generating employment and supporting allied services. In addition to economic benefits, a robust bus-based public transport system delivers substantial co-benefits, including reductions in air pollution and traffic congestion.

Currently, India operates approximately 150,500[1] public transport buses, falling significantly short of projected demand of approximately 504,000 buses by 2031—a

demand nearly 4.2 times the current supply[2]. Recognizing this critical gap, the Government of India has initiated large-scale deployment and electrification of buses as a strategic measure to address both mobility needs and environmental challenges in the transport sector.

The India Electric Bus Market is projected to be valued at 1.17 billion USD in 2025 and is expected to grow to 2.48 billion USD by 2029, reflecting a Compound Annual Growth Rate (CAGR) of 20.66% during the forecast period (2025-2029)[3]. The Government of India have introduced both demand and supply incentives for investment in electric bus infrastructure through its various public transport schemes and EV policies. Several such schemes that can be referred are PM-eBus Sewa Scheme (2023) to incentivise 10,000 buses, PM E DRIVE Scheme (2024) to incentivise 14,028 buses, PM-eBus Sewa-Payment Security Mechanism Scheme (2024) to incentivise over 38,000 buses. Additionally, NITI Aayog's target of achieving 40% sales penetration of electric buses by 2030[4] presents an ambitious target for the sector. India's initiative to transform its public transportation system with the introduction of electric buses marks a significant step toward creating a more accessible, affordable, safe, and eco-friendly public transport network.

Along with changes in the government's perspective, the electric bus manufacturing landscape in India also has undergone significant changes, with domestic players expanding their production capacities and forming strategic partnerships. Anticipating a major surge in demand for electric buses as highlighted above, coupled with the Indian government's strict regulations on vehicular pollution, several manufacturers have established electric vehicle assembly plants in the country. There are primarily five types of electric bus manufacturers in India: 1) Traditional manufacturers such as Tata Motors, Ashok Leyland, 2) Indian Manufacturers with International collaborations - Volvo Eicher Commercial Vehicle Ltd.; 3) Indian bus body builder - PMI Electro Mobility Solutions Private Limited 4) Service providers like Eka Mobility, JBM, Olectra Greentech Ltd.; and 5) New companies assembling parts sourced from both India and abroad, such as Veera and Mozev and Black buck. The Indian Electric Bus Market is concentrated, with the top five companies holding a 79.05% market share. Major players in this market include Tata Motors, Ashok Leyland, JBM, PMI, Olectra and Volvo Eicher Commercial Vehicle Ltd., EKA Mobility amongst others. Given the immense market potential, it is crucial to bridge the gap between demand and supply of electric buses in the country by understanding the various enablers and barriers faced by domestic and international OEMs in the Indian market.

To enhance the supply for electric bus manufacturing, UITP[5] supported by NITI Aayog organized a one-day "National Workshop for International Electric Bus OEMs" under the project "Advancing Electric Buses in India". On 30 November 2023 in New Delhi UITP brought together international electric bus Original Equipment Manufacturers (OEMs) and key stakeholders from the Indian government and the state governments on a common platform, to assess the current demand and supply of electric buses and to identify conditions that are either favourable or unfavourable for international OEMs to enter Indian market. The workshop saw participation from five international OEMs – Bozankya, IVECO Group, Daimler, Pepper Motion GmbH, Hess Corporation and two ancillary part manufacturers - Ventura Systems Private Limited and Wabtec Corporation, nine state industries department, and 13 transport departments. Additionally, UITP India team developed a detailed questionnaire targeting major Indian OEMs and interviewed —Tata Motors, Ashok Leyland, PMI Electro Mobility Solutions Private Limited, Volvo Eicher Commercial Vehicle Ltd., and Eka Mobility (no response was received from JBM and Olectra Greentech Limited)—to gather insights on specific indicators relating to the same. The in-depth interviews and feedback provided valuable insights into the OEMs' operations, presence, and key factors that serve as enablers and barriers for both national and international OEMs, which are presented in the table below.

1 Bus electrification in India: Charting the path ahead-NITI Aayog Report
2 Development of the India Zero Emission Bus Market Investor's Guide
3 https://convergence.co.in/public/images/electric_bus/EOI_E-Buses_MHI_04-12-24.pdf
4 Report by RMI & NITI Aayog
5 UITP only worldwide network to bring together all public transport stakeholders and all sustainable transport modes. Also there exist the UITP Industry Division with over 800 members and 19 bus OEMs as its major constituent

TABLE 1 : GLIMPSES OF MAJOR INDIAN ELECTRIC BUS OEMS

SL NO	PARAMETERS	PMI ELECTRO MOBILITY SOLUTIONS PVT. LTD.	EKA MOBILITY	ASHOK LEYLAND	VOLVO EICHER COMMERCIAL VEHICLE LTD.	TATA MOTORS
	Established in	2017	2023	2021	2008	Founded in 1945 but entered commercial sector in 1954.
1.	**Ownership**					
a)	**Single handled operations**	Promoted by Mr. Satish Kumar Jain, having more than 4 decades experience in Bus Manufacturing & Mr. Anurag Agarwal, having experience of more than 2 decades and is successfully operating more than 800 buses in Kolkata				Yes
b)	**Joint Venture operations**	N.A	EKA is part of a dynamic group of companies that includes Pinnacle Industries, Instor India, and VDL Pinnacle	SWITCH Mobility, a key part of the Hinduja Group, formed through the collaboration of Ashok Leyland's engineering strength and Optare's innovative design,UK	Joint venture between the Volvo Group and Eicher Motors Limited Ltd.	N.A
2.	**Drivers for entry into the e-bus market**	Change in government policy in 2017 along with promoters vision to diversify the ectric business led to inception of PMI Electro Mobility Solutions Private Limited	Pure EV vehicle company, specialises in buses, cargo vehicles	Government policies, already an existing bus manufacturing giant in India	Government policy, special incentive2017-retrofitment first bus with KPIT for parliament & Kolkata, FAME 1 started exploring, commercialisation, partner was involved in sustainability	Presence in the market for goodwill relationship built with STUs. Being a bigger giant in the market, it was realised that majority of the current STUs will require retirement and replacement. Therefore, they had advocated with DHI, MoHUA, NITI Aayog for policy formulation towards e-buses. Also, the government push towards e-buses through schemes, and market progression towards electric buses are added factors to the same

SL NO	PARAMETERS	PMI ELECTRO MOBILITY SOLUTIONS PVT. LTD.	EKA MOBILITY	ASHOK LEYLAND	VOLVO EICHER COMMERCIAL VEHICLE LTD.	TATA MOTORS
3.	**Main Characteristics**	Pioneer in all types of 7m, 9m, 12 m electric buses, all floor heights, rapid fast charging of Buses, Light weight Body, customisation available	Platform designs are per EV vehicles compared to others, indicating better performance of our vehicles in terms of efficiencies, the design; synergies across multiple companies becomes easy to integrate, each playing an important role from designing to engineering to execution etc.	In business since last 75 years, is a global leader in electric mobility, specializing in electric buses and electric light commercial vehicles, 1,000 plus buses in India and in UK about 250 buses. First OEM to mount all the batteries on the low floor double decker bus upto 400 kWh	Business was built with focus on retail, developing distribution, support network, for whole ecosystem in EV ,, after sales support 1,000 touchpoints in country	Pioneer in e-bus segments, and started developing Hybrid e-buses in 2005, and Fully electric bus in 2010. Also involved in policy advocacy towards public transport.
4.	**Prior experience in manufacturing**	The PMI team comes with background of decades of experience in the industry including bus body / coach manufacturing & Fabrication, planning and operation of buses, and many more	India's largest integrated commercial vehicle seating and interiors company; offering end-to-end solutions for Indian and international commercial vehicle OEMs across ICE and EV spaces	Among top 2 giants of manufacture in India, assembly line in India and UK, strong engineering and R&D experience -Optare, so Hinduja took over and later customised to Indian needs	Eicher Trucks and Buses, Volvo Buses, exclusive distribution of Volvo Trucks in India, engine manufacturing and export hub for Volvo Group, non-automotive engines and Eicher component business	India's largest manufacturer of trucks and buses, with a global presence.
a)	**Production capacity**	Annual Production capacity of 1,500-2,000 Electric Buses Further annual production capacity of 4,000-4,500 Bus Bodies other than electric buses	1,000 buses/year and can use the truck facility to expand	2,500-3,000 buses/annum, can be scaled	Dedicated 1,500 bus/annum for bus plant and EV is made to order, 500 buses extra can be expanded with other external tie-ups of VECV	12,000 e-buses per year, It can be extended to 15,000 in next 1 year Plan to extend to 20,000
b)	**Location of manufacturing units**	3 units at Dharuhera, Haryana Plots situated at Plot No 26, 39, 48 & 49 Industrial Area, Dharuhera for EV Bus Manufacturing/ assembly, Battery, Motor & Wiring harness, Bus Body building	2 units at Jakart and Kodaga in Pune, one for bus and other for cargo	Chennai -last 75 years	Pitampur , Baggar with 150 kms from Indore-Eicher motors, Bangalore -Volvo, Ujjain -new plants	R&D facility in Lucknow-UP and Pune-Maharashtra. Manufacturing Units in Dharward-Karnataka, and Lucknow-UP. Body manufacturing facility in SCGL Goa

SL NO	PARAMETERS	PMI ELECTRO MOBILITY SOLUTIONS PVT. LTD.	EKA MOBILITY	ASHOK LEYLAND	VOLVO EICHER COMMERCIAL VEHICLE LTD.	TATA MOTORS
5. Key factors considered in location						
a)	State-specific incentives	✓	✓	✓	✓	
b)	Labor availability and skill levels	✓	✓	✓	✓	✓
c)	Role of infrastructure availability	✓	✓	✓	✓	✓
d)	Proximity to suppliers	✓	✓	✓	✓	✓
e)	State EV policies impact	✓	✓	✓	✓	✓
6.	**Kind of JV**	N.A	EKA, VDL Groep and Mitsui have formed a strategic long-term partnership focused on joint investments, equity, and technology cooperation	N.A	Volvo - active role, market experience, after sales support, financial process , legal matters , board level decision, 50-50 partners	N.A
7. Market entry barriers						
a)	Volatile Political will	✓	✓	✓	✓	✓
b)	Lack of long term commitment/goals	✓	✓	✓	✓	✓
c)	Vehicle specifications/ Regulatory compliances			✓	✓	✓
d)	Financing	✓	✓	✓	✓	✓
e)	Supply chain	✓	✓	✓	✓	
f)	Infrastructure facilities	✓	✓	✓	✓	✓
g)	Others		✓			✓
8. Market entry enablers						
a)	India's commitments to international forums	✓	✓	✓	✓	✓
b)	Policy framework	✓	✓	✓	✓	✓
c)	Financial subsidies	✓	✓	✓	✓	✓
d)	Rise in fuel cost	✓	✓	✓	✓	
9. Component sourcing strategy						
a)	Local vs imported components ratio	In compliances with localisation norms of Govt of India	50% at vehicle levels, battery packs are sourced from suppliers	75% localised and 25% imported, battery cells is imported majorly, and assembly in India, target to 90%	Tier 1 cities -100%, tier 2-4 - 60%	50% minimum as mandated by Govt of India

SL NO	PARAMETERS	PMI ELECTRO MOBILITY SOLUTIONS PVT. LTD.	EKA MOBILITY	ASHOK LEYLAND	VOLVO EICHER COMMERCIAL VEHICLE LTD.	TATA MOTORS
10. Growth plans						
	Capacity expansion plans	School Buses, Light Commercial Vehicles (Open & Close)	Position in sectors with high passenger flows like shuttle in airports like Pune, picking up small tenders to start; also teamed up with certain legacy operators to operate a buses; target the western market of India like Pune, Mumbai corporations; Delhi	Participate in all schemes of Government of India and win 30-40% tenders, expand portfolio to 7 m and 9 m buses	30% target in buses in next 2 years exports	

Source: Primary interviews, UITP India Team

TABLE 2 : GLIMPSES OF 2 MAJOR INTERNATIONAL OEMS

SL NO	PARAMETERS	BOZANKYA	IVECO GROUP
	Established in	1989	1975
1	**Ownership**	Started as a R & D company in Germany and then invested in Turkey	Italian multinational transport vehicle manufacturing company
2	**Main Characterstics**	manufactures metro, tram, tram, bus and electric buses, Bozankaya holds the title of producing Turkey's first 100% electric bus and continues to design vehicles that meet the needs of the modern era through its R&D	Offers full range of environmentally friendly solutions, including natural gas and electric vehicles as well as a widespread service network and connected services
2. Current manufacturing unit			
a)	Production capacity	Approximately 500 uses annually	Annual production of 13,000 buses
b)	No of manufacturing units	one	11 production sites
c)	Presence	Turkey, Germany, Australia, Canada, Thailand, Luxembourg	IVECO Group holds a substantial 22.6% market share in Europe, and operates globally in more than 40 countries
3. Market entry barriers			
a)	Lack of long-term commitment/goals	✓	✓
b)	Bids focusing on low financial quotes compared to quality	✓	
c)	Open bidding process		✓
d)	Supply chain	✓	✓
e)	Workforce training needs	✓	
f)	Competition from established players	✓	
g)	Infrastructure facilities	✓	
h)	Lack of trusted partners	✓	✓
4. Market entry enablers			
a)	Government support	✓	✓
b)	Government Financial incentives	✓	✓

Based on the interviews with the Indian and international OEMs the following major factors for enablers and barriers are discussed below in the subsequent paragraphs.

ENABLERS

1. INTERNATIONAL COMMITMENT AT WORLD FORUM - COP & PARIS AGREEMENT

India has set and actively pursued ambitious climate goals, establishing itself as an emerging market dedicated to environmental protection. As part of these efforts, India's National Statement at COP26 in Glasgow represented a major advancement in fulfilling its Paris Agreement commitments[6]. The country presented five key targets, known as Panchamrit, or the five "nectars for immortality"[7]. These targets include expanding non-fossil energy capacity to 500 GW, sourcing half of the nation's energy from renewable sources, reducing total projected carbon emissions, achieving a more substantial reduction in emissions intensity relative to GDP than the Paris Agreement requires, and reaching net-zero emissions by 2070. Both national and international OEMs view this international commitment as a significant boost for the EV industry, recognizing it as a positive step toward long-term sustainability.

ITEM	NATIONAL STATEMENT AT UNSDS (2015)	2016 NDC	NATIONAL STATEMENT AT COP26 (2021)	2022 NDC
Renewable energy generation capacity	175 GW by 2022		50% energy requirement by 2030	
Emissions intensity with respect to GDP relative to 2005		30 - 35% by 2030	45% by 2030	45% by 2030
Non-fossil-fuel-based electricity generation capacity		45% by 2030	500 GW by 2030	50% by 2030
Additional carbon sink through forestry		2.5-3 billion metric tons of CO^2 equivalent		2.5-3 billion metric tons of CO^2 equivalent
Reduce total projected carbon emissions			1 billion tons from 2022 till 2030	
Net-zero goal			Net zero by 2070	

Figure 2 India's commitment to Net Zero
Source: https://www.energypolicy.columbia.edu/cop28-assessing-indias-progress-against-climate-goals/

2. POLICY FRAMEWORK

India's electric bus market is growing rapidly, with increase in sales of electric buses picking up from 2008 to 37,08 units sold indicating approximately 85% rise between 2023 and 2024[8] respectively and is also noticed in increase in numbers of electric buses in operations i.e approx. more than 10,000 buses in 2025[9]. This is driven by various policy initiatives aimed at promoting sustainable public transport and improving infrastructure. This can be broadly divided into two parts – (1) demand created by the policies/schemes and (2) financial incentives provided to operators and users.

Demand created by policies/schemes

This can be divided under two heads as given below:

a) National level

At the national level, India has shown a strong commitment to electrifying its public transportation system, with significant funding allocated for electric vehicles (EVs) and charging infrastructure. The push for public transport (PT) electrification began in 2013 with the introduction of the National Electric Mobility Plan 2020 by the Department of Heavy Industries (DHI). This was followed by the FAME I scheme from 2015 to 2017, which allocated 425 electric buses across 10

6 https://unfccc.int/sites/default/files/resource/India_LTLEDS.pdf
7 https://www.energypolicy.columbia.edu/cop28-assessing-indias-progress-against-climate-goals/
8 https://jmkresearch.com/wp-content/uploads/2024/05/Annual-India-EV-Report-Card-FY2024.pdf
9 MHI

cities in India. During this period, major Indian OEMs like Tata Motors, Ashok Leyland, and Volvo-Eicher began investing in R&D and exploring the EV sector. Also, giants like Tata Motors played a crucial role in policy advocacy to the Government of India on electrification as it was considered a good alternative to diesel buses. The FAME II scheme, launched in 2019 with a focus on the Gross Cost Model (GCC)[10], allocated 6,862[11] electric buses. Under the GCC model for the first time, the OEMs apart from procuring and maintaining the buses were allowed to even operate the buses, indicating a change in roles for the Indian OEMs. In 2021, the CESL Grand Challenge for aggregating demand for 5,450 electric buses was introduced, helping identify the lowest operating rates for e-buses. Additionally, the Government of India has continued to roll out several initiatives over the years, including the Production Linked Incentive (PLI) Scheme in 2021, the PM-eBus Sewa Scheme in 2023 includes a subsidy component that ensures sustainable operations for 10–12 years. A majority of the 10,000 planned buses are to be introduced in new cities, where operational breakeven is possible—potentially driving further demand. PM-eBus Sewa-Payment Security Mechanism Scheme in 2024-scheme aims to support the deployment of more than 38,000 electric buses for period of 12 years , and the PM E-DRIVE in 2024 - deployment of 14,028 e-buses in nine major cities, all of which further support the growth of the electric bus market. This scheme offers production-linked incentives for further encouraging manufacturers to scale up production capacity. Thus, a huge, aggregated demand of approximately 62,000 buses in the various schemes over the next few years is anticipated by the manufacturers and thus all these schemes have resulted all Indian OEMs irrespective of its size to focus on electric bus manufacturing.

- 2011 National Council for Electric Mobility (NCEM)
- 2013 Nation Electric Mobility Mission Plan 2020 (NEMMP)
- 2015 FAME India Scheme Phase I
- 2017 National Clean Air Program
- 2019 National Mission on Transformative Mobility & Battery Storage
- 2019 FAME Phase II
- 2021 FAME Phase II Amendment
- 2021 Grand Challenge – Demand Aggregation
- 2021 Production Linked Incentive Scheme for Auto sector
- 2022 National Electric Bus Program
- 2023 PMe-Bus Sewa scheme
- 2024 PMe-Bus Sewa-Payment Security Mechanism Scheme
- 2024 PMe-DRIVE Scheme

Figure 3. List of Government of India's scheme over the last decade

Besides, several states have implemented policies to support the electrification of road transport. For instance, 33 states/Union Territories (UTs) out of 36 have taken the lead by developing and announcing EV policies with public transport targets. Some states /UTs have updated their policies to offer upfront capital subsidies for vehicle purchases, along with various incentives such as tax exemptions and registration fee waivers, which are making electrification more accessible. State road transport agencies are also working on modernizing their fleets with electric vehicles and have set internal targets to achieve net-zero emissions. Given the substantial

10 Gross cost contract (GCC)- operators procure, operate, and maintain the electric buses, and the Public Transport Authority pays a pre-determined per-kilometer fee, covering all costs.
11 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2112237

funding allocated to these schemes, both international and Indian OEMs view it as a significant opportunity for growth in the sector. List of few states and its incentives provisions are given in table below:

TABLE 3 : LIST OF INCENTIVES STATE WISE FOR EVS

STATES	YEAR OF RELEASE	VALID TILL	CAPITAL SUBSIDY	TAX EXEMPTIONS & INCENTIVES	LAND DEVELOPMENT INCENTIVES	CONCESSIONS AND INFRASTRUCTURE	CHARGING INFRA INCENTIVES
Delhi	2020	till new EV policy comes in place	–	√	–	–	–
Goa	2021	Discontinued	–	–	–	–	–
Karnataka	2017	five years or till a new policy is announced	√	√	√	√	√
Rajasthan	2022	2026	√	√	√	–	–
West Bengal	2021	2025	–	–	–	–	–
Andhra Pradesh	2018	2022	√	√	√	√	√
Assam	2021	2025	√	–	–	√	√
Bihar	2019	2023	–	√	√	–	√
Gujrat	2021	2024	√	√	√	√	√
Haryana	2022	2026	√	√	√	√	√
Kerala	2019	2022	–	–	√	–	√
Madhya Pradesh	2019	2023	√	√	–	√	√
Maharashtra	2021	2024	–	√	–	√	√
Manipur	2021	2025	–	–	–	–	–
Odisha	2021	2025	√	√	–	–	√
Punjab	2022	2024	√	√	√	√	√
Tamil Nadu	2019	2028	√	√	√	√	√
Telangana	2020	2029	√	√	√	√	–
Uttar Pradesh	2019	2023	–	√	√	√	√
Uttarakhand	2018	2022	√	√	√	√	–

Source: UITP India analysis

b) Financial Incentives

The government provides financial incentives to businesses, institutions, or individuals in the form of cash, grants, subsidies, reduced interest rates, or tax breaks to alleviate their financial burdens. These incentives are intended to support social and economic policies that benefit the public. In a similar vein, the Ministry of Heavy Industries (MHI) does not directly provide subsidies for electric buses to state governments, but consumers are encouraged through various incentive schemes. Some key schemes[12] include:

1. **Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme Phase-II:** This scheme outlays Rs. 11,500 crore and offers incentives for electric two-wheelers (e-2Ws), three-wheelers (e-3Ws), four-wheelers (e-4Ws), buses, and EV public charging stations. Under FAME II, electric buses receive a demand incentive of up to 40% of the estimated cost.
2. **Production Linked Incentive (PLI) Scheme for the Automobile and Auto Component Industry in India (PLI-Auto):** This scheme offers financial incentives

12 https://www.uitp.org/publications/payment-security-mechanism-psm-ushering-a-new-era-of-electric-bus-deployment-in-india/

of about Rs. 25,938 crore to boost domestic manufacturing of automotive products with at least 50% Domestic Value Addition (DVA), encouraging investments in the automotive manufacturing sector.

3. **PLI Scheme for Advanced Chemistry Cell (ACC):** The scheme outlays Rs.18,100 crore and aims to develop a competitive domestic manufacturing ecosystem for 50 GWh of ACC batteries.
4. **PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) Scheme:** A two-year initiative with Rs 4,391 crore supporting electric vehicles including e-2Ws, e-3Ws, e-trucks, e-buses, e-ambulances, EV public charging stations, and the upgrading of testing agencies.
5. **PM-eBus Sewa-Payment Security Mechanism Scheme:** This scheme provides payment security to electric bus operators in case of defaults by Public Transport Authorities. This outlays about Rs. 3,435.33 crore.
6. **Ministry of Finance:** The Goods and Service Tax on electric vehicles has been reduced from 12% to 5%.
7. **Ministry of Road Transport and Highways:** Road tax on electric vehicles is waived.

Public transport is subsidized by the government as its operating costs often exceeds the revenue, and it is viewed as an essential social service for a country's development. As such, original equipment manufacturers consider these government initiatives as a positive step forward and think it to be a major reason for push towards the electric bus segment. Thus, such incentives from the Government side should continue which ultimately helps to build more trust and engagement for the OEMs. Also, Government of India could emphasis on policies like dual credit mechanism[13] as followed by China and few other countries of West, helps to incentivizes automakers to produce both fuel-efficient vehicles and new energy vehicles. This in turn would lead to additional revenue sources for the manufacturers.

3. Rise in Fuel cost

The international price of crude oil directly affects fuel prices in India. These prices can fluctuate due to various reasons such as global political tensions and changes in supply and demand. For example, the Russia-Ukraine war and the Iran-Israel conflict contribute to rising fuel prices. Since India is a crude oil-importing country, global market fluctuations directly impact fuel prices in India. Also, central government imposes excise duty, and state governments impose Value Added Taxes. Both types of taxes directly impact the prices of petrol and diesel. In recent years, the government has significantly increased excise duty. Diesel/litre price in the last 10 years have fluctuated from Rs 48.33/- in 2016 to 89.62 in 2024[14] indicating a growth rate of over 85% in Delhi. The fluctuations for period of 9 years are given in the graph below for case of Delhi[15]. Focusing on the electrification of public transport fleet along with typical day-fluctuation inherent to domestic electricity prices peak hours vs off-peak hours and high versus low prices, as this dictates the charging strategy to adopt is crucial for ensuring long-term sustainability in capital investment decisions.

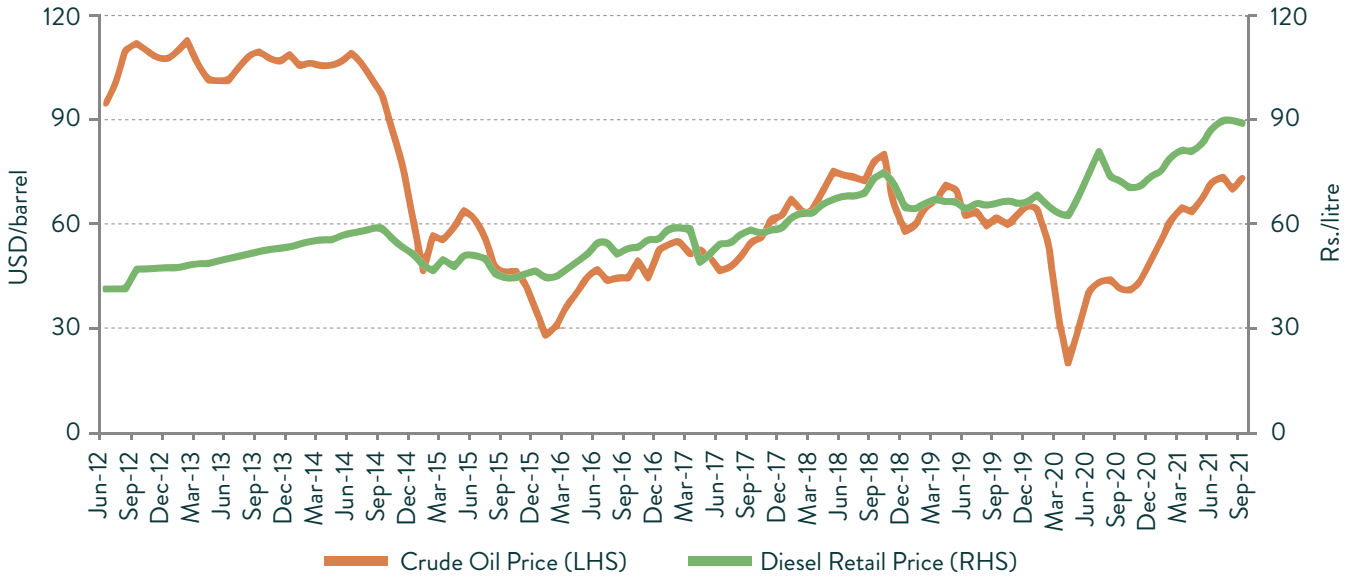

Figure 4 Trend of the global crude oil price vis-à-vis retail prices of petrol and diesel in Delhi (Source : https://prsindia.org/theprsblog/petrol-and-diesel-prices)

13 https://theicct.org/china-dual-credit-policy-feb22/
14 https://www.mycarhelpline.com/index.php?option=com_easyblog&view=entry&id=808&Itemid=91
15 https://prsindia.org/theprsblog/petrol-and-diesel-prices#:~:text=Between%20June%202014%20and%20October,litre%2C%20respectively%20in%20May%202020.

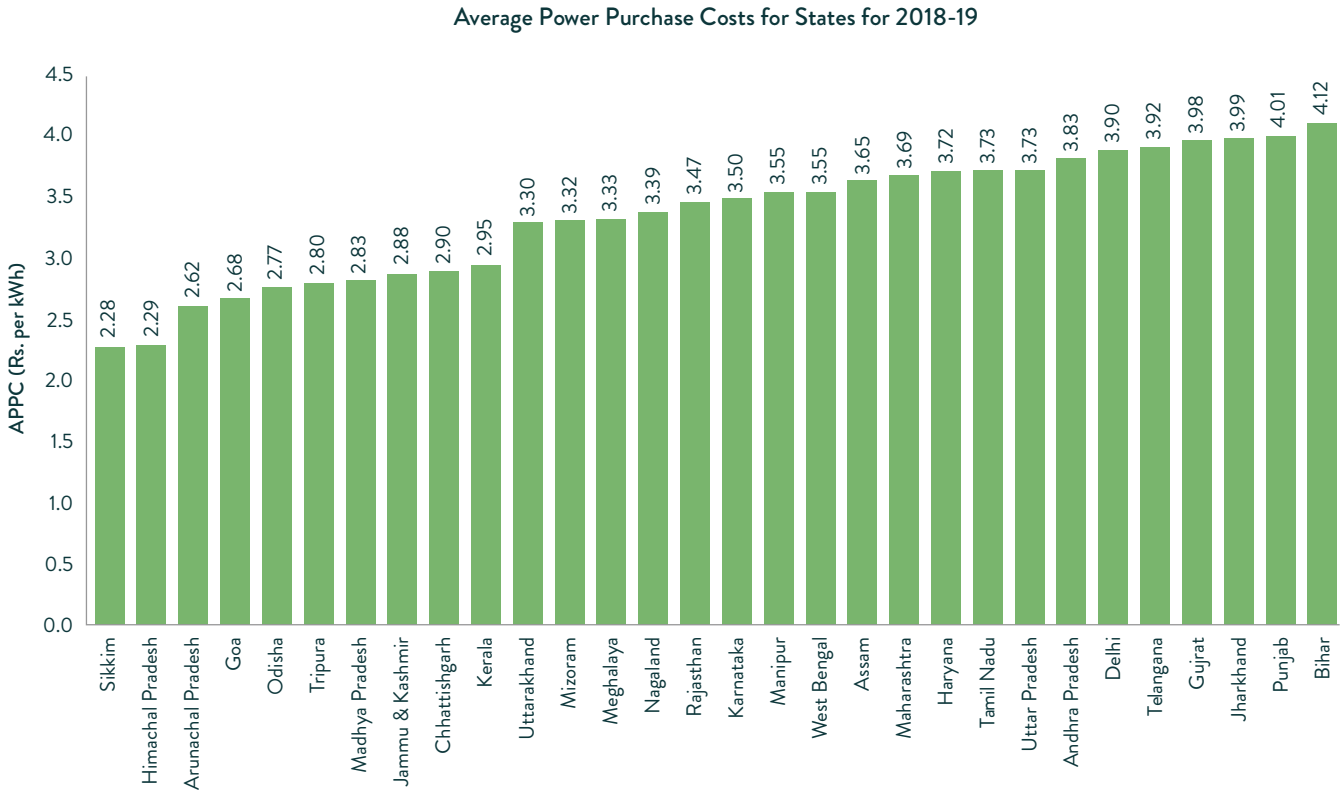

Figure 5 APPC cost for States in 2018-2019[16]

However, if we see the Average Power Purchase Cost (APPC) of electricity for states it is found to be much lower for example Delhi is at Rs 3.90 /kWh in 2019[17] compared to current years 5.49 /kWh[18]. Thus, this is also considered as a major pull factor for entering such business. The average energy consumption of electric bus typically consumes around 1.2 kWh per kilometer[19] with the average price can be higher, around Rs. 8.57 per kWh[20].

BARRIERS

While the current trend in the country is focused on promoting sustainable public transport modes, bus manufacturers face several challenges. Some of the key barriers identified during interviews with bus OEMs include:

1. Volatility of Political-Will in Decision-Making: Political agendas refer to the set of issues that are prioritized and debated within a political system at any given time. This concept is crucial because the attention different political entities give to various events and ideas ultimately shapes public policy. Changes in the political agenda can result from long-term developments or sudden shifts. In India, policy stability is often challenging due to changing political parties in power, which can disrupt long-term planning and national vision. Additionally, with India's federal structure, state ideologies may conflict with the central government's policies, causing resistance to development initiatives. As a result, Indian and International manufacturers struggle to navigate such an environment. For example, the Payment Security Mechanism introduced by the Ministry of Heavy Industries has not been universally accepted by all states, as states must act as a guarantor in this scheme.
2. Lack of long-term goals in Public Policy: One of the most frequently cited institutional barriers was the lack of enabling public policies and/or a specific implementation plan to guide e-bus adoption. It is found that plans lack clear long-term commitments

16 https://library.niti.gov.in/cgi-bin/koha/opac-retrieve-file.pl?id=fa032a58ad88d01c6dc83c12d7a174a3
17 https://library.niti.gov.in/cgi-bin/koha/opac-retrieve-file.pl?id=fa032a58ad88d01c6dc83c12d7a174a3
18 https://www.bsesdelhi.com/documents/55701/91985/Understanding_Tariff_BSES.pdf
19 https://cms.uitp.org/wp/wp-content/uploads/2022/11/Action-Points-Electric-Bus-Performance-Evaluation-OK.pdf#:~:text=Energy%20consumption%20of%20e%2Dbuses%20varied%20between%200.8,on%20the%20fleet%20availability%20and%20daily%20utilisation.
20 https://www.nobroker.in/blog/electricity-rate-per-unit-in-india/#:~:text=Electricity%20Rate%20per%20unit%20in%20India%20varies%20by%20state%20and,%E2%82%B93%20to%20%E2%82%B98.

and goals (eg next 5 years) from the Government resulting in uncertainty in the type of business. For example, the trend is now towards the development of EV sector, however the focus is also changing to other alternatives like hydrogen, ethanol blend etc. Thus, a roadmap of government policies would help the manufacturers to be future ready. The international OEMs also consider it as a major hurdle for losing interest for investment in the country. Thus, at the national level, setting up long term goals and commitment for EV manufacturers in the next few years would be considered a welcome step by all OEMs.

3. **Lack of clear technical vehicle specifications:** Indian manufacturers often face challenges in delivering buses due to the way demand aggregation tenders are structured. These tenders typically specify the number of buses to be supplied to each state or city, along with basic guidelines to follow the urban bus specifications set by MoHUA[21]. However, these guidelines are usually vague and do not clearly outline the specific requirements for each state or city. As a result, manufacturers face significant difficulties later when they typically engage with state /city authorities after receiving the Letter of Award (LoA), leading to delays in deployment timelines. Each state or city has its own unique needs and specifications and goes to various testing agencies for certifications, which the manufacturer must address by designing buses to meet local standards. This process results in extended production turnaround time. Currently. the government tenders specify a delivery time of approximately of 1 year time for 100% deployment of orders in cities. But due to this process cities often complain about delay of more than 1.5 years or 2 years. To reduce the production turnaround time, standardisation of specifications for all types i.e 7m, 9m and 12m of e-buses in the contract at national will help to reduce delays.

4. **Dearth of testing agencies:** various regulations and standards related to electric mobility have been introduced to which Indian OEMs have to adhere to address environmental concerns, product safety, and reliability. Automotive testing organizations play a crucial role in ensuring that manufacturers deliver comfortable, safe, and high-performance vehicles that can operate efficiently over the long term. The Government of India (GOI) has fostered global competencies by establishing world-class testing, homologation, and R&D facilities, as well as upgrading two existing testing centers. Currently, India has only a few such centers, including ICAT, GARC, NATRAX, CIRT, VRDE, and ARAI. To begin manufacturing a vehicle, a prototype must first be developed and undergo various testing and homologation processes at these institutes. However, due to the high volume of orders Indian OEMs need to process, based on state and city-specific requirements, the testing process often has a waiting period of up to three months, which

Source: https://www.unitechcorporation.in/core_activities.html

21 https://www.convergence.co.in/public/images/electric_bus/1935.pdf

delays the testing and homologation process of manufacturing of electric buses. Setting up more testing agencies at the national levels will help to ease the load on existing agencies.

5. **Financial regulatory compliances:** Payment Incentive Link Scheme also contributes to manufacturing delays. This scheme offers financial incentives to promote domestic manufacturing of Advanced Automotive Technology (AAT) products with a minimum of 50% Domestic Value Addition (DVA) and aims to attract investments in the automotive manufacturing value chain. Compliance with this scheme can take upto six months, as it is a rigorous process and involves lot of documentation and several stakeholders' involvement. Thus, OEMs are faced with challenge of payment of late delivery charges to the cities, as OEMs are unable to deliver the electric buses on time. This, results in a considerable amount of delay to OEMs and compromise on getting the incentive under the scheme or the electric buses delivered on time to cities. In case of International OEMs, Make in India policy, of 50 % localisation of goods imposes excessive challenges as well. Thus, process of compliance could be made simpler by the Government of India, so that not much delay is caused in manufacturing by OEMs.

6. **Lack of long-term financing model of electric buses:** Given the risks, uncertainties, and nature of the e-bus industry, financing poses a significant barrier to large-scale implementation to the STUs/SPVs and OEMs. This challenge is especially pronounced for STUs/SPVs that have not demonstrated strong creditworthiness through past investments and often runs into financial losses over the years. Scaling e-bus projects requires substantial capital investment, both for procuring the vehicles, establishing the necessary charging infrastructure and depot adaptations and grid upgrades. To mitigate these risks for STUs/SPVs, recent schemes of Government focus on the Gross Cost Model, where Indian manufacturers/OEMs are responsible for purchasing, operating, and maintaining electric buses on a per-kilometer basis. However, the large upfront investment required can be challenging for OEMs. As a result, OEMs often turn to commercial banks for loans with high interest rates and seek investors who are primarily focused on returns after electric business is established. Alternative financing models like facilitating access to green financing instruments such as ESG investments and green bonds, provision of lower rate of interest from the lenders should be explored by the Government. Also a shift towards a Manufacturer–Financier–Operator model is recommended. This structure would allow manufacturers to focus on scaling production, while financiers and operators take on their respective roles more efficiently.

7. **Supply chain disruption:** The Government of India's guidelines have contributed to supply chain disruptions in electric bus (e-bus) manufacturing in several ways:

   - **Registration requirements:** Service providers from countries sharing a land border with India must register with the Department for Promotion of Industry and Internal Trade (DPIIT) to secure projects.
   - **Local production:** The government has introduced policies to promote domestic production of EV components, such as the Make in India initiative, the Production Linked Incentive (PLI) scheme, and the Phased Manufacturing Plan (PMP). However, the supply chain has struggled to localize production quickly. Bidders must ensure more than 50% domestic value addition at the vehicle level, in compliance with standards from ICAT, ARAI, CIRT, and others. Additionally, traction battery packs must be assembled domestically, with battery cells and associated Battery Management Systems (BMS) potentially being imported. These leads to challenges for both International and national manufacturers.

   However, current Geopolitical tensions and supply chain dependencies from neighbouring countries, particularly in importing battery cells and critical EV components, lead to higher cost and timeline uncertainties. Therefore, increasing investment by the Government of India in R&D for battery cells production would act as an enabler

8. **Lack of skilled workforce:** City officials including (both OEMs and authorities) often lack an understanding deep technical expertise in electricity infrastructure and often struggle to meet the specifications or requirements for setting up support depot infrastructure like electricity connection to the depots etc and thus leading to delay in depot development and setting up charging infrastructure for electric buses. Single window benefit for each state regrading provision of power supply to support infrastructure would help to ease the constraints for OEMs. Also, Government, investing in more national level capacity development schemes in cities for electric buses would help to accelerate the process for electric bus adoption.

9. **Lack of infrastructure facilities:** The lack of access to land and property also presented a substantial barrier to upgrading and installing the charging and grid infrastructure that e-bus projects require. The problem of simply the availability of charging ports specially in small cities hampers the deployment of electric buses. Also setting up charging stations are typically expensive and need to be protected. For these reasons, it is often difficult to install large numbers of charging stations, as there is problem of theft in cities. In India, one of the identified barriers was simply ensuring that the local utility company could provide a reliable flow of electricity for the e-buses, given those cities' current general difficulty supplying consistent electricity. Apart from this as there is lack of standardized and interoperable charging infrastructure creates operational rigidity. The International OEMs also consider a major obstacle to development. Thus, setting of national and state targets for next few years in building robust charging infrastructure and mandating interoperability of chargers will provide greater flexibility for all OEMs. Also, develop a wholistic plan for cities to reduce the load on the grid, as more and more cities undertake on the electrification process.
10. **Established players:** New emerging companies like EKA Mobility, which have just begun their journey in India's manufacturing sector, face intense competition from established OEM giants like Tata Motors and Ashok Leyland. This creates challenges such as building brand trust, as many consumers and government organizations are hesitant to rely on newer OEMs. Additionally, developing a completely new EV ecosystem is a complex task that requires far more effort compared to established players. Furthermore, attracting skilled talent for plant operations and R&D becomes more difficult under these circumstances.
11. **Gross cost contract model:** OEMs currently under the GCC model, are required to operate electric buses, an area in which they may lack expertise. To address this, they often hire third-party agencies to manage driver recruitment, adding an external operational burden. This is because these OEMs are primarily focused on manufacturing rather than the operational aspects, such as managing drivers, leading to greater risk sharing by OEMs. Thus, driver provision under the GCC contract should be removed and OEMs should be allowed to focus only on production and the maintenance of the vehicles.
12. **Energy efficiency of electric buses:** it is considered an important parameter for OEMs both major and minor OEMs on the commitment given during contract signing of GCC cost of operations of buses and the penalties. As efficiency and adherence to schedule is key for day-to-day operations of electric buses. But due to different working conditions of states/cities, often OEMs struggle to meet the criteria of operations as in the contract and end up paying penalties. Also, when Govt of India schemes push towards electrification of smaller cities, no OEMs have the experience in running buses in tier two and three cities, thus would be struggling in future. Thus, to solve this maybe experience of other case cities from abroad like China, Europe could be studied in detail and incorporate such clause in the contract or give some extra time for trail run before fixing the GCC rate by OEMs.

Source: https://cdn.prod.website-files.com/62607d74b51bbab6e9f-6d12a/6408c2d9fd068f7081cf3550_Work%20Platforms%20for%20Electric%20Bus%20Manufacturing%20110468.pdf

International OEMs considers the Indian bus sector as a large, growing market with significant future potential. However, some additional points highlighted by International OEMs as barriers are:

- Governments in their home countries tend to prioritize providing quality consumer services rather than focusing on lowering production costs, thus a major concern for international OEMs.
- Apprehension amongst OEMs due to the lack of understanding of local conditions leads to delay in developing partnerships with locals.
- Challenging environment to compete with well-established players in India's open procurement system.
- Unfavourable customs duties on imported components due to the localization policy.

The following steps would help to attract International OEMs as well:

a. Setting up long term goals and commitment for EV manufacturers in the next few years
b. Privilege access to bus procurement
c. Lowering of custom duties for importing contents
d. CAPEX and Energy commitment to OEMs

CONCLUSION

The electric bus manufacturing sector in India presents a promising pathway toward sustainable public transportation. Several enablers are driving the growth of this sector, including strong government support, favourable policies such as subsidies and incentives for electric vehicles, and the increasing demand for clean energy alternatives, further accelerating the adoption of electric buses in the country. While the government has made commendable efforts to identify and organize both the enabling and limiting factors of fleet decarbonisation, challenges in technological, economic, and managerial domains still hamper widespread implementation. However, recent developments in these areas are beginning to ease some of the earlier bottlenecks. There is a strong need to develop a holistic framework that facilitates the transition to electric buses.

However, there are still considerable barriers that needs to be addressed for the successful large-scale implementation of electric buses. Key challenges include high initial capital costs investment, limited local manufacturing of critical components (such as battery cells), lack of adequate charging infrastructure, lack of adequate testing and homologation agencies, varied bus specifications etc. Additionally, addressing challenges in policy implementation, simplifying the regulatory framework, will be vital for the sector's growth.

In conclusion, while there are barriers that need to be overcome, the enablers for electric bus manufacturing in India present a strong foundation for creating a cleaner, more sustainable transportation future. Through collaborative efforts, technological innovations, and targeted policy support, India has the potential to emerge as a global leader in electric bus manufacturing.

Source: https://stablediffusionweb.com/image/23199873-hyper-realistic-side-view-city-bus-image

Source: https://www.hindustantimes.com/analysis/urban-agenda-the-nuts-and-bolts-of-e-bus-rollout-in-indias-smaller-cities-101712497252753.html

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