Market Assessment for **Intercity Electric Buses** in India

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Executive summary

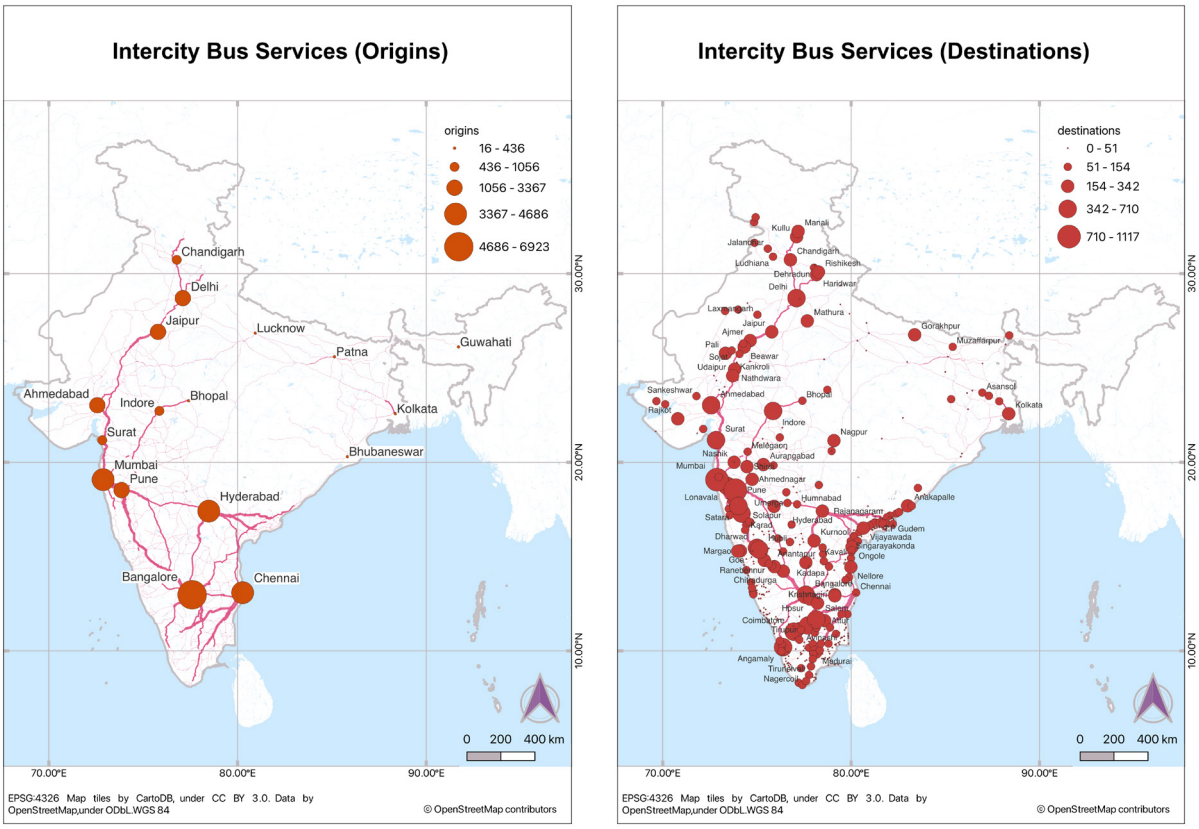
E-bus market assessment

- Rural and intercity buses are crucial to meeting several policy objectives: ensuring access to mobility for various users solely dependent on them, providing livelihood opportunities to millions of people employed in the sector, and reducing the energy and emission intensity of the bus sector.
- India's bus market is estimated to grow from 23 lakh (2.3 million) buses in 2023 to 31.6 lakh (3.16 million) buses by 2030. This involves procuring 20 lakh (2.0 million) buses for fleet replacement and augmentation needs.
- About 10% of the bus fleet in India is operated by government agencies for public bus transport and various other government applications. The remaining 90% is operated by private bus operators in rural transport, intercity transport, school buses, employee transport, tourist transport, and other use cases.
- Achieving Government of India's EV 30@30 goal, i.e. reaching an electric bus (e-bus) share of 30% in overall bus sales by 2030, will require deployment of 3.15 lakh (0.315 million) e-buses in total, out of which about 2.52 lakh (252,000) are estimated to be in the private bus market.
- Deploying 2.52 lakh e-buses in intercity bus operations can enhance access to affordable and space efficient mobility for an estimated 212 billion passenger-km of journeys.
- Assuming that e-buses have an INR 5 per kilometre (km) lower total cost of ownership (TCO) than internal combustion engine (ICE) buses, and the TCO savings are transferred to the end user, this would lead to an estimated cost saving of INR 1.06 billion for users over the 12-year life of the vehicle.
- Adoption of 2.52 lakh e-buses in the private bus market would also bring substantial environmental benefits by mitigating emission of 25.2 Cr tonnes of carbon dioxide equivalent (tCO2e) (252 million tCO2e) greenhouse gas (GHG) emissions and 4,000 tonnes of fine particulate (tPM2.5) emissions, and reducing air pollution along highways.
- Procurement of 3.15 lakh (0.315 million) e-buses would require substantial capital investments, upwards of INR 3 lakh Cr (~USD 37.8 billion) by 2030. However, there exists limited understand of the operational and financial characteristics of the market that can drive these investments.
- A detailed understanding of the baseline scenario of intercity buses and specific recommendations to unlock large-scale investments for e-bus adoption are needed to effectively implement the e-bus agenda.

Operational and financial characteristics of intercity buses

- A total of 32,653 intercity bus services originating from 17 cities in January 2024 have been extracted through various online ticket booking platforms to establish a baseline of existing intercity bus service characteristics.
- Bengaluru, Chennai, Hyderabad, Mumbai, Pune, and Delhi have been identified as the top six Indian cities in decreasing order of intercity (contract carriage) bus demand.
- Data on privately operated stage carriage services, which provide public transport-like services for rural and intercity demand, are not available at the national level.
- The key demand centres for intercity bus services, types of services, and operational characteristics indicate that ~70% of the market is either sleeper or seater cum sleeper buses.
- About 70% of all intercity trips across seater, sleeper, semi sleeper and their combinations are operated using air-conditioned (AC) buses, indicating passengers' preference for comfortable services in this market segment.
- The average route length of intercity buses is around 407 km, with 34% routes shorter than 300 km and 53% shorter than 500 km.
- Current e-bus adoption in the intercity market is predominantly in the AC seater segment, which has an average route length of 210 km and one-way travel time of less than 6 hours.
- Seater buses form 8% of the market share within the intercity segment. Improvement of e-bus technology to meet the range requirements of sleeper buses will be crucial to their adoption in sleeper bus services with average route lengths above 400 km, which constitute up to 85% of the market share.
- About 61% of intercity buses depart between 7 PM and midnight, out of which 9-10 PM is the peak hour, with 17% of departures.
- The key demand centres and corridors of operation have been mapped (Figure i) to identify high demand highway networks where charging infrastructure may be established for the e-bus transition.

Figure i: Demand centres and key highways for intercity (contract carriage) buses from 17 Indian cities



Findings from bus operator surveys

i. Operational characteristics

- Questionnaire-based surveys have been conducted with 365 intercity bus operators across the 10 most populated Indian cities, of which 306 clean data samples have been used for detailed analysis.
- 95% of bus operators in India own fewer than 50 buses, out of which 78% own fewer than 5 buses. However, the remaining 5% of operators own 61% of the fleet. Therefore, e-bus adoption may target the larger operators owning more than 50 buses, who are likely to have better infrastructure and financial preparedness to invest in e-buses.
- About 69% of the fleet is operated in the 'firsthand' market, while the remaining 31% operate in the secondhand market.
- The average fleet age for the interviewed operators was 5.2 years, with the maximum bus life reported to be an average of 7.4 years across firsthand operations and 8.2 years across secondhand operators.
- Buses operate 12-14 hours per day, while the remaining time, typically during the day, is available for parking, maintenance, and charging, in the case of e-buses.
- Only 1% of all operators use government-provided facilities for parking and maintenance. About 50% operators have their own facilities, while the remaining 49% use ad-hoc measures like on-road

- Only 1% of all operators use government-provided facilities for parking and maintenance. About 50% operators have their own facilities, while the remaining 49% use ad-hoc measures like on-road parking, shared parking, schools, etc.
- The prevalence of exclusive parking will lead to charging infrastructure needing to be created by each operator, which will add to their fixed costs, as presented in the TCO analysis below.
- About 48% of intercity bus demand is sourced through online booking platforms, 34% through offline travel agents, and 18% through on-demand spot bookings.
- Operators reported an average of 215 peak days in a year with more than 80% occupancy on 98% of their routes. The remaining 150 days still attract more than 60% occupancy for 68% of the routes. Many operators reported cancelling the service if the occupancy was lower than the operational expenses for the trip. Private operators always ensure significant demand and therefore revenue visibility for themselves, as well as their financing entities.

ii. Financial characteristics

- Fuel cost (63%) constitutes the single largest cost head for private operators, followed by equated monthly instalments (EMIs) (9.7%) paid against bus loans.
- Unlike public bus operations, where staff costs are the predominant cost head, private operators spend just 4% of their operational budget on staff, with another 9% being spent on bus maintenance. The low staff cost can also be attributed to the common scenario of small operators driving the buses themselves and taking care of regular maintenance.
- The average loan-to-value (LTV) ratio of ICE bus loans is reported as 78%, with a minimum of 70% and a maximum of up to 100% of the vehicle cost being financed.
- The average loan tenure is about 4.2 years, with a minimum of 3 years and a maximum of 8 years.
- 86% of existing buses are financed by banks, followed by non-banking finance companies (NBFCs) (6%), private financiers (5%), and own funds, indicating a good level of bankability for the ICE buses.

Stakeholder feedback on key barriers to and enablers for e-bus adoption in intercity services

i. Operators

- 80% of operators ranked e-buses are their first-choice vehicle technology for the future. The share dropped to 43% once they were presented with the relative unit economics of e-buses and ICE buses at the current prices.

- E-bus ranges meeting operational requirements, availability of parking and charging infrastructure space, reduction in e-bus purchase price, access to finance, and clarity on the long-term road map for e-bus-related tax and electricity tariff benefits have been identified as the key enablers needed for operators to adopt e-buses.

ii. Financing institutions

- Lack of understanding of intercity bus operations, limited transparency in revenues accrued, and the limited bankability of individual procurements and operators are some of the key barriers identified by financing institutions.
- De-risking the e-bus market through performance guarantees on the bus and battery technology and provision of partial credit guarantees for operators have been identified as key enablers to accelerate financing in the intercity e-bus market.

iii. Original equipment manufacturers (OEMs)

- Lack of long-term visibility in demand, variability in battery pricing, and supply chain challenges associated with various components have been identified as the key barriers for OEMs in producing intercity-specific e-buses.

iv. E-bus enablers identified across stakeholders

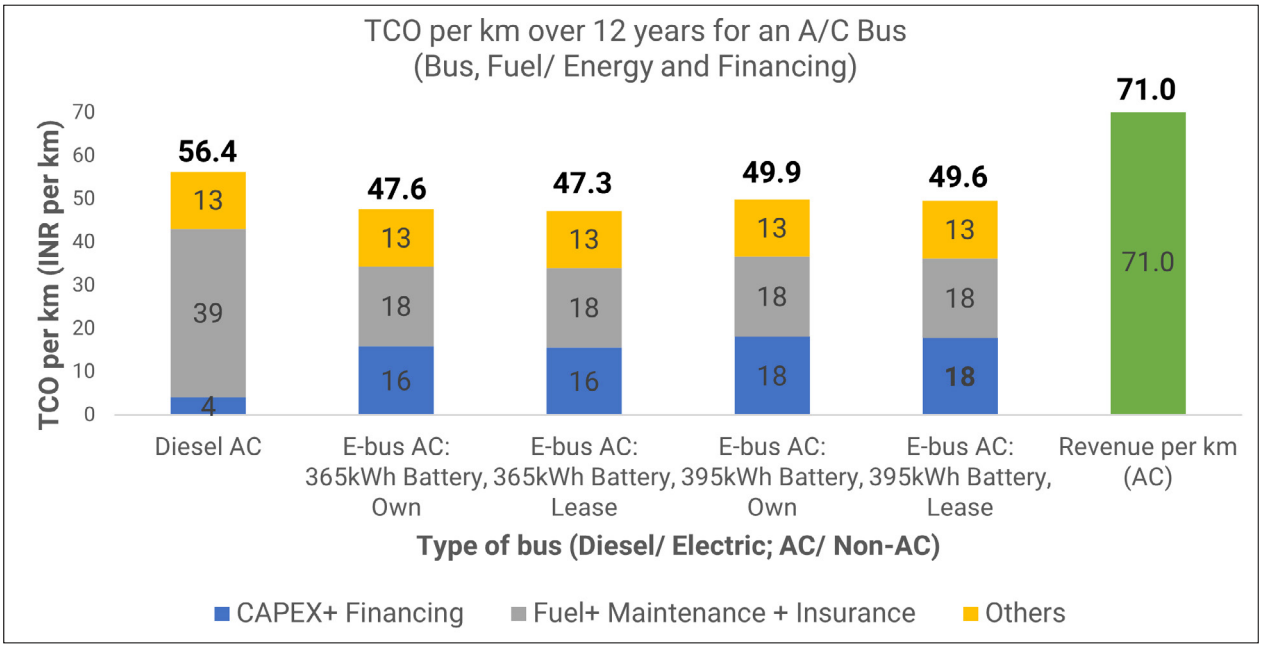
- Clarity in the policy roadmap and incentives over the long term, aggregated procurement for demand visibility, and establishment of lease-based business models that take capital commitments off OEMs have been identified as key enablers to accelerate the market.
- Reducing the trust deficit between different parties through transparent reporting of the operational and financial performance of different bus types, routes, and operators was another key enabler highlighted across stakeholder groups.

v. TCO of e-buses vs. ICE buses

- Comparative TCO analysis has been carried out for diesel and electric buses for a typical case of contract carriage operation (AC buses with a utilisation of 500 km/bus/day) and stage carriage operation (non-AC buses with a utilisation of 400 km/bus/day).
- A base case scenario with assumptions corresponding to an existing intercity e-bus operator has been used to understand the overall TCO comparison, followed by a sensitivity analysis to establish the impact of various key variables in determining the TCO. A conservative scenario is presented to demonstrate the TCO impact of the high risk attributed to e-buses by various stakeholders.

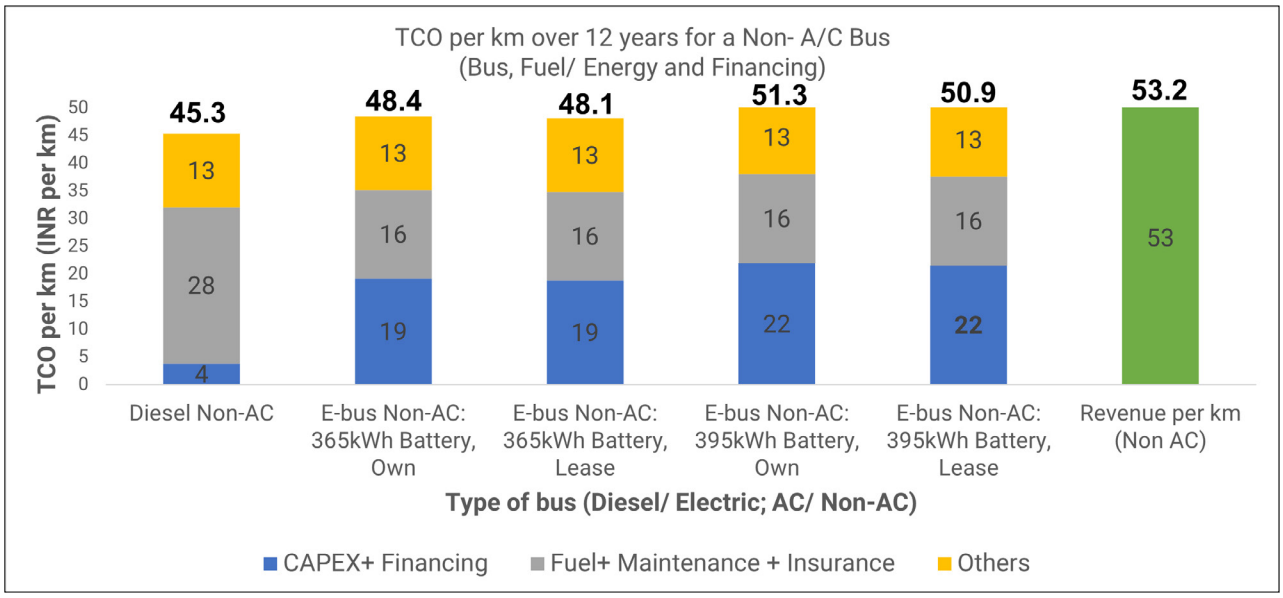
- The AC e-bus TCO in the case of a contract carriage bus (Figure ii) is estimated to be 12-15% lower than that of Tata/Ashok-Leyland AC diesel buses over their 12-year life. In case the ICE bus considered is a Volvo bus, this differential would be higher, given the higher capital and operational costs of these buses compared to Tata/Ashok Leyland buses.
- The leasing model is likely to be marginally cheaper for the operator, given the leasing entities' ability to obtain a lower cost of finance compared to private operators. However, the appropriate choice of battery size according to operating requirements is likely to deliver more savings than the choice of leasing model or various financing terms.

Figure ii: 12-year TCO (INR/km) of 12 m AC diesel & electric buses (contract carriage: 500 km/day)



- The TCO of non-AC e-buses operating as stage carriage buses (Figure iii) is estimated to be around 6-13% higher than that of non-AC diesel buses over their 12-year life, due to the significant capital cost differential between the two vehicle types, combined with fewer daily-km of operation compared to contract carriage buses.
- Reducing the purchase price of e-buses from the current INR 1.5 Cr to 1.1 Cr will result in TCO parity with diesel buses.
- Despite the higher TCO of e-buses compared to ICE buses, it is still lower than the revenue earned by the operator.

Figure iii: 12-year TCO (INR/km) of 12 m non-AC diesel & electric buses (stage carriage: 400 km/day)



- **The capital cost of the bus**, batteries (including replacements), and chargers and interest paid on their financing adds up to 33-36% of the TCO for AC e-buses and 39-43% in the case of non-AC e-buses with stage carriage permits. Reducing these capital costs has the highest potential to reduce overall e-bus TCO.
- **Daily vehicle-km operated,** bus life, and electricity tariff are the operational attributes with the maximum TCO impact.
- **The LTV ratio and loan interest rate** are the financing terms crucial to improving access to finance for e-buses and reducing their overall TCO.
- **Lack of clarity on key variables** like bus purchase price, bus life, operator creditworthiness, routes of operation, and long-term electricity tariffs can add to the perceived risk of investing in and financing e-buses. This can result in 31-34% higher TCO across AC and non-AC buses, making the switch to e-buses financially unviable for the operators.
- **Improved transparency in costs**, standardisation of technological performance, and partial credit guarantees for e-bus loans can play a major role in de-risking the e-bus sector and thereby improve its TCO and uptake.

Key recommendations for accelerated e-bus adoption in intercity operations

- **Institutional anchor within the government to advance private e-bus adoption:** Implementing policy and regulatory reforms related to permits and taxation, facilitating land and infrastructure development for e-buses, and developing financial de-risking mechanisms for e-buses require a strong institutional anchor to support private bus operators, working in close collaboration with the Bus & Car Operators Confederation of India (BOCI). The Ministry of Road Transport and Highways (MoRTH) and Ministry of Heavy Industries (MHI) within the Government of India (GoI), as well as the state road transport authorities (RTAs) regulating intercity buses, need to play a more proactive role in advancing e-bus adoption in the intercity market.

- **Prioritising contract carriage vs. stage carriage buses for electrification:** Contract carriage operations are likely to witness faster uptake of e-buses than stage carriage operations due to favourable unit economics, despite stage carriage operations needing limited range and fewer daily-km to be operated. Therefore, government initiatives may focus on contract carriage operations in the short term and expand their scope to include stage carriage services in due course.

- **Increasing the number of available vehicle models for intercity buses and improving their ability to serve long-range routes:** The number of OEMs offering intercity buses needs to increase from the current 2-3 to 6-7 to provide a wider range of vehicle options to operators while also reducing the price per bus due to increased competition in the market.

- **Transparency in bus costs:** A government- or industry-driven effort to publish the costs and specifications of various models of e-buses, batteries, and chargers in an open forum would allow individual operators and financing entities to compare the specifications across OEMs and ascertain the costs of a new e-bus purchase, thereby bringing in much needed transparency in private bus contracts.

- **Cost reduction through demand aggregation and standardisation:** A consolidated procurement effort across private operators, subject to predefined screening criteria to identify quality demand, can potentially provide the much-needed initial push and clarity in business models for intercity buses. The initial procurement may be piloted and treated as the basis for further rounds of procurement that follow a similar business model.

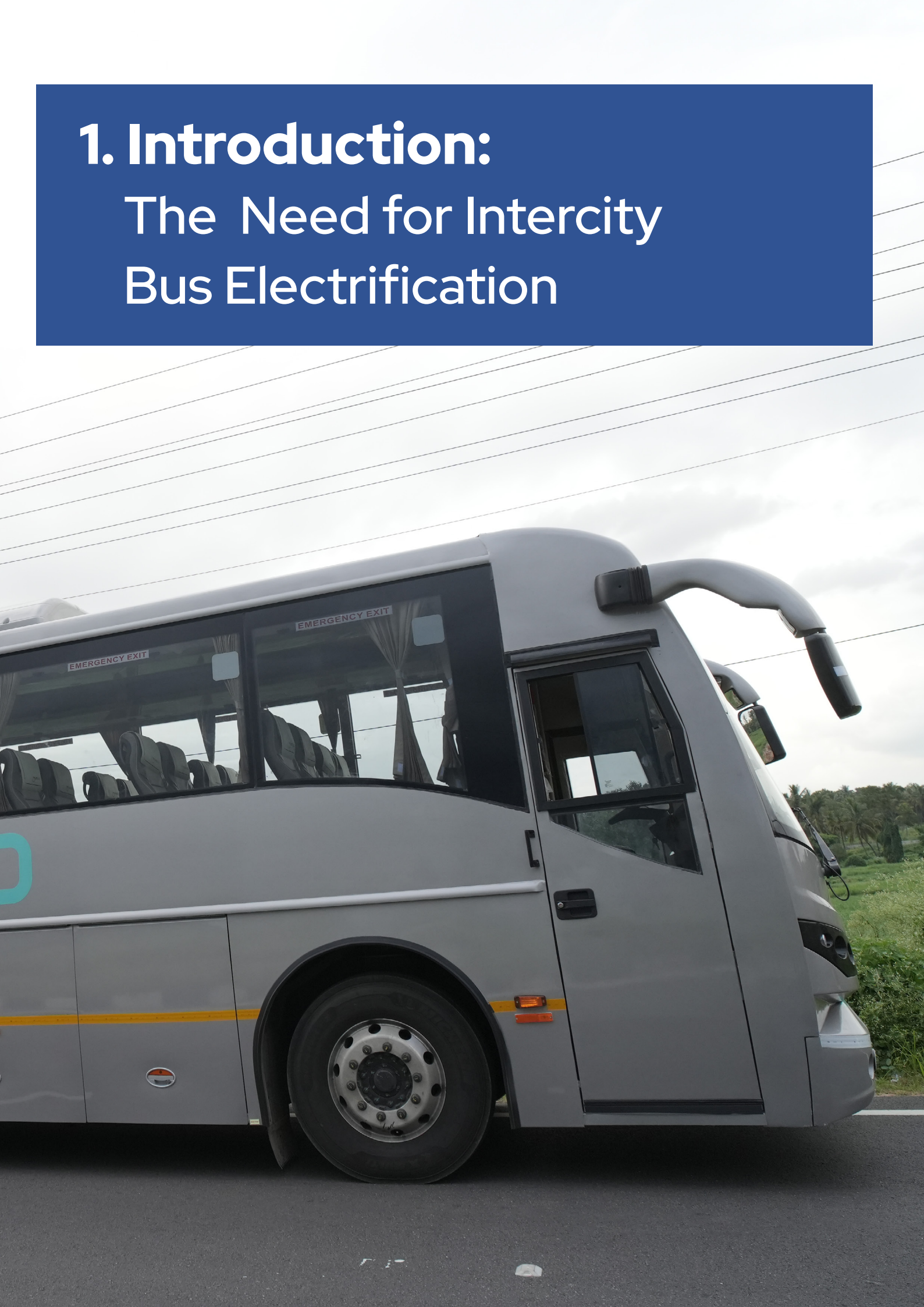
- **Transparent reporting of intercity bus performance across India:** Independent efforts to develop information sharing portals and publication of periodic reports on key indicators concerning intercity e-buses like route-wise bus allocation, fleet utilisation, vehicle utilisation, occupancy, fares, revenue, etc., across operators, similar to the annual reports published by the Central Institute of Road Transport (CIRT) for public bus agencies, can be of significant value in de-risking the market for financing entities.

- **Extending electricity tariff subsidies for electric vehicles** for a few more years is crucial until the capital costs reduce to a breakeven point of INR 1.1 Cr per bus, at which point e-buses may be cost-competitive. Until then, electricity tariffs need to continue to be subsidised to offset other costs.

- **Reducing the cost of annual maintenance contracts (AMCs)** through local supply chain development for spare parts and pricing them realistically based on data from existing operations are two strategic areas that have a significant impact on the achievement of long-term e-bus transition goals.
- **Long-term clarity on permits and taxes** through national policy advisories by GoI and state EV policies may include a timebound action plan, including the current relaxation of permits and taxes on e-buses and their end of tenure, to facilitate long-term planning by bus operators and financing institutions.
- **Mitigating technology risks through warranties and technical evaluation of standard products** would de-risk investments, thereby improving an e-bus's financial valuation at different points of its life and resulting in enhanced financing.
- **Shared infrastructure for parking, charging, and maintenance** with high-quality power supply is a key prerequisite for large-scale e-bus adoption. Public-private partnerships (PPPs) where the government provides land on which private players can establish bus depots and maintenance centres may be taken up across India.
- **Business models to attract capital for private operators:** Developing the right business models to infuse the initial capital that can be recovered from operators over the bus life, with adequate safeguards, is crucial to attracting large-scale financing to the sector.
- **Factors determining the choice between leasing and outright purchase:** Leasing offers lower-cost financing, reducing the TCO compared to the outright purchase model, but it will also include operational boundary conditions set by the leasing company, which the operators currently feel are overbearing. As a result, operators with limited financing capabilities are likely to choose the leasing model, while larger operators will continue to seek finance for outright purchase. Therefore, Government incentives and financial products by banks/ NBFCs may focus on leasing for the smaller operators and lending for the larger operators.
- **Interest subvention programmes** with a certain upper limit on the number of e-buses receiving the benefit may be designed to improve access to finance for the early adopters of intercity e-buses.
- **De-risking products for e-bus financing:** Despite capital support, the diversity of private bus operators and emerging nature of e-bus technology will continue to make e-buses a risky investment for financiers. The following de-risking mechanisms are recommended:
    - Creating a loss-pool for batteries and other key components
    - Credit guarantees for loans on purchased vehicles.

The findings from this study provide necessary inputs for operators, OEMs, and financing entities deploying e-buses in the intercity market and can be built upon to advance the e-bus adoption mandate across India.

1. Introduction:
The Need for Intercity Bus Electrification



1.1 The Role of Buses in India

India's growing population and economic activity has led to a continuous increase in people's travel demand to access various activities and services.

Personal vehicle ownership in India is still relatively low, at about **31 cars and 174 two-wheelers owned per 1,000 people (MoRTH, 2023)**. As a result, a large share of the population is dependent on public transport as their primary mode of transport to meet their travel needs. **Buses are the predominant** form of public transport in India, covering around **40% of road-based travel** demand (measured in passenger-kilometres (km) travelled) (TERI, 2024[1]), making India the third largest bus market in the world (MoRTH, 2023). Buses also contribute to about 4% of total diesel consumption in India, 15% of energy consumed and greenhouse gases (GHG) emitted from the transport sector overall, and 23% of energy consumed and GHG emitted within passenger transport. India's passenger transport demand is projected to grow by 2.6-3 times between 2021 and 2050, and buses will continue to play a key role in meeting the growing travel needs of the country, as well as achieving the decarbonisation targets of the transport sector (TERI (2021)[2], IEA (2023)[3]).

India has committed to reducing its carbon emissions to net zero by 2070 and has developed a Long-Term Low-Emission Development Strategy (LT-LEDS)[4], unveiled at the 26th session of the United Nations Framework Convention on Climate Change (COP 27) in November 2022. Encouraging bus usage and transitioning from internal combustion engine (ICE) buses to electric buses (e-buses) is crucial to decarbonising passenger transport in India[5] and is therefore a key strategic priority within India's LT-LEDS. India has also included the promotion of public transport and its electrification as a priority under its commitment to achieving a 30% sales share of electric vehicles (EVs) by 2030 across all market segments[6].

Over the past few years, public bus agencies have made significant efforts to deploy e-buses, with national and state government support through programmes such as the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles (FAME), Smart Cities Mission, National Electric Bus Programme (NEBP), and state-level electric mobility (e-mobility) incentives. These initiatives have led to about 6,800 e-buses being operationalised across public transport authorities (PTAs), while another 10,000 e-buses have already been contracted and are expected to be deployed by the end of 2024. Public bus electrification is expected to gain further momentum through upcoming initiatives such as the PM-eBus Sewa scheme and a payment security mechanism (PSM) for e-buses.

[1] The Energy and Resources Institute (TERI). 2024. Roadmap for India's Energy Transition in the Transport Sector. New Delhi, India: TERI.

[2] https://www.teriin.org/sites/default/files/files/Decarbonization_of_Transport Sector_in_India.pdf

[3] https://www.iea.org/reports/transitioning-indias-road-transport-sector

[4] https://unfccc.int/sites/default/files/resource/India_LTLEDS.pdf

[5] ITF, World Bank (2023), Lifecycle Assessment of passenger transport: Case study of India

[6] https://www.iea.org/news/new-cem-campaign-aims-for-goal-of-30-new-electric-vehicle-sales- by-2030

1.2 The need to focus on private buses in rural and intercity applications

While the momentum for public bus fleet electrification has increased in recent years, achieving India's ambitious e-mobility goals requires large-scale electrification of the private bus market. India has about 23 lakh (2.3 million) registered buses, out of which around 1.4 lakh (0.14 million) buses, i.e. about 6.3% of the fleet, are operated by PTAs such as state and municipal transport undertakings. About 90% of the total bus stock is estimated to be operated by private operators as rural and intercity services, school buses, corporate transport services, tourist buses, and other applications. The remaining buses operate in applications for central and state governments, local authorities, and other government departments.

About 6.9 lakh (0.69 million) buses, i.e. around 30% of the total bus fleet in India, are owned by private operators providing rural and intercity services. These services are sanctioned through contract carriage or stage carriage permits issued by the Government of India (GoI) and state/union territory transport departments after adequate safety and emission fitness tests. Rural and intercity bus activity is estimated to account for around 64% of total vehicle-km operated by buses, given the relatively long distances covered in this segment compared to others like school, corporate, and tourist buses (see Chapter 2 for more details). These buses are estimated to carry about 22.8 crore (Cr) (228 million) passengers on a daily basis, which is close to 10 times the daily ridership carried by the Indian railways, indicating the scale, coverage, and level of users' dependence on these services. At least 20 lakh (2 million) people are directly employed to operate rural and intercity buses as drivers, mechanics, and other support staff. Electrifying each intercity bus can reduce GHG emissions by ~1,000 tonnes of carbon dioxide equivalent (tCO2e), which is equivalent to the savings achieved from electrification of 2 urban buses, 80 personal cars, and 500 two-wheelers[5].

In summary, rural and intercity buses are crucial to meeting several policy objectives, including ensuring access to mobility for various users solely dependent on them, providing livelihood opportunities to millions of people employed in the sector, and reducing the bus sector's energy and emission intensity.

Electrification of private rural and intercity bus fleets will be key to meeting these policy objectives. E-buses offer significant operating cost savings for operators, given their higher energy efficiency compared to ICE buses and the relatively stable prices of electricity compared to diesel or CNG[7]. Despite the various benefits, e-bus uptake among private intercity and rural fleets has been limited. This is due to a combination of factors, including higher cost, lack of infrastructure, lack of understanding of the market needs, limited e-bus models for this segment, and limited financing to support the sector. However, the relative impact of each of these barriers and the key solutions to address them have not yet been established due to the limited availability of data on the existing intercity bus market and its operators.

[7]https://www.uitp.org/publications/financial-planning-for-the-electric-bus-transition/

1.3 Research Objectives and Scope

In this context, this study has the following objectives:

1. Conduct a comprehensive assessment of the intercity bus market in India based on secondary data and consultations with operators, original equipment manufacturers (OEMs), and financing entities.
2. Identify key barriers to e-bus adoption and recommendations to improve the policy, regulatory, and financing ecosystem to address these barriers.
3. Engage with key stakeholders to pilot proposed financing models for e-bus adoption.

This report provides the following inputs to facilitate accelerated e-bus uptake in the private operator-driven rural and intercity market:

1. A long-term outlook on the intercity bus market and the potential market for e-buses.
2. Market prioritisation for intercity e-bus deployment, i.e. identification of the organised market, key routes, their operational needs, and the current operators' characteristics.
3. Identification of the operational and financial characteristics of intercity bus operators through questionnaire-based surveys and qualitative assessments.
4. A summary of findings from interactions between potential investors and fund recipients like bus operators/asset leasing companies to facilitate debt/equity financing for e-buses.
5. Identification of the potential business models and their financing terms to minimise the total cost of ownership (TCO) of e-buses in intercity operations.
6. Recommendations on technological, policy, regulatory, and financing measures to accelerate e-bus uptake.

The rest of the report is organised as follows:

Chapter 2 presents an overview of the current bus market in India and its projections for 2030, including the share of e-buses;

Chapter 34 describes the operational characteristics of intercity buses in India, established through secondary data and questionnaire-based surveys with operators;

Chapter 4 summarises the barriers and recommendations for e-bus adoption and financing identified through consultations conducted with key stakeholders;

Chapter 5 covers the TCO analysis and business models for e-bus adoption; and

Chapter 6 summarises the key findings from the study and recommendations to advance the sector.

2. Market assessment for e-buses in India

This section presents the current baseline scenario of existing bus operations, followed by bus fleet projections for 2030 and the potential e-bus share.

2.1 The baseline: overview of the existing bus fleet and activity in India

India has about 23 lakh (2.3 million (m)) registered buses, estimated to carry about 39.9 Cr (399 m) passengers per day, indicating the extensive coverage provided by bus services across India and the heavy dependence Indians have on these services. Table 1 presents an overview of the registered bus fleet in India, its operational characteristics, and daily ridership, estimated based on available secondary data8 and consultations with key stakeholders in BOCI.

PTAs in India operate about 1.45 lakh (~6.3% of total) buses, while another 1 lakh (~4%) are estimated to be in various government and affiliated departments at the national and state levels. The remaining 90% of the market is controlled by private operators. Among private operators, vehicular activity is the highest in the rural and intercity bus market, where buses with stage carriage and contract carriage permits cover 64% of the total vehicle-km operated by buses. In this report, rural and intercity buses together are referred to as intercity buses for ease of readability.

The daily ridership of intercity bus services is about 22.8 Cr (228 million), which is about 57% of daily bus ridership and 10 times the daily ridership of the Indian railways. These numbers highlight the importance of the intercity bus market in India, which has often been neglected in policy making and infrastructure development discussions. It is imperative that the sector is taken up on a priority basis to initiate the necessary policy, financing, and infrastructure-related measures to improve this market's overall conditions and simultaneously make the transition within the sector to e-buses.

Table 1: Overview of bus fleet and utilisation in India (March, 2020)[8]

Type of bus	No. of buses (1000s)	Annual days of operation	Daily-km per bus (km)	Annual veh-km operated (in Cr-km)	Share of annual-km operated	Passen-gers /bus/day	Daily ridership (lakhs)
PTA* - urban	33	310	170	174	1%	750	210
PTA - non-urban	112	330	330	1,220	9%	450	456
Private - stage carriage	400	350	350	4,900	35%	450	1,726
Private - contract carriage	290	350	400	4,060	29%	200	556
School/education	280	200	100	560	4%	100	153
Omni	210	330	100	693	5%	100	190
Omni for private use	600	200	100	1,200	8%	100	329
Others	380	350	100	1,330	9%	100	364
Total buses	2,305			14,137	100%		3,985

(*1 lakh = 0.1 million, 1 Cr = 10 million)

[8] Estimated using the MoRTH road transport year book (2019-20) and consultations with BOCI

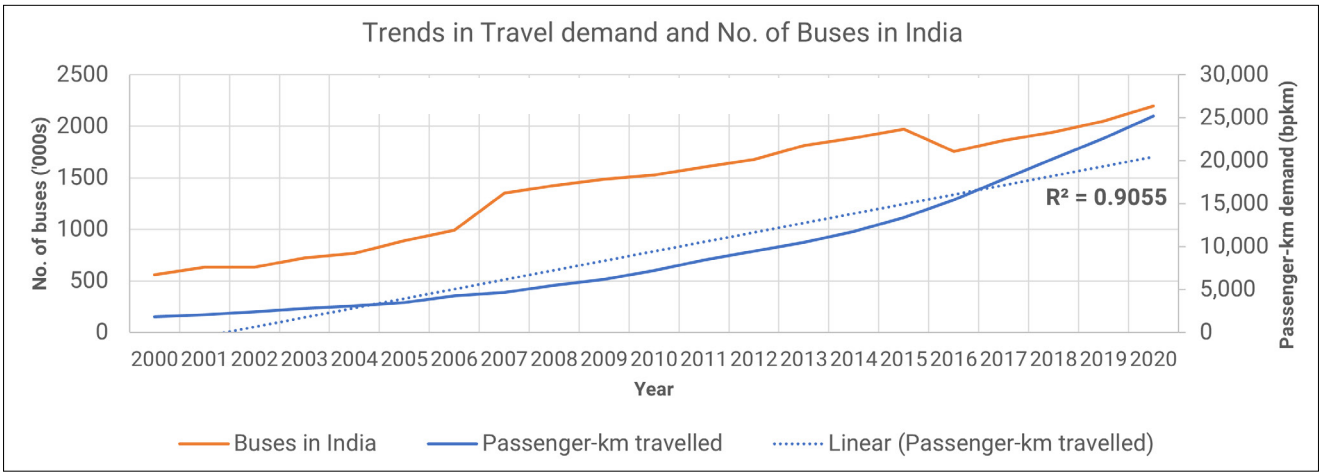
2.2 India's e-bus fleet market assessment for 2030

The market assessment for e-buses up to 2030 has been carried out in a three-step process:

1. Estimating the total number of buses likely to be operating in India by 2030
2. Estimating the number of buses to be procured between 2024 and 2030 to replace the aging bus fleet within the existing bus stock and the fleet likely to be augmented to meet future travel needs
3. Estimating the likely share of e-buses within the total bus fleet to be procured up to 2030.

The growth trajectory of buses in India is a function of the overall travel demand trends and the share of buses within this demand. Studies analysing future travel demand, energy consumption, and climate impact trends for India conducted by the International Energy Agency (IEA)[9] and the Climate Transparency Initiative (CTI)[10] established that India has witnessed steady growth in travel demand over the past two decades due to an increase in population and economic activity. It is estimated that the trends in travel demand will continue in the coming decade up to 2030, post which the growth rates are likely to decline as the economy matures and various emission mitigation measures to avoid travel come into effect. Given the horizon year of 2030 for the current study, the trends from the past two decades have been extrapolated to derive the travel demand and bus fleet size in 2030. The travel demand and vehicle registration in India experienced a decline between 2020 and 2022 due to subdued economic activity during the COVID-19 pandemic. Hence, the two decades leading up to 2020 were analysed to understand the past trends in demand and bus sector growth.

Figure 1: Growth trends in passenger travel demand and no. of buses in India



(Source: Road Transport Year Book, MoRTH (2019-20))

[9] https://iea.blob.core.windows.net/assets/06ad8de6-52c6-4be3-96fc-2bdc3510617d/TransitioningIndias-RoadTransportSector.pdf

[10] https://www.climate-transparency.org/wp-content/uploads/2020/11/India-CT-2020-WEB.pdf

Figure 1 presents the correlation between passenger travel demand and bus registration trends in India over a two-decade period up to 2020 (Road Transport Year Book (2019-20), MoRTH, Government of India)[11]. The two variables exhibit significant correlation (R2 = 0.91). Combining the IEA and CTI projections that the passenger-km demand growth will continue over the next decade with the correlation observed between bus registrations and passenger demand growth, the number of buses in India is projected to grow at the same rate between 2020 and 2030 as it did in the decade between 2010 and 2020. The decline in registrations between 2020 and 2022 is assumed to be compensated for by additional registrations likely to happen in subsequent years.

Table 2 presents the number of public and private buses registered in India between 2010 and 2020. The compounded annual growth rates (CAGR) of public and private buses during this decade were 3.2% and 3.7%, respectively. The 'Roadmap for India's energy transition in the transport sector (2024)' study by The Energy Resources Institute (TERI) also estimates a 3.7% CAGR for India's passenger transport demand up to 2030, correlating well with the trends in private bus registration growth rates over the past decade, while public buses have not kept pace with growing market demands. These trends are expected to continue in the near future, and, hence, the CAGR of 3.2% and 3.7% for public and private buses have been applied to estimate the number of buses in each category in 2030.

It is estimated that India will have 3.16 million buses by 2030, including 0.22 million public buses and 2.94 million private buses. Given the 2024 value of approx. 2.4 million buses registered in India (Source: Vaahan[12]), it is estimated that the bus fleet will be augmented by about 760,000 buses, while close to 40% of the currently operational fleet is likely to reach its end of life and will need to be replaced with new buses.

[11] https://morth.nic.in/sites/default/files/RTYB_Publication_2019_20 (1).pdf
[12] https://vahan.parivahan.gov.in/vahan4dashboard/

Table 2: Number of public and private buses registered in India from 2010 to 2020 and 2030 projections

Year (As on 31st March)	Public sector buses (1000s)	Private sector (1000s)	Total buses (1000s)
2010	119	1,408	**1,527**
2011	131	1,473	**1,604**
2012	132	1,545	**1,677**
2013	138	1,676	**1,814**
2014	140	1,747	**1,887**
2015	141	1,830	**1,971**
2016	143	1,614	**1,757**
2017	149	1,715	**1,864**
2018	152	1,791	**1,943**
2019	152	1,897	**2,049**
2020	163	2,033	**2,196**
CAGR	3.2%	3.7%	
2030	222	2,936	**3,159**

(Source: Road Transport Year Book (2019-20), MoRTH)

A total of 20 lakh (2 million) buses are likely to be procured in India between 2024 and 2030 to meet the combined demand from fleet augmentation and replacement of buses in the existing fleet reaching their end of life. This includes about 18 lakh (1.8 million) buses (90% of sales share) to be procured in the private bus market, while the remaining 2 lakh buses (10% of sales share) will be procured by PTAs and other government departments.

Applying GoI's target of 30% sales share of EVs by 2030 from the current share of about 4%[13] requires an annual increase of 5% sales share over the next 6 years up to 2030. These e-bus sales shares are applied to the projected demand, assuming that the 18 lakh (1.8 million) buses projected to be procured up to 2030 are equally distributed in tranches of 3 lakh (0.3 million) buses per year.

This would lead to an estimated sale of 3.15 lakh e-buses in the private bus market by 2030. Given the profitable nature of the intercity bus market and commitments by various investors to the market, it is estimated that 80% of e-buses in the private operator market would be in the intercity segment.

Accordingly, a market size of 2.52 lakh buses (0.252 million) is estimated for the private intercity e-bus market up to 2030.

Tables 3 and 4 summarise these estimates and present the key statistics.

[13] https://www.crisilratings.com/en/home/newsroom/press-releases/2023/12/penetration-of-electric-buses-set-to-double-next-fiscal.html

Estimating an average capital cost of Indian rupee (INR) 1.2 Cr (~USD 150,000) per bus (up to 2030), including the vehicle and charger, the sector needs about INR 3.02 lakh Cr (~USD 37.8 billion) in capital investment.

Table 3: Estimated bus sales in India up to 2030

Indicator	No. of buses (lakhs)
Current fleet (2024) (A)	**23.05**
Projected fleet (2030) (B)	**31.59**
Fleet replaced (C = 50% of current fleet (A))	**11.5**
Fleet to be augmented (D = B-A)	**8.5**
Total bus procurement up to 2030 (E = C+D)	**20**
Private bus procurement up to 2030 (F = 90% of E)	**18**
Annual bus procurement up to 2030 (G = F/6)	**3**

Table 4: Estimated private e-bus procurement up to 2030

Year	No. of private buses procured	Project-ed e-bus share	No. of e-buses procured by private operators	Intercity e-buses procured (80% of total)
2024-25	3,00,000	5%	15,000	12,000
2025-26	3,00,000	10%	30,000	24,000
2026-27	3,00,000	15%	45,000	36,000
2027-28	3,00,000	20%	60,000	48,000
2028-29	3,00,000	25%	75,000	60,000
2029-30	3,00,000	30%	90,000	72,000
Total/average	18,00,000	18%	3,15,000	2,52,000

2.3 Potential benefits of intercity e-buses

Deploying 2.52 lakh e-buses in intercity bus operations can provide mobility for an estimated 212 billion passenger-km of journeys. Assuming that e-buses have an INR 5 per km lower TCO than ICE buses and the TCO savings are transferred to the end user, this would lead to an estimated cost saving of INR 1.05 lakh Cr (USD 132 billion) for users over the 12-year life of these buses. Apart from cost savings to individual users, transition to e-buses will also reduce the diesel import requirement for India. Assuming the current import bill of approximately USD 0.4 per litre of diesel to continue, the 2.52 lakh e-buses would save India an additional USD 48 billion in the form of foreign exchange outgo over the 12 year life of these buses. Furthermore, the 1,000 tCO2e reduction in GHG emissions for each intercity bus5 implies that achieving this target would deliver a total reduction of 25.2 Cr tCO2e (252 million tCO2e) in GHG emissions over the life of these buses. **This indicates the substantial climate change mitigation benefits on offer through electrification of intercity buses. Moreover, these buses would save around 4,000 tonnes of fine particulate (PM2.5) emissions, thereby contributing significantly to improving ambient air quality across India.**

3. Operational and Financial Characteristics of intercity buses in India

Private bus services provided constitute the largest share of the intercity fleet and vehicle-km operated, as established in the previous chapter. However, there is little data available on their service characteristics, such as the key demand centres across India, route lengths, operating hours, types of services (seater, sleeper, AC, & non-AC), etc., as well as their operators' characteristics, such as fleet size, age, demand patterns, operating cost, sources of financing, etc. Furthermore, the operators' perception of e-bus adoption, along with the key challenges faced and the enablers needed to address them, have not yet been established.

To bridge the abovementioned gaps, we present a two-stage approach for detailed assessment of the operational characteristics of intercity e-buses across India:

1. **A national assessment of intercity** (contract carriage) bus operations that analyses intercity services originating from the 17 cities across India that have the highest demand. Service details available on online ticketing booking platforms such as redbus, abhibus, and individual operator websites have been extracted through a combination of web scraping and manual observations. These services predominantly feature contract carriage buses providing point to point intercity services rather than stage carriage buses that provide public transport like services predominantly picking up passengers during operations and not through prior bookings like the contract carriage buses. Additionally, the websites show each Origin-Destination (OD) pair as a separate trip even though a bus may cover several destinations within a single trip. Therefore, the analysis covers the OD pairs covered and not necessarily separate end to end bus-trips.
2. **Questionnaire-based surveys with operators** to identify the operational and financial characteristics of individual operators. Interviews have been conducted with 365 bus operators across 10 metropolitan cities in India through a combination of in-person and online surveys.

The findings from these assessments are detailed in the following sections.

Image courtesy : Rohit Dhende

3.1 National assessment of intercity bus service characteristics

A total of 32,653 intercity bus OD pairs (also referred to as bus services) originating from 17 cities have been extracted through various online ticket booking platforms. These cities were selected to cover the ten most populated metropolitan cities in India and state capitals which act as regional hubs. Intercity operations experience peak demand on the weekend, i.e. Friday to Sunday, as people may travel to visit family or for recreational purposes during this period, in contrast to urban operations, which have the highest demand from Monday to Friday, as work and education trips typically dominate demand. Therefore, the following Sundays were used to study intercity trips from the 17 cities selected for analysis: Delhi and Jaipur - December 31, 2023, Ahmedabad, Bengaluru, Bhopal, Chandigarh, Chennai, Hyderabad, Indore, Mumbai, Pune, and Surat - January 07, 2024, and Bhubaneshwar, Guwahati, Kolkata, Lucknow, and Patna - January 21, 2024.

It should be noted that these trips represent those available on online ticketing platforms for the dates analysed and therefore do not cover the exhaustive list of all services operating from these cities, as many services may not be available on these platforms and may accept bookings offline. Notwithstanding this drawback, interviews with operators with contract carriage permit buses covered in this data revealed that the majority of their bookings are made online, and, hence, the service characteristics observed here should be representative of the intercity services operating from these cities.

3.1.1. Key operating characteristics of intercity bus services.

Service details extracted for intercity buses from the 17 cities selected for analysis were used to identify the following key characteristics that could potentially affect e-bus deployment on these routes:

Top origins and destinations: Table 5 presents the number and percentage of trips originating from the 17 cities. Bengaluru has the largest number of such bus trips, followed by Chennai, Hyderabad, Mumbai, and Pune. Surprisingly, Delhi ranks 6th among all cities, despite being the second most populous metropolitan city after Mumbai. This is possibly due to the extensive rail connectivity from Delhi to various parts of India, along with the likelihood of trips originating at the border locations like Gurugram, Noida, Ghaziabad and Faridabad, which would not be counted in Delhi.

Interviews with financing entities revealed the lack of information on the relative demand between different intercity routes. Hence, the destinations of buses originating from the 17 cities have been identified and listed in Annexure 1—while a total of 487 destinations were identified, only the ones with at least 50 services have been included in Annexure 1. It is interesting to note that some of the cities outside these 17 cities are identified to have more services, despite having lower populations.

. **Table 5: Intercity bus trips – number & percentage (January 2024)**

S. no.	City	Bus trips (no.)	Bus trips (%)
1	Bengaluru	6,923	21%
2	Chennai	4,686	14%
3	Hyderabad	4,478	14%
4	Mumbai	4,068	12%
5	Pune	3,367	10%
6	Delhi	1,805	6%
7	Jaipur	1,759	5%
8	Ahmedabad	1,425	4%
9	Surat	1,056	3%
10	Indore	754	2%
11	Chandigarh	645	2%
12	Kolkata	436	1%
13	Bhopal	382	1%
14	Lucknow	350	1%
15	Patna	293	1%
16	Bhubaneswar	210	1%
17	Guwahati	16	0.05%
	Total	**32,653**	**100%**

Types of services: Table 6 presents the types of services and their share, average route length, and fare per km across bus trips originating from the 17 cities analysed. There is a clear preference for AC services, which account for 70% of all trips. This could possibly be due to the fact that premium services are typically booked on online booking platforms. The other key trend observed is the preference for sleeper services over semi-sleeper and seater services. 57% of the services are exclusively sleeper services, while 28% services have a mix of seater and sleeper seats. The remainder are semi-sleeper and seater services.

Route lengths: There is also a clear correlation between the route length and service preference. Sleeper/seater + sleeper services are the preferred choice in the case of routes with an average length above 400 km, semi sleeper services are preferred for routes of 300-400 km, and exclusively seater services typically operate on routes shorter than 300 km. The fares are higher for the most preferred services, with AC buses being 32-54% more expensive than non-AC services. In the case of seater buses, the average fare per km is lower for AC buses than non-AC ones, due to the different geographies they operate in and the customers' paying potential in those regions.

Table 7 presents the cumulative percentage of routes in each route length category for each service type. 53% of all intercity routes are shorter than 400 km while 34% are shorter than 300km, indicating that even the currently available intercity bus technologies would be able to cover them with a single opportunity charge. Another 31% routes in the 400-600 km category may become feasible for electrification in the near future as the batteries become smaller and lighter. The remaining 16% routes are likely to be the hardest to electrify as they would ned ubiquitous charging infrastructure along highways and adequate opportunity charging time. Among the service categories, route lengths are the shorted for seater services followed by semi sleeper and sleeper services. Predictably, the currently operating e-buses are in the seater service category with the shortest routes given the lower range required.

Table 6: Types of services, average route length, and fare per km across 17 cities (January 2024)

Type of service	% of trips	Average route length (km)	Fare per km (INR/km)	Average travel time (h:min)
AC sleeper	44%	432	5.8	8:54
Non-AC sleeper	13%	417	4.0	9:00
AC seater + sleeper	15%	440	4.7	5:43
Non-AC seater + sleeper	13%	408	3.6	8:53
AC semi sleeper	6%	355	4.1	7:04
Non-AC semi sleeper	1%	394	2.7	8:05
AC seater	5%	210	4.5	5:13
Non-AC seater	3%	282	4.9	7:47
AC seater (electric)	0.5%	215	1.7	4:21
Total/average	**100%**	**407**	**4.9**	**8:06**

Table 7: Cumulative percentage of routes by route length category and service type (January 2024)

Type of Service	Route length category (in km)							
	<=100	>100 & <=200	>200 & <=300	>300 & <=400	>400 & <=500	>500 & <=600	>600 & <=1000	>1000
AC seater	18%	61%	86%	92%	96%	97%	98%	100%
AC seater (electric)	0%	67%	90%	100%	100%	100%	100%	100%
AC seater + sleeper	2%	14%	30%	47%	62%	78%	91%	100%
AC semi sleeper	5%	12%	52%	66%	81%	89%	100%	100%
AC sleeper	2%	13%	31%	48%	63%	81%	97%	100%
Non-AC seater	9%	40%	56%	79%	91%	98%	100%	100%
Non-AC seater + sleeper	1%	10%	26%	52%	75%	88%	99%	100%
Non-AC semi sleeper	0%	1%	27%	54%	70%	91%	100%	100%
Non-AC sleeper	1%	10%	28%	50%	73%	89%	99%	100%
Total	**3%**	**16%**	**34%**	**53%**	**69%**	**84%**	**97%**	**100%**

Fare per km is broadly similar across sleeper, semi-sleeper, and seater categories within the AC and non-AC service categories. However, it is also dependent on the routes served, their demand patterns, and the paying capability of users. Hence, it may not be possible to directly compare this indicator across service categories. The values presented here are intended to provide a broad perspective to estimate the returns to investors for intercity e-buses.

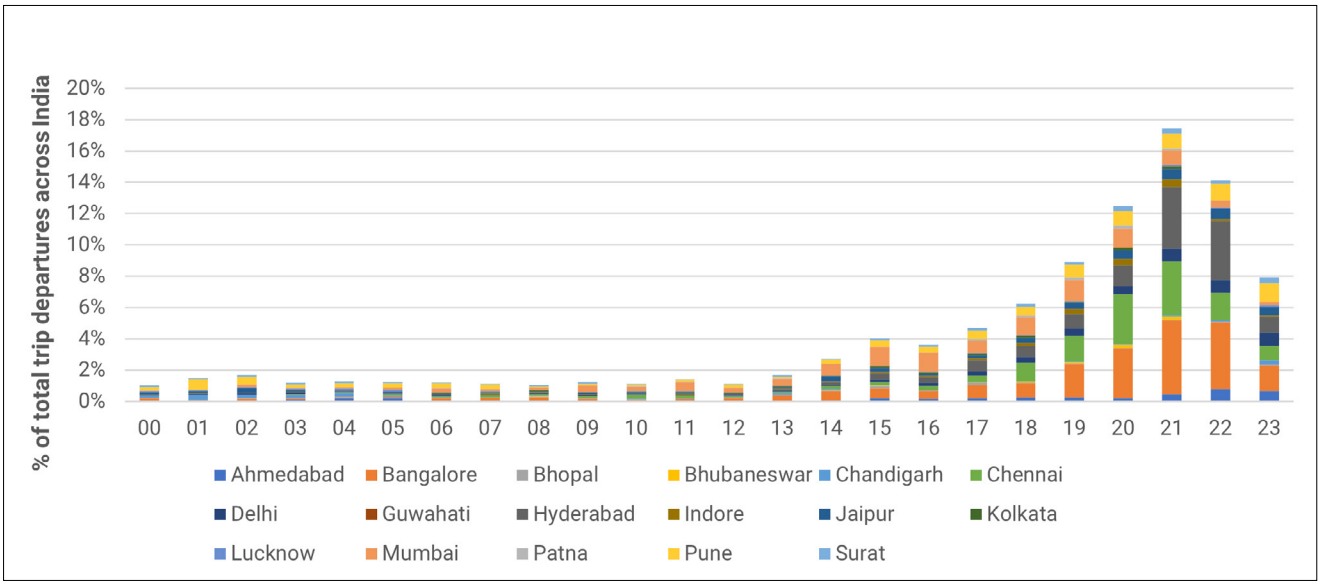
Electric buses form a 0.5% share of intercity services and almost exclusively operate as AC seater buses, with an average route length of 215 km, which is comparable to the average diesel bus AC seater route length of 210 km. The fare per km of electric AC seater buses is 60% lower than that of average AC seater buses, due to a combination of lower operating costs thanks to the use of electricity instead of diesel and the lack of MV tax and permit requirements for e-buses-as per the current incentives offered across states. The lower pricing can also be partially attributed to the pricing strategy adopted by e-bus operators to attract more customers to their newly launched services. However, pricing strategies in the intercity market evolve rapidly and the case explained here is likely to vary between regions and even for the same region in the future.

The route lengths also provide inputs for battery sizing and range requirements in case existing buses are replaced by e-buses in the future. The average route length of up to 432 km implies that the currently available intercity e-buses, with ranges of up to 300 km, would be able to serve the majority of routes if opportunity charging is planned appropriately.

Travel time: The average travel time across intercity buses is about 8 hours and 6 min. While AC seater and seater + sleeper services have travel times below 6 hours, most other services operate for 7 hours or longer on average. This is crucial to charging infrastructure planning in the e-bus transition, as e-buses typically need longer charging times at the terminals and intermittent opportunity charging points to top up the battery. The e-bus range and charger capacity need to be planned such that the overall travel time of the routes does not increase due to opportunity charging requirements.

Time of departure: In addition to route lengths and travel times, the time of departure also plays an important role in e-bus transition planning, as e-bus charging needs to be planned accordingly. Intercity service departures are limited during the day and gradually pick up after 2 PM. Figure 2 presents the percentage of buses departing in each hour of the day. The hours between 7 PM and midnight see the highest number of departures, with up to 61% trips departing during those 5 hours and 9-10 PM being the peak hour of departure, with 17% trips. This pattern differs from that of urban bus services, where there is greater demand in the morning, along with evening peaks, due to daily commute trips for work and education. Given the long distances, buses are only likely to make a one-way trip during the day, which once again can inform the type of battery range and charger needed for the service.

Figure 2: Hourly departures of intercity buses across India



The departure times and arrival times at the destinations have been analysed in further detail for different service types to provide inputs to OEMs and operators planning for e-buses on each service type. Figures 3 and 4 present the hourly departure and arrival patterns of different service types, with the thickness of the dot indicating the number of services and the concentric circles representing 10 minute-periods within the hour labelled at the edge of the concentric circles. The trends in these charts follow similar patterns to the India-level summary but provide more details on the arrival time patterns and service-wise trends. For example, AC sleeper and semi-sleeper services are observed to have more uniform distribution of departure and arrival times than other service types.

Image courtesy : Rohit Dhende

Figure 3: Hourly departure patterns for different service types

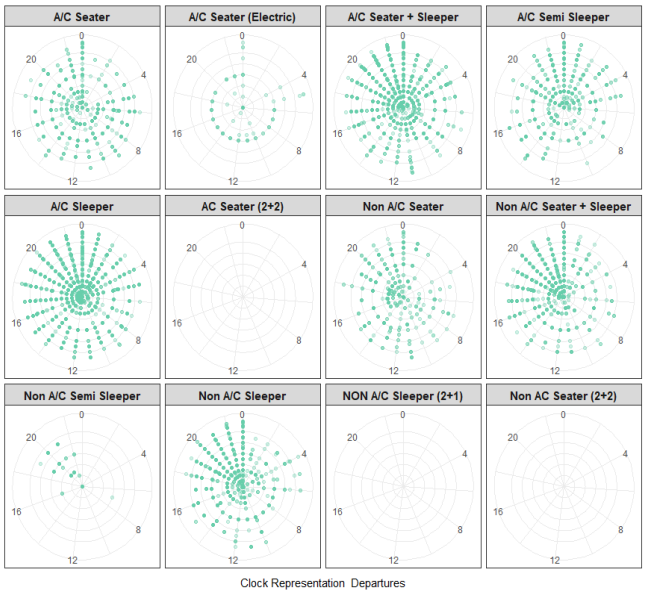
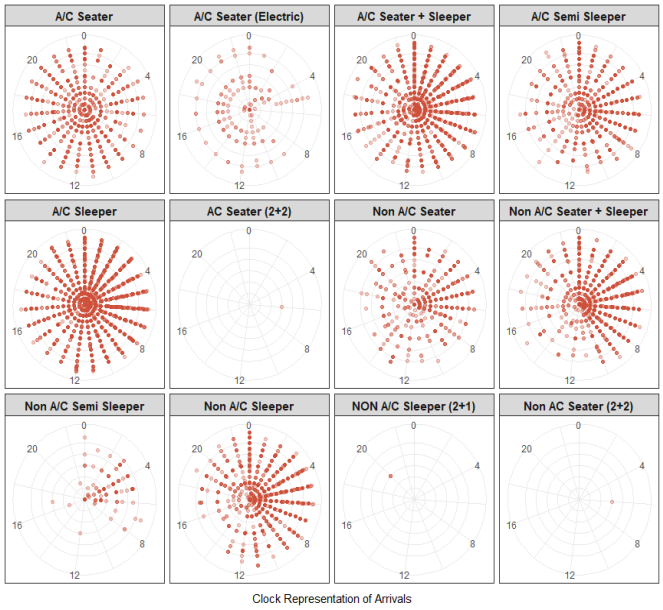


Figure 4: Hourly arrival patterns for different service types



Key demand centres: The origins and destinations of intercity buses operating from the 17 case cities have been mapped to provide a visual representation of the demand centres across India. Error! Reference source not found. presents the key demand centres for intercity travel in India. Furthermore, these routes are assigned to the national highway network of India to identify the top priority corridors for deployment of charging infrastructure to serve these buses. Open source geographic information systems (GIS) and travel demand modelling tools have been used for this exercise. Figure 6 presents the network flows across India's national highway network, which highlights the concentration of intercity bus operations along a few high demand corridors. These corridors can be prioritised for e-bus adoption and deployment of associated charging infrastructure.

Figure 5: Intercity bus travel patterns from 17 high-demand centres in India

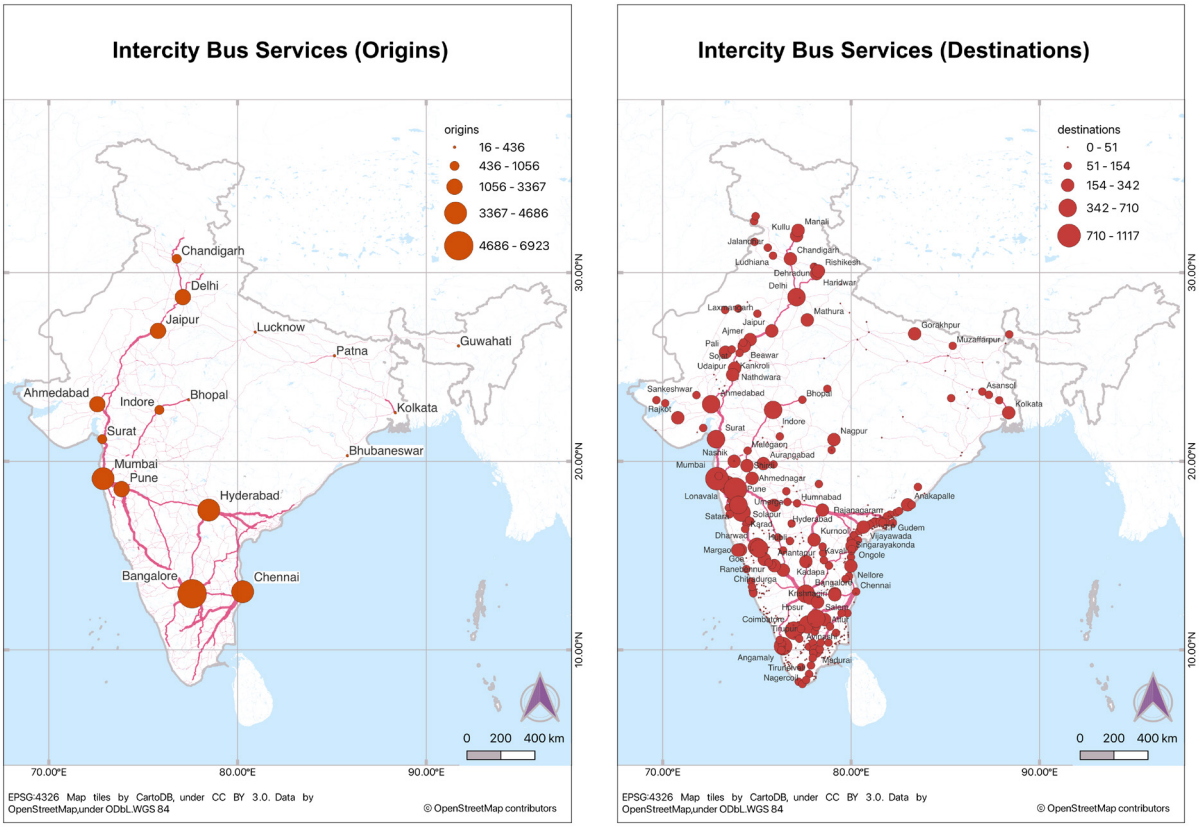
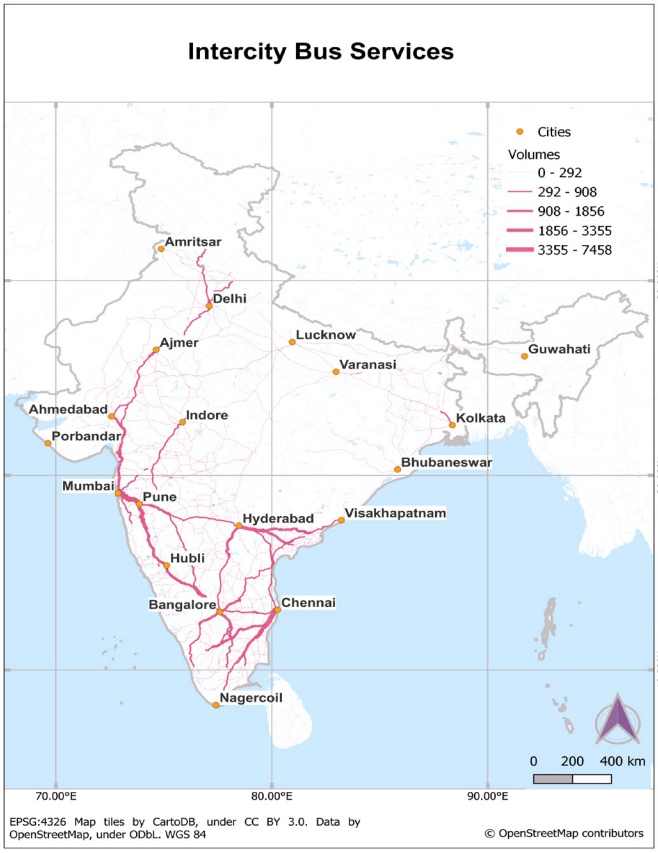


Figure 6: Corridors with maximum intercity bus services



3.2 Operator surveys

Questionnaire-based surveys have been conducted with 365 intercity bus operators from the 10 most populated Indian cities - Delhi, Mumbai, Kolkata, Bengaluru, Chennai, Hyderabad, Ahmedabad, Pune, Surat, and Indore - to get an understanding of their existing operations and preferences regarding e-buses. The operators for the survey have been shortlisted with the support of BOCI to identify the top operators in each city and through random sampling of operators during on-ground surveys. A total of 306 samples have been used for detailed analysis after discarding samples with incomplete data. The process of conducting questionnaire-based surveys with bus operators across cities has generated several interesting insights on intercity bus services and operators. The survey findings are presented in the following sections, divided into operational details, financial details, and outlook for the future. While the study had a target of 500 operator surveys, identifying operators willing to spend the time required to respond to a detailed questionnaire was challenging. However, the operators who responded to the survey provided valuable insights that provide a detailed understanding of the market.

3.2.1 Operational characteristics of private bus operators

Fleet ownership characteristics

- The 306 operators who responded to the majority of the survey own a combined fleet strength of 3,881 buses.
- This represents about 0.6% of the 6.9-lakh strong rural and intercity buses in India.
- The operators indicated plans to procure a total of around 5,267 buses over the next three years to meet the future travel demand. This includes the replacement of about 2,250 buses, i.e. 58% of the existing fleet, which will be due for replacement as the buses reach their end of life during this period.
- 99% of the fleet is owned by the operators, while about 0.7% is on lease from financing entities, and the remaining 0.3% is owned by the operators but operated under a bigger brand name.
- Table 8 summarises the fleet ownership patterns among operators. Small (<=5 buses, 78% of operators) and medium-sized operators (>5 buses and <=50 buses, 17%) make up around 95% of survey respondents. However, large operators (>50 buses) control the majority, i.e. 61%, of the fleet.
- Initial e-bus adoption is likely to be taken up by the larger fleet owners, who are typically more likely to have the required infrastructure and capital readiness. Since they currently own the majority of their fleet, these operators will have the flexibility to choose from several alternative routes according to their feasibility for e-bus operations.

Table 8: Fleet sizes of private operators

Fleet operated	No. of operators (%)	Total fleet (AC + non-AC) (%)
<=5	78%	10%
>5 and <= 50	17%	29%
>50	5%	61%
Total	**100%**	**100%**

The majority of the buses are owned by individuals (62%), followed by other company structures, as listed in Table 9.

Table 9: Bus ownership – legal entity

Legal entity	Number of operators (%)
Individual	62%
Partnership	14%
LLP	11%
Private ltd. co.	10%
Others	0%
Section 8 company	2%
Total	**100%**

3.2.2 Average fleet age and life

- The practice of using the fleet for a few years and selling it on the secondhand market for operation in lower demand areas is quite prevalent among private bus operators across India.
- Firsthand vehicles operate in trunk routes with higher passenger demand and vehicle utilisation, while secondhand vehicles are used in lower intensity applications like rural buses, school buses, etc.
- Among intercity operators, 69% of the fleet consists of firsthand vehicles, while the remaining 31% are secondhand vehicles.
- The average age of the fleet was reported to be 5.2 years, with the maximum going up to 15 years.
- The average life of a firsthand bus is reported to be 7.4 years, while the secondhand bus life is reported to be 8.2 years on average. Therefore, the overall life of a bus can be estimated as 15.6 years.

3.2.3 Service hours and parking locations

- Buses are operational for 12-14 hours per day on average across all operators.
- Operators have a mix of choices for parking and maintaining buses during non-operational hours.
- The types of locations available for parking for buses at either end of their route are summarised in Table 10.
- About 51% operators have access to a designated parking slot, while 48% park on roads, and the remaining 2% operators depend on makeshift arrangements.

Table 10: Parking locations of private bus operators

Type of parking location	Number of operators (%)
Private parking	50%
On-road	48%
Government bus stand/depot	1%
Others (own space/shared parking/schools/etc.)	1%
Total	**100%**

3.2.4 Travel demand characteristics

- 48% of intercity bus demand is sourced through online booking platforms such as RedBus, Abhibus, operators' individual websites, and other web-based platforms.
- About 34% of bookings are made offline through travel agents, while around 18% of the demand is sourced through on-the-spot bookings, i.e. tickets purchased from the driver/conductor.
- Travel demand varies significantly between peak seasons like summer holidays, festivals, & weekends and the rest of the year, considered as the off-peak period.
- Operators reported an average of 150 off-peak days per year, with less demand and 215 peak days. Table 11 below summarises the occupancy (% seats occupied) patterns during the peak and off-peak periods.
- The number of peak and off-peak days as well as the occupancy levels during these days is crucial to ensuring the bankability of financing for private bus operators. Off-peak demand and revenue patterns provide revenue visibility to financiers that are interested in providing debt/lease support for e-bus procurement for intercity services.
- The fact that 98% of intercity bus trips have occupancy above 80% for about 215 days of the year should provide adequate revenue visibility for operators in the intercity market.

Table 11: Occupancy of private buses in peak and off-peak periods

Occupancy ratio (%)	Peak season	Off-peak season
<=60	1%	32%
60-70	0%	49%
70-80	1%	16%
80-90	80%	3%
>90	18%	0%
Total	**100%**	**100%**

3.2.5 Financial characteristics of bus operations

Cost break-up

- Fuel cost (63%) constitutes the single largest cost head for private operators, followed by equated monthly instalments (EMI) (9.7%) to be paid against bus loans.
- Unlike public bus operations, where staff costs are the predominant cost head, private operators just spend 4% of their operational budget on staff, with another 9% being spent on bus maintenance. The low cost on staff can also be attributed to many cases of small operators driving the buses themselves and taking care of regular maintenance.
- Table 12 provides the full breakdown of costs reported by operators.
- In the case of ICE buses, 72% of the total cost is spent on diesel and bus maintenance, which highlights the high share of operational expenditure (OPEX) in ICE bus operations. Therefore, switching to e-buses reduces the most expensive component of bus operations due to lower energy cost of e-buses. However, the impact of OPEX savings need to be weighed against the additional cost of capital to ascertain the net returns for operators, assuming the same level of demand.
- ICE bus operations spend a relatively low fraction of the OPEX on the EMI on the bus loan - this share is likely to be up to 2 times higher for e-buses at the current price, and, hence, the relative cost benefit analysis needs to take into account these aspects.
- The remaining cost elements form a relatively small fraction of the total OPEX.

Table 12: Cost structure of private bus operations

Cost head	% of total cost of operations
Diesel cost	63%
EMI on loan	10%
Maintenance cost	9%
Staff cost	4%
Tolls	4%
MV tax	3%
Permit fees	3%
Administrative expenses	1%
Parking fees	2%
Other costs	2%
Total	**100%**

3.2.6 Vehicle financing

- The e-bus transition depends significantly on the financing models available for the technology. Therefore, the current financing patterns of diesel buses have been analysed in further detail to get a better understanding of the baseline situation.
- The average LTV ratio of buses is reported as 78%, with a minimum of 70% and a maximum of up to 100% of the vehicle cost being financed.
- The average loan tenure is about 4.2 years, with a minimum of 3 years and a maximum of 8 years.
- The vast majority, i.e. 86%, of buses are financed by banks, followed by NBFCs and other entities, as shown in Table 13.
- E-buses would require significantly higher LTV ratios because of the higher capital cost, making it difficult for the operators to raise the down payment amount separately. Even the loan tenure needs to be longer, as a higher value loan with the same tenure can lead to unaffordable EMIs for operators, thereby reducing their willingness to switch to e-buses.

Table 13: Sources of finance for private bus operators

Source of finance	% of operators
Banks	86%
NBFCs	6%
Private financiers	5%
Own funds	3%
Total	**100%**

- The collateral provided for new buses is the existing bus fleet in most cases. The same scenario is less likely to succeed for e-buses, given the significantly high cost per bus, which requires many existing buses to be provided as collateral. Table 14 gives more details on the different types of collateral.

Table 14: Collateral provided by operators to access finance

Type of collateral	% of operators
Existing bus fleet	67%
Personal assets to be mortgaged (properties, land, gold, etc.)	22%
Company balance sheet and assets (that can be mortgaged)	1%
Total	**100%**

- The prevalence of bus re-financing, where the operator extends loans due their inability to pay on time, has increased after the 2019 coronavirus disease (COVID-19) pandemic due to the hardships faced by operators. As many as 33% operators reported having to refinance their vehicle, although only 1% refinance regularly (Table 15).

Table 15: Frequency of bus refinancing

How often do you refinance buses?	% of operators
Never	67%
Occasionally	32%
Regularly	1%
Total	**100%**

- The refinance tenures vary from 2 to 4 years for the majority of operators, which, when combined with the typical original loan tenure of 5 years, consumes the majority of the bus life (Table 16). This further compels operators to keep servicing debts for the majority of the bus's operational life.

Table 16: Loan tenures in refinancing

Typical refinancing tenure	% of operators
6 months-1 year	5%
1-2 years	42%
2-4 years	53%
Total	**100%**

- Vehicle technology preference: 80% of operators ranked e-buses are their first-choice vehicle technology for the future, while 19% identified diesel as their first preference, and the remaining 1% preferred compressed natural gas (CNG) buses.
- The share of operators willing to own/lease e-buses dropped to just 43% once they were presented with the relative unit economics of these buses at the current prices.
- Significant reduction of the financing burden on operators and addressing operators' perceived risk of purchasing e-buses are needed to encourage private operators to make e-buses their preferred choice in the future.

3.2.7 Feedback on e-buses and outlook for the future

- **Vehicle technology preference:** 80% of operators ranked e-buses are their first-choice vehicle technology for the future, while 19% identified diesel as their first preference, and the remaining 1% preferred compressed natural gas (CNG) buses.
    - The share of operators willing to own/lease e-buses dropped to just 43% once they were presented with the relative unit economics of these buses at the current prices.
    - Significant reduction of the financing burden on operators and addressing operators' perceived risk of purchasing e-buses are needed to encourage private operators to make e-buses their preferred choice in the future.
- **Challenges with current bus operations:** Table 17 presents the key challenges identified with current bus operations, with a corresponding rating given for each challenge.
    - Fuel cost, which is the largest cost head, was predictably identified as the top challenge.
    - Lack of bus parking and maintenance facilities was identified as the second biggest challenge - this is a significant challenge for e-buses, given the structured charging facilities needed for their operations.
    - Access to financing was not identified as a key challenge for ICE buses, but the situation is likely to change for e-buses, given their higher capital requirements.
    - The majority of the remaining challenges, such as operating cost, taxes, and permit fees and availability, are likely to be partly addressed for e-buses, given the positive policy ecosystem.

Table 17: Ratings of key challenges currently faced by bus operators

Challenge	Average operator rating out of 10
Cost of fuel (diesel/CNG)	9.6
Lack of bus parking and maintenance facilities	8.5
Revenue recovery of operating cost	7.2
Hiring and managing staff	7.1
MV tax	6.6
Irregular payments	5.4
Permit cost	5.1
Vehicle model availability and quality	4.1
Access to finance	4.2
Permit availability	3.3

- **Key enablers for e-buses:** Operators identified the key enablers listed in Table 18 to accelerate e-bus uptake.
  - Improving technology to increase the driving range per single charge and reducing the cost of e-buses were the top-rated enablers mentioned by operators.
  - Increasing charging infrastructure availability and space for parking and charging were also highlighted.
  - Financial issues such as improving access to finance and reducing e-bus cost through lower taxes and permit fees were also identified.
  - Other recommendations include sharing knowledge on best practices for e-buses and increasing the number of e-bus models available on the market.

Table 18: Ratings of key enablers for e-bus transition

Enabler	Average operator rating out of 10
Improve e-bus driving range per charge	9.67
Increase availability of charging infrastructure	9.62
Reduce e-bus cost	9.57
Provide parking and charging space	9.31
Reduce taxes and permit fees	8.79
Share knowledge on e-buses	8.13
Improve access to finance	8.11
Increase number of vehicle models	7.70

- **Business model for e-buses:** Table 19 presents operators' preferred business models for e-bus adoption
  - Operating a bus on a revenue sharing basis, i.e., where the operator does not invest in the capital but just focuses on operations and gets paid a fixed revenue per month, is ranked as the most preferred e-bus business model.
  - While this is a low-risk option for the operator, it is also a deviation from the current practice of fleets being predominantly owned by the operators themselves.
  - Leasing buses from government and private entities are the second and third preferences, respectively.
  - The preference for owning and operating buses has the least interest, given the higher financial burden for the operators in this model.
  - Despite operator interest, operators are rarely hired on a fixed income basis. Although Flixbus has initiated this practice on a small scale, achieving it on a large scale across India may not be feasible in the near future.

Table 19: Preferred business models for e-bus transition

Business model	% of responses
Operate buses on a fixed income basis (without revenue risk)	70%
Lease/rent buses from government	17%
Lease/rent buses from private entities	7%
Own and operate	6%

3.3 Observations on intercity services and operators

This section presents the team's learnings from the surveys and data collection in the 17 selected cities.

3.3.1 Overview of Delhi's private intercity bus market

- Delhi serves is a major hub for intercity bus operations, with a substantial fleet of 2290 private buses. The city's strategic location and extensive connectivity make it a focal point for tourists, particularly from large northern cities and tourist hubs. The intercity bus routes from Delhi span tourism-centric states such as Rajasthan, Punjab, Himachal Pradesh, and Uttarakhand, contributing to the city's pivotal role as a gateway to these popular destinations. Furthermore, a significant bus network connects Delhi to various parts of Uttar Pradesh, with a particular emphasis on cargo transport.
- While Delhi has a structured network of intercity buses, there are also operators running buses on a casual contract basis where buses are typically hired for intercity bus services cater to the dynamic transport demands in the region. Majority of the intercity buses departing from Delhi are concentrated at Mori Gate and Kashmiri Gate. These key departure points also serve as parking spaces, optimising operational efficiency and facilitating the seamless flow of intercity bus services.

3.3.2 Overview of Mumbai's intercity bus market

- Mumbai serves as a pivotal hub for intercity bus operations, with a total of 1390 private buses. As the commercial centre of India, Mumbai attracts a large number of individuals from various regions seeking employment and business opportunities. In particular, there are a lot of migrants from Konkan and West Maharashtra, contributing to the high demand for buses connecting Mumbai to these areas.
- Intercity bus services originating from Mumbai extend beyond regional boundaries, to states such as Gujarat, Karnataka, Goa, Telangana, and Madhya Pradesh. This extensive network caters to a diverse range of travel needs, reflecting Mumbai's role as a central node in the regional transport ecosystem.
- Despite alternative modes of transport such as trains and cabs linking Mumbai and Pune, the frequency of buses, with departures every 15 minutes, underscores the sustained demand for this mode of travel. Moreover, Mumbai's status as an international gateway generates passenger demand for intercity buses to and from the airport.
- The large number of pick-up points in Mumbai is a notable feature, with strategic locations in Thane and Navi Mumbai contributing to the increased accessibility of intercity buses, and, thus, passenger convenience. A significant majority (~80%) of the intercity buses depart from Borivali in Mumbai, making it a strategic location in the intercity bus network.
- However, Mumbai imposes restrictions on large vehicles during specific hours, prohibiting their entry from 8 AM to 8 PM. Moreover, buses are mandated to park outside the city limits, contributing to logistical challenges. Furthermore, the municipal regulations in Mumbai restrict heavy commercial vehicles beyond 8 years from entering the city, reflecting an emphasis on vehicular sustainability.

3.3.3 Overview of Hyderabad's private intercity bus market

- Hyderabad is another major centre for intercity bus operations, with a total of 2144 private buses. Known for its service industry, Hyderabad exhibits a unique pattern with a prevalence of night buses, aligning with the city's operational characteristics. The high demand for sleeper buses can be attributed to the city's service industry dynamics. Between 8:30 AM and 9:30 PM, the restriction on entry of large buses, imposed by the traffic police to reduce congestion n the city, necessitates the use of minibuses for pickups. Subsequently, operators gather at designated locations such as the ring road to transfer passengers from minibuses to intercity buses.
- A distinctive feature of Hyderabad's intercity bus landscape is the concentration of service centres in areas like Miyapur and Kukatpally. This has prompted many bus operators to establish their parking facilities and garages in these strategic locations, enhancing operational efficiency and facilitating smoother pick-up and drop-off operations.

3.3.4 Overview of Pune's private intercity bus market

- The intercity bus landscape in Pune is quite diverse, with a total of 1450 private buses connecting Pune to various parts of the country. A majority of these buses are operated by external entities, predominantly hailing from the Vidarbha, Khandesh, and Marathwada regions, with relatively limited representation of local Pune-based operators.
- Pune's significance as an educational and information technology (IT) hub attracts a diverse population of students and professionals, particularly from Vidarbha and Marathwada. The good connectivity offered by Pune to states such as Gujarat, Madhya Pradesh, Karnataka, Telangana, and Goa further contributes to the substantial influx of travelers into the city.
- Bhosari, Sangamwadi, and Nigdi are focal points for bus operations, hosting bus parking arrangements and garages. Approximately 70% of intercity buses depart from Bhosari, making it a key departure hub.
- The strategic geographical location of Pune results in intercity buses originating from Mumbai traversing Pune en route to Satara, Kolhapur, and Solapur. Consequently, there is a high number of buses operating between Mumbai and Pune. There is also a high frequency of daily connections between Pune and Nagpur, as well as Pune and Latur, with these routes accounting for 15-20% of all intercity buses.
- In terms of bus configurations, an overwhelming majority of drivers' buses (98%) in Pune belong to the sleeper and sleeper + seater categories. The ratio of AC to non-AC buses is 60:40, reflecting a diverse range of travel preferences among passengers.

3.3.5 Overview of Ahmedabad's private intercity bus market

- Ahmedabad, as the largest city in Gujarat, serves as a major hub for intercity bus operations, with a total of 1192 private buses. It is a central point for buses arriving from numerous small villages in the surrounding areas. Furthermore, there is a significant presence of AC buses. A distinctive feature of intercity buses in Ahmedabad is the presence of several operators with 36 sleeper berths (13.5 m long buses)-compared to the predominance of 30 sleeper berth (12m long buses) in many other cities, indicating the demand for such services. Operators in Ahmedabad have significant focus on parcel transport given the non-fare revenue potential of these services.
- Municipal regulations in Ahmedabad impose restrictions on private buses entering the city between 8 AM and 8 PM. Consequently, many bus operators have established pickup points along ring routes, and larger operators' buses are permitted, while smaller operators face restrictions enforced by the police. To navigate these restrictions, minibuses often undertake pickup operations within the city. Smaller operators park their buses in private lots located outside the city limits.
- Ahmedabad's strategic location in Gujarat makes it a hub for interstate connectivity. Services extend to destinations such as Rajasthan, Haryana, Delhi, Madhya Pradesh, Maharashtra, Karnataka, and Goa. Notably, Ahmedabad is not only a destination but also a transit point for numerous buses traveling between states. Examples include routes like Mumbai-Indore, Surat-Jaisalmer, Surat-Jodhpur, and Vapi-Mount Abu, further reinforcing Ahmedabad's central positioning in the broader intercity bus network.

3.3.6 Overview of Surat's private intercity bus market

- Surat, a major commercial centre, attracts buses not only from various small villages in Gujarat, but also neighbouring states, making it a pivotal node in the regional transport network.
- The significance of Surat as a major commercial and industrial hub, particularly renowned for its textile industry, plays a crucial role in shaping the dynamics of intercity bus operations. The city serves as a conduit for goods transport, a substantial portion of which is done through buses, with storage provided by the bus operators. Intercity buses thus play an integral role in supporting the logistics and supply chain networks associated with Surat's textile industry.
- Unlike the other cities visited during this study, majority of buses departing from Surat are non-AC buses indicating the cost sensitive clientele of the city. Furthermore, these buses are characterised by a minimum of 36 berths, achieved through chassis extensions, catering to the specific needs of passengers.
- A significant proportion of buses depart from the Parsi Panchayat parking lot, strategically located near the textile industry facilities. This centralised departure point enhances the efficiency of bus operations, streamlining the boarding and departure processes for both passengers and operators.

3.3.7 Overview of Indore's private intercity bus market

- Indore is another significant player in intercity bus operations, with a total of 1600 private buses. The city's cultural significance, coupled with its proximity to major religious destinations like Mahakaleshwar and Omkareshwar, attracts a substantial number of tourists.
- The intercity routes from Indore connect it with states surrounding Madhya Pradesh. A significant portion of these buses extend their journeys to Bhopal, contributing to the connectivity between major cities in the state. Major intercity routes from Indore go to big cities such as Mumbai, Pune, and Ahmedabad. On the intercity routes covering Indore, AC sleeper buses are in high demand, indicating passenger preferences for comfort during their travels.
- A distinctive feature of intercity bus operations in Madhya Pradesh is the absence of state transport. Instead, private bus operators hold stage carriage permits granted by the government. These permits delineate specific routes and timings, with buses departing from designated bus stations like Sarawate. However, adherence to strict timelines is crucial, as these buses are only allowed a brief half-hour stop at such stations. To operate under the stage carriage framework, each bus operator is mandated to deposit advance taxes to the government. The tax amount is determined by route indicators and the total seating capacity of the bus.
- Bus stands designated for stage carriage permits exclusively accommodate operators holding such permits; contract carriages plying intercity routes cannot use these bus stands. The distinctive regulatory framework, characterised by stage carriage permits and tax deposits, adds a layer of technical intricacy to the operational landscape.

3.4 Summary of findings from the national market assessment and city-wise operator surveys

- **The national market assessment established the most high demand routes and corridors for intercity buses in India, which can be used for prioritising e-bus deployment on the most profitable routes and developing public charging infrastructure to facilitate e-bus adoption. The top operators in each city and their service timings have been identified – this can aid stakeholders in defining the types of buses required in a given location, along with their range and charging needs.**
- **The operator surveys provided further details at the operator level, establishing the different types of operators and their fleets serving the routes identified in the market assessment. A detailed breakdown of the cost and revenue patterns and financing characteristics of existing bus operators can serve as relevant inputs to financing entities, as well as development banks and government entities facilitating an accelerated transition of intercity services to e-buses.**

4. Stakeholder Feedback on key barriers to e-bus adoption

Key stakeholders driving e-bus adoption in India such as financial institutions, OEMs, private bus operators and their associations, and other relevant stakeholders have been consulted through one-on-one meetings to identify the key barriers to e-bus adoption in the intercity market and their proposed solutions to address these barriers. The market consultations covered one on one interactions with about forty key stakeholders across financing institutions, state- and national-level associations/ aggregators representing private bus operators, and OEMs providing e-buses along with interactions at key discussion forums on the topic. Financing institutions included a mix of debt providers like banks, non-banking finance companies (NBFCs), and alternative investment funds (AIFs), equity providers like venture capitalists (VCs), and development finance institutions (DFIs). Annexure 3 provides a list of some of the stakeholders consulted. A summary of the insights generated from these consultations is given in this section, after consolidating the inputs from individuals into a category-wise summary.

Table 20 summarises the key barriers to intercity bus electrification highlighted according to the types of stakeholders raising these issues. The issues mentioned by more than one stakeholder group have been placed under the 'Cross-cutting barriers' heading. Each of these barriers is elaborated upon in the subsequent sections.

Table 20: Summary of e-bus barriers identified through stakeholder consultations

Operators	Financing institutions	OEMs	Cross-cutting barriers
Lack of infrastructure (depot and charging) and technology readiness (range and cabin space)	Lack of understanding of operations and fragmented nature of market	Lack of long-term data on demand and lack of consolidated procurement	Trust deficit between stakeholders
Change in the nature of business from low-CAPEX, high-OPEX to high-CAPEX, low-OPEX	Poor creditworthiness of operators post COVID-19	Difficulty with long-term commitment to contracts	Lack of data on existing operations
Unfavourable unit economics (financial viability per bus and uncertainty of returns compared to ICE buses)	Bankability of individual projects/ deals unclear	Leasing model economics unfavourable	Product quality and safety unclear
OEMs outpricing the buses compared to specs offered	Lack of financial de-risking products	Variability in battery pricing	Policy issues concerning permits, infrastructure, and financing
Lack of access to finance	Lack of transparency on and access to ticketing revenue	Supply chain challenges of EVs due to import dependence	Lack of clarity on timeline for GST benefits
Need for new business models for e-buses: leasing and revenue sharing	Lack of price benchmarks compared to ICE buses and limited resale value of e-buses		
Loss of jobs for people employed for diesel bus maintenance	OEMs unwilling to underwrite product performance		
Limited resale value of buses and rigidity in route deployment due to charging constraints	Operators unwilling to pay for e-bus risk premium		

4.1 Operators' barriers for e-bus adoption and potential solutions

Operators invest in e-buses and operate and maintain them throughout the lifecycle, and their confidence in the associated technology and business models is central to the market transition. Their feedback has been captured in detail as a part of the questionnaire-based surveys and is explained later in the report. This section presents the feedback given during one-on-one interactions with representatives of bus operators in the Bus & Car Operators Confederation of India (BOCI) and state-level bus associations in Maharashtra, Karnataka, and Tamil Nadu.

> *"The intercity bus segment plays a major role in passenger transport in India and can benefit from significant operating cost savings by transitioning to electric buses. Improved access to financing (leasing, de-risking, aggregation, etc.) and availability of dependable and preferably green charging technologies will determine the pace of this transformation."*
>
> ***- Mr. Gerald Ollivier, Electric mobility policy and financing specialist***

The following is the feedback received from operators, including some of the key barriers to e-bus deployment and potential solutions:

i. **Bus cost, unit economics, and financial viability in the current business model:** A typical BS IV Tata Motors AC ICE bus operator purchases a bus with a down payment of about INR 10 lakhs, with the remaining 90% of the bus cost secured as a loan. They operate the bus for around 5 years for a net revenue (excluding all costs) of about INR 5 lakh per bus and sell it on the secondhand market for about INR 30 lakhs. The revenue from secondhand sales is seen as the net profit from the bus, while the annual net revenue is treated as income. Overall, the ICE bus provides an internal rate of return (IRR) of over 20 percent. While the prices have increased for BS VI buses due to the additional features added for passenger comfort, operators were used to these economics until recently.

   In the case of e-buses, these numbers are fundamentally different. The upfront investment would be much higher, giver the higher vehicle cost and lower share of loan provided. The secondhand market is uncertain due to a lack of knowledge on vehicle and battery performance. However, the bus lifetime would be much longer for e-buses, and the net revenue would be higher, thanks to the lower operating cost. The lifecycle impact of this change in cost structure is still unclear to many operators. Operators also need to create a new business model around e-bus ownership & operations to benefit from the longer life and lower operating cost, which is yet to be established. E-buses need to provide a higher net IRR than that of ICE buses to attract operator interest.

ii. **Vehicle specifications and product quality:** The e-bus models currently on the market are deemed to be of a lower quality overall in terms of aspects that affect passenger experience such as cabin space, suspension, etc. Therefore, operators are having to invest more in e-buses but experience lower passenger satisfaction levels.

"BOCI and its members are actively working towards advancing e-bus adoption in the private operator market across India. Along with the traditional operator-wise purchase and ownership model, aggregated bus procurement through leasing is being explored across use cases such as contract carriage, stage carriage, and school bus applications.

High capital expenditure, inadequate charging infrastructure, and limited access to finance are key barriers to e-bus adoption for private operators. Financial incentives from the government to address these barriers will accelerate e-bus adoption in the coming years."

- Mr. Prasanna Patwardhan, President, BOCI (e-bus operator)

iii. **Trade-off between battery capacity and cabin space:** The large battery sizes needed for long-distance buses are reducing the cabin space and/or luggage space available in e-buses compared to in ICE buses, which is typically a key source of revenue for private operators beyond the ticketing revenue. This reduces the revenue generated from passengers and goods transported in these buses. Improving bus design to address these concerns is vital to improving operator acceptance of e-buses.

"Government policies promoting sustainable transport, including subsidies and incentives for electric buses, are reshaping the landscape for intercity bus operators. Transitioning to e-buses not only aligns with environmental goals but also offers long-term cost savings and operational efficiencies, making it a sensible choice for the future of public transit in our country.

Chartered Bus, being India's largest bus operator, has committed to switching completely to e-buses in its short to medium distance intercity bus segment in 2024-25."

- Mr. Sanyam Gandhi, Director, Chartered Speed (e-bus operator)

iv. **Readiness of infrastructure and technology:** The majority of intercity buses cover more than 400 km in a day. The availability of e-bus models that meet these daily operational needs is limited, and, in many cases, these models do not yet match the service quality offered by equivalent ICE buses. Furthermore, these buses need charging infrastructure that is currently unavailable, i.e. public charging stations. Many operators also lack dedicated space for parking and currently use makeshift arrangements for parking and maintenance during the day. Operators currently deploying e-buses are arranging for their own captive charging infrastructure and are unwilling to share it with other operators, because they do not want to lose their competitive advantage. Lack of enroute high-capacity opportunity charging facilities for long-distance buses is another associated barrier. Even here, some operators have been installing captive charging stations, which may not be feasible at scale without public charging stations.

v. **Access to finance:** Operators depend on banks, NBFCs, or local financiers to mobilise the capital needed to purchase buses. The cost of finance increases progressively from banks to NBFCs and local financiers, while the risk appetite reduces in the same order. Therefore, operators prefer financing from banks, but their financial situation, particularly after the difficulties faced due to reduced revenues during the 2019 coronavirus disease (COVID-19) pandemic, is not allowing them to access finance from banks, or even NBFCs in many cases. Therefore, operators are either trying to extend the life of existing buses or opting for buses with lower capital costs like ICE buses where necessary.

> *"India's bus market is largely in the hands of private operators. Data on existing operations is an important starting point to help build business models that can enable these operators to replace diesel fueled buses with electric buses. Now that we have proven that India can replace diesel buses at scale for public bus operations, our attention must turn to those that are privately operated."*
>
> *- Ms. Mahua Acharya, International Energy Transition Platform (INTENT)*

vi. **High bus costs imply reduced revenue for e-buses on outright purchase:** Even if the operators overcome financing challenges to purchasing e-buses, given the higher capital investment, they would own fewer buses than if they purchased ICE buses. Therefore, the net revenue from their fleet, even after accounting for reduced energy costs, would be lower if they transitioned to e-buses. Hence, the current model of bus ownership may not result in large-scale e-bus adoption at current costs. At the same time, several operators stated that OEMs are pricing the e-buses higher than their real cost to be eligible for subsidies available when these buses are sold to public bus agencies, as the subsidies are linked to the bus cost. A combination of reduction of bus costs and alternative business models like vehicle leasing needs to be promoted to address this barrier.

vii. **Unfavourable terms of leasing and revenue sharing models:** New business models to address the abovementioned barriers, such as financing entities investing in the buses and leasing them to operators, are being explored. However, the lease rate on offer is relatively high, because the entire product and operational risk is being transferred to the lessor. Similarly, aggregator-driven models where large investors own the buses and collect revenue, while operators manage day-to-day operations for a share of the revenue, are being explored. However, the current terms offered in both these models include restrictions on the minimum and maximum km operated in a day, route changes etc. which limit flexibility of operators. Operators perceive that such terms would result in lower net returns compared to ICE buses, and, hence, prefer to continue with their current model of owning and operating buses even for e-buses and thereby controlling the full revenue.

viii. **Risk to livelihoods in the e-bus ownership model:** As owning and operating e-buses in the current model would mean reducing the fleet size due to higher capital costs, operator associations also expressed concern regarding the loss of livelihoods for drivers, cleaners, and mechanics dependent on these buses.

In summary, the operators' current outlook towards e-buses is not very favourable due to technological, infrastructure-related, and financial uncertainties regarding the shift from ICE buses. Reducing bus costs and developing new business models to address the capital cost barriers are crucial to addressing their concerns.

4.2 OEM outlook on private intercity buses

OEMs have played a key role in advancing e-bus adoption in public bus agencies by leading the bids for gross cost contracts (GCC) and thereby mobilising the necessary finance, as well as showing the commitment to stay with the project throughout the life of the bus. E-bus adoption in private bus operations would also require significant investment and long-term commitment from the OEMs to the sector, which has thus far been limited given that the limited e-bus manufacturing capacity has been dedicated to serve the public bus market with assured revenues. The following barriers to e-bus uptake in the intercity market were highlighted by OEMs:

i. **Lack of a long-term demand roadmap for e-bus adoption in the private bus market:** OEMs were attracted to the e-bus market through public bus agencies when GoI initiated the FAME II scheme in 2019, with a demand target of 7,000 e-buses, and followed it up in 2022 with an even more ambitious target of 50,000 e-buses under NEBP. These GCC-based operations also offer fixed contracted revenue, which makes them attractive to financiers and investors. However, a clear roadmap for e-bus adoption in the private bus market has thus far been missing, and it is left to the operator's discretion to switch to e-buses. This makes the demand uncertain and lacking in long-term visibility for the OEMs to invest in the market. A predictable demand in the market will encourage OEMs take the market more seriously.

> *"Electric buses are already cost competitive on a lifecycle basis. However, the upfront price, which is currently around INR 1.2-1.45 Cr to the manufacturer, is the key bottleneck for operators.*
>
> *Achieving a price point of INR 80 lakhs will be the inflection point to cause a large-scale disruption in the intercity market as operators would then voluntarily adopt e-buses.*
>
> *Cost of batteries and traction motors along with the localization of their manufacturing will be key to achieve this price point and achieve mass transition in the market."*
>
> *- Mr. Sumit Mittal, CEO, JSW e-mobility (OEM)*

ii. **Operators' expectation of long-term commitment from OEMs:** The GCC model by public bus agencies set the precedent for OEM to be involved in the contract for the entire life of the bus. As a result, the market now expects the same level of involvement from OEMs. However, OEMs would not want lifelong involvement in the operation of buses. Instead, they are more interested in selling the buses and providing annual maintenance contracts (AMCs) that take care of any major maintenance requirements. This is resulting in a deadlock, as the outright purchase model is not palatable to operators, given their limited ability to raise the necessary capital.

iii. **Leasing model with external support:** The leasing model where the operator only pays the monthly lease, while the bus is owned by the financing institution (or the lessor), is more likely to unlock the e-bus market than the traditional outright purchase by operator model as it reduces the upfront capital investment needed by the operators. However, financing institutions are unwilling to take the revenue risk with private operators and would like OEMs to back the lease for payment guarantees from the operators. This would once again result in a GCC-like OEM involvement for the entire bus life and even the OEMs would not want to take up the revenue risk associated with the operator. Therefore, external support, preferably from the government, to secure lease payments and enable operators to cover the initial investment is necessary to attract financing entities and facilitate the scale-up of leasing model-based e-bus adoption.

iv. **Fiscal incentives for private e-buses:** Fiscal incentives for e-buses have thus far focused on public bus agencies. A well-designed fiscal incentive programme centred on unlocking the best business models and market investments in private buses can provide significant impetus to the industry. An initial pilot with up to 500 buses, followed by a larger programme, could help achieve this.

4.3 Feedback from financing institutions

i. **Limited understanding of private bus operations and business:** An extension of the fragmented nature of the private bus market is the lack of information on its nature of operations and business trends. Unlike public bus agencies, there is a complete lack of consolidated market knowledge even on basic aspects such as routes operated, operating hours, mix of services offered (AC vs. non-AC buses, seater vs. sleeper buses, etc.), fare structures, occupancy patterns, daily and seasonal demand variations, etc. Even though online ticket booking platforms record demand and supply patterns, they only provide instantaneous information to users and not historical reports on operations. The lack of such information results in financing entities being unable to ascertain the probability of loan payback and therefore apportioning higher risk to operations, leading to increased cost of finance. Government support could help decrease this cost via financial de-risking platforms and priority sector lending for e-buses and related infrastructure, among other measures.

"Intercity private bus market is a very price sensitive market and is considered higher risk for financing than long distance trucking due to the revenue risk. The following are a few barriers and their solutions we're pursuing to advance e-buses in this market:

- *High upfront cost being mitigated by rightsizing the bus, battery and charger configuration to route-specific operating needs. Seasonal variability in revenues being mitigated through project financing structures including six month debt service reserve accounts to account for off-season repayments and cash flow sweep structures to use peak season surpluses to pre-pay lean season EMIs.*
- *Battery life and changeover risk being resolved through warranties for 3,000 cycles (over 5,00,000 km) and building funds for replacement batteries by deducting payments per km during the initial operation period or asking operators to set money aside in an escrow for battery replacement.*
- *Loan guarantee/ de-risking constructs support by Development Finance Institutions (DFI) would also help cover for the risk of unforeseen portfolio losses in the market."*

- Mr. Jayant Prasad, Executive Director, cKers Finance

ii. **Lack of transparency on and access to ticketing revenue:** Unlike in public bus contracts, private bus operations do not have fixed and transparent revenues, and the current revenue patterns of various routes, services, and operators are not publicly available. Therefore, the financier must estimate the likely revenue and associated risk. A significant share of operators' revenue comes from offline bookings in cash that is not deposited into any bank account. Moreover, even though revenue collected through online bookings is deposited into the operators' bank account, the financing entity typically does not get access to this revenue. Overall, the financing entities lack access to both the online and offline revenue of private operators. Allowing financing entities the first right to revenue collected from bus operations would significantly increase their confidence in recovering payments from the operators and therefore attract better financing terms. This has already been implemented in the form of exclusive escrow accounts for operators in the case of public bus agencies but has not yet been mainstreamed in the private bus market.

iii. **Creditworthiness of operators and risk associated with financing:** The majority of private bus operators have financing challenges even for ICE buses due to their weak balance sheets, which are inadequate to de-risk individual loans and mitigate revenue risks associated with income variability due to seasonal travel demand variations. In many cases, operators do not have credit history or Credit Information Bureau (India) Limited CIBIL scores, which are typically used to evaluate loan applications. These problems get exacerbated in the case of e-buses due to higher capital requirements.

> *"Electric buses will be game changer for reducing emissions from transportation in India and providing green public transport. This transition requires extensive research on the sector to understand the zone of profitability for inter-city bus operators. Lessons learnt from promoting green public transport in India can be replicated across emerging markets. Setting the regulatory and user framework for the growth of electric buses in India will be key."*
>
> ***- Ms. Anita George, Sustainability Investor***

iv. **Product risks associated with e-buses and their resale value:** The e-bus technology is evolving rapidly, with OEMs offering different types of battery chemistries, battery capacities, charger types, and even bus body designs. Financing entities currently have no standardised way to ascertain the quality of a particular product and consequently have to hire their own specialists to evaluate this. Lack of battery performance data leads to uncertainty about secondary routes, unlike in the case of ICE buses, where established benchmarks exist. In addition to impacting new e-bus buyers, battery performance is key to the secondhand sales market, as the buyer needs to evaluate if the bus needs a new battery—battery purchase requires significant additional investment. If the government releases data on the e-bus safety and energy efficiency performance in the form of a standards and labelling programme, as has been done for many electrical appliances, financing entities will find it simpler to assess product quality. Similarly, OEMs need to provide long-term warranties and product buyback guarantees to increase financier confidence in e-buses.

"Attracting debt capital will be key for the rapid electrification of the intercity bus market. Accurate assessment of risks in the intercity market where the revenue track record of various routes and operators is not available is a challenge. Building the secondhand market through e-buses by ascertaining the end of life value through measures like longer-term warranties on batteries, building in reserve pool of finances for battery replacement will are crucial enablers for the market."

- Mr. Mudit Jain, Head-Research, Tata Cleantech Capital Limited

v. **Financing terms:** Financiers typically look for a debt service coverage ratio (DSCR), i.e. cash flow to be maintained to service the debt, of 1.2 for bus financing. A DSCR of 1.2 is uncertain in the e-bus sector, due to the higher vehicle cost and lack of operating data on additional cost savings over fuel. Therefore, to maintain the DSCR, financiers would typically look for a higher equity contribution, i.e. lower loan-to-value (LTV) ratio. The higher equity contribution required distorts the expected IRR in this sector.

vi. **Fragmented market:** The intercity market is served by a wide range of organised and unorganised operators. Even though no comprehensive and representative market research has been carried out so far, anecdotal evidence suggests that there are about 28,000 operators in charge of the 4 lakh buses operating in the intercity market. Among these, about 70,000 buses[14] are believed to be operated by organised operators, while the rest are operated by small-scale operators with less than five buses per owner. Such fragmented ownership structures make it difficult to design and implement financial products for such a diverse set of individuals/entities.

vii. **Leasing models and tenures for financial feasibility:** Given the challenges with raising capital for outright purchase-based e-bus procurement, a few NBFCs have been exploring vehicle leasing. A leasing model allows financing entities to own the asset and lease it to operators on a monthly payment basis. Operators are typically required to pay an upfront security deposit to access the lease programme. The ownership of the asset at the end of the lease period varies based on the leasing model adopted. A 'financial lease' allows the operator to own the asset at the end of the lease period by paying an amount equivalent to the residual value of the asset, whereas an 'operating lease' allows the financing entity to continue owning the asset at the end of the lease period.

    Initial interactions indicated that both operators and financing entities prefer the 'financial lease' model, given its similarity to outright purchase on debt. A financial lease allows operators to continue the current model of owning the asset at the end of the lease tenure, while the financing entities do not have to assume the risk of finding a new operator for a used asset. However, the financing entity also needs to take on the risk of the residual value of the asset in a leasing model, which is not currently the case. Therefore, the financing entities are likely incorporate the risk factor into the lease cost unless they are incentivised externally through OEMs or the government.

[14] https://pgalabs.in/PGALabsImages/ReportPdf/intercity-travel-mobility-market-in-india-pgalabs.pdf

Operators have not yet shown significant interest in the terms currently being offered for financial leases, including the security deposit to be paid by the operator, lease term, and payment at the end of the lease period to own the asset. For example, the lease terms of one financing entity include a security deposit of INR 25 lakhs, a lease period of 6 years, with a monthly payment of INR 2 lakhs, and an end-of-lease ownership cost of another INR 25 lakhs. In contrast, the operator is currently only paying INR 10 lakh upfront for a Non-AC ICE bus and gets ownership of the asset in 4-5 years. While the operator may still earn more revenue due to lower e-bus operating costs, they are unable to raise the capital needed for the security deposit and end-of-lease payment to retain ownership. Therefore, drawing operators away from a currently well-paying business model requires significant additional efforts to address risks and further refine the e-bus business model.

How can leasing of e-buses help the market? What can be done to make it a mainstream business model for e-buses in India? How can the Government help? *- Thoughts from Mr. Amit Kumar, CEO, EV leasing, Gensol Engineering Ltd.*

"Leasing offers a long-term solution to the high capital requirements of e-buses. Leasing companies can create an attractive proposition for operators to adopt e-buses subject to the following conditions:

- *Mitigation of credit risk by way of some security on payments / Credit Guarantee from the Government specific for e-buses*
- *Leasing companies can offer long term leases which will reduce the monthly outflow for the operator what the leasing company's require is a support from OEM in terms of comprehensive warranty on the product and some assurance on the buy back value in case of default situation.*
- *To further help the Operator Leasing Company can also factor in the cost of replacement of battery in the lease calculation and offer a 7 to 8 year lease contract which will enable to Operator to sweat the asset for a longer period of time without incurring any additional capital expense during the lease term.*
- *While there is a subsidy available at the inception of lease is some mechanism is created to subsidise the cost of replacement battery it will further add to the confidence of the leasing company to use the asset for its 2nd usage case after 1st lease is completed by taking better residual value risk on the asset.*

Government support in the form of financial de-risking platforms and inclusion of e-buses and high-capacity charging infrastructure under priority sector lending will open up cheaper funding lines. Government partnership with Charge Point Operators (CPOs) to provide charging infrastructure at strategic locations is also crucial."

4.4 Barriers highlighted across stakeholder groups

The following are common issues faced by operators, OEMs, and financing entities.

i. **Trust deficit between stakeholders:** The consultations revealed a general trust deficit in the market among operators, OEMs, and financing entities, because the market is fragmented and lacks transparent reporting of operations, demand characteristics, and finances. For example, financing entities do not trust operators' creditworthiness in the absence of traditional metrics, operators do not trust the e-bus models being launched, and so on. The first step towards addressing the trust gap could be for the government to encourage periodic reporting of private bus operations, like the annual PTA performance reporting.

ii. **Consolidation of the private bus market and its financing:** The current practice of small fleet operators managing the majority of the market will continue to pose problems for e-bus uptake due to its capital-intensive nature, as well as the need to organise proper parking and charging infrastructure. These operators would also require external support to maintain the e-buses better through advanced battery management systems (BMS), etc. At the same time, banks, NBFCs, and private equity investors interested in the e-bus market are looking to large-scale operators with strong financial credibility to lead the e-bus transition. Therefore, some consolidation of the operator market may be necessary for efficient operations, as well as to attract financing.

iii. **Policy issues:** The following key policy barriers were identified for private bus electrification:

   a. **Policies for private buses:** National e-bus policies and incentives like FAME, NEBP, PM-eBus Sewa, and PSM focus on public bus agencies, with little to no attention paid to enabling the ecosystem for private e-bus electrification.

   b. **Access to infrastructure:** At the state level, most states treat private bus operators as competitors to the public bus agencies and thus disallow stage carriage permits and do not provide any infrastructure for their parking, maintenance, and passenger terminals. Sharing of bus depot and terminal infrastructure between public and private operators, along with high-capacity public fast charging, is important for e-bus electrification.

   c. **'Infrastructure' financing status for e-buses:** Including buses, and more specifically, e-buses, as 'infrastructure' has been a long-standing demand of both public and private bus operators. This classification results in favourable financing terms such as longer tenures and lower interest rates. It is an opportune time to classify e-buses and associated charging and upstream power infrastructure as 'infrastructure' to encourage financing of the sector.

   d. **Priority sector status for e-mobility** has been advocated for over the years to improve financing availability. However, it has also been met with opposition, as this could also benefit private cars and two-wheelers, which cause externalities like congestion. To address this, a priority sector status specific to e-buses could be considered.

iv. **Regulatory issues:** Regulatory discussions concerning ICE bus services have been largely dominated by the binary choice of 'stage carriage' vs. 'contract carriage' permits for intrastate movement, 'interstate permits', and 'All India Tourist permits' for movement beyond state boundaries. E-buses have broken these barriers, thanks to the GoI mandate to exempt e-buses from permit requirements. As a result, e-bus operators need to register their vehicles but do not need to obtain any permits, thereby resulting in significant deregulation of the sector. Despite this development, the following issues remain:

   a. **Lack of long-term clarity on permits:** Many operators are unclear about whether the current rules exempting e-buses from permits and motor vehicle (MV) taxes will remain in effect in the future. While the current rules are favourable, there is a possibility that e-bus taxes will be introduced in a few years' time when they reach scale. The unit economics of buses may vary significantly accordingly. Furthermore, regulations involved in such permitting are also unclear. Currently, ICE buses receive a permit for five years, after which the permit can be extended by paying the necessary fees. Simultaneously, the buses need to obtain a fitness certificate once every 2 years until they cross 7 years of age and annually after that. It is possible that e-buses could have similar requirements once permits are introduced.

   b. **Lack of long-term clarity on goods and services tax (GST) for e-bus purchase and leasing:** EV purchase and leasing currently attracts 5% GST, while ICE bus purchase and leasing attracts 18-43% GST, depending on the type of vehicle and lease model. However, there is a lack of clarity on how long these soft-GST rates will be offered. This is crucial, particularly for the leasing model, because changing GST values midway through the lease term can significantly alter the feasibility of the business. A time-bound plan to extend GST benefits would provide significant comfort to the industry.

   c. **Regulations to encourage corporatisation of the sector:** ICE bus permits are issued to individuals with valid heavy duty vehicle licences, which has led to fragmentation of the market. As mentioned earlier, market corporatisation is crucial to encourage capital flow and improve operations and fleet maintenance. The necessary regulatory framework to allow and encourage such industrial structures needs to be adopted.

5. Enabling Financing : Total cost of ownership analysis for e-buses

Electric buses have higher capital costs compared to ICE buses but benefit from lower and more stable operating costs due to the affordability and price stability of electricity. However, this is fundamentally different to the current business model of lower capital cost and higher operating cost of diesel buses. Therefore, the current approach of operators comparing current (diesel) and new (electric) buses based on upfront cost alone is incomplete, as it does not allow them to effectively evaluate the operational cost savings from e-buses.

To address this gap, total cost of ownership (TCO) models have been designed to evaluate the lifecycle cost of ownership and operation of an e-bus and compare it to that of traditional ICE-based diesel or CNG fuelled buses. TCO analysis enables holistic assessment of the cost of owning and operating different types of buses.

Here, we present the comparative TCO of diesel and electric buses for two different cases: 1) a privately operated intercity contract carriage permit bus and 2) a private stage carriage permit bus. A spreadsheet-based TCO model prepared for the current context has been used to derive the comparative TCO of diesel and electric buses. The input values for the TCO model, such as the operational and financial characteristics, are based on prevailing market conditions established through the operator surveys conducted over the course of this project.

Apart from the cost, private operators are also concerned about the technological readiness of e-buses to replace ICE buses, due to uncertainties regarding their long-term performance and lifecycle management of the buses, batteries, and charges, unavailability of public charging infrastructure, and limited staff capabilities for the new technology.

5.1 Business models for TCO analysis.

Alternative business models to address the technological and financial barriers to e-bus adoption were previously studied as part of the Electric Mobility Market Assessment (EMMA)[15] and 'Bankability improvement of e-buses in India'[16] studies supported by the World Bank Group. These studies have identified aggregated ownership of e-bus fleets by creditworthy entities and leasing to private operators, who make periodic (e.g. monthly) payments for the asset, as a promising business model that could address the technological risks of e-buses listed above. Table 21 presents a high-level overview of the activity distribution in a leasing model of procurement vs. the traditional model where operators own and operate their buses. The TCO analysis presents the comparative analysis of the various financial terms and costs of the own-and-operate and leasing models.

[15] https://openknowledge.worldbank.org/handle/10986/37898
[16] World Bank Document

Table 21: Distribution of activities across ownership and leasing models

Type of activity involved	Selected business model	
	Ownership	Leasing
Bus owned by	Operator	Lessor
Battery & charging infrastructure owned by	Operator	Lessor
Major bus & charger maintenance (including battery replacement + mid-life refurbishment+ major component replacement) by	Operator	Lessor
Bus operated by	Operator	Operator
Minor bus & charger maintenance (including cleaning, charging, and upkeep) by	Operator	Operator
Driver employed by	Operator	Operator
Conductor employed by	Operator	Operator
Revenue risk taken by	Operator	Operator

Application of the leasing model for e-buses is still nascent in India, and the ecosystem for this model, including leasing companies, their financing entities, and the contractual agreements between various entities and the operators, is yet to be established. **Two types of leasing models** are currently available on the Indian market: operating leases, where the operator makes a periodic payment (typically monthly) for the lease tenure and hands over the asset at the end of the tenure, and financial leases, where the operator makes a periodic payment (typically monthly) as well but owns the asset at the end of the lease tenure. Operating leases require determining the value of the asset at the end of lease tenure, which varies widely based on the risk perception during the valuation of the bus and battery. **The analysis presented here uses the financial lease model, due to the preference of Indian bus operators to own the assets and sell them on the secondhand market, where feasible.**

5.2 TCO modelling: input variables and assumptions

The model estimates the capital costs based on the price of the bus, battery, and charging infrastructure, as well as the salvage value of these assets. The operational costs include fuel/energy costs and maintenance costs. Financing costs are also added in terms of interest payment and the cost of equity. All other cost items, including staff, taxes, tolls, and administrative expenses, are clubbed into a single category called 'overhead costs', with the underlying assumption that they would remain the same for both diesel and electric buses. Even though policy incentives like MV tax and permit cost exemption currently exist for e-buses in some states, this study aims to understand the relative economics of the two bus models assuming no government incentives are available. The methodology is applied to study the TCO for a typical intercity contract carriage bus based on its operating characteristics, derived from operator surveys.

The details of the input parameters and key assumptions are provided below in Tables 22 and 23. The key outputs generated by the model include TCO for the selected bus, charging technologies, and route type, year on year costs over the bus service life, and year on year cash flow for different actors, as defined by the business model.

5.2.1 TCO for the base case, sensitivity analysis, and conservative scenario for AC & non-AC buses

The input assumptions for the reference TCO model are based on market consultations with intercity operators at various stages of e-bus planning, procurement, and operations. The inputs received varied widely based on the stage of operations, with operators at the planning stage typically reporting significantly higher bus and financing costs, while operators with deployment experience reported lower costs. Similarly, larger operators with more than 100 e-buses reported lower capital and financing costs, due to a combination of economies of scale and operator creditworthiness, while smaller operators with less than 25 e-buses reported higher costs.

The higher costs being reported by some operators may be due to cost inflations caused by limited manufacturing capacity in India and high price benchmarks set by some OEMs to qualify for government subsidies, which are determined in proportion to the bus cost. However, concerns regarding the high cost of financing have been expressed by several operators, and these costs have been modelled in the sensitivity analysis. To cover the entire spectrum of operations, the TCO analysis is presented in three parts:

i. A base case scenario based on input values corresponding to mature operators with a procurement scale of 100 buses, as initial e-bus adoption in India is likely to be driven by either larger operators or aggregators procuring e-buses at scale and leasing them to smaller operators.

ii. A sensitivity analysis on key input attributes.

iii. A conservative scenario representing the TCO of smaller and newer operators, assuming shorter bus life and higher bus and financing costs.

Each of these scenarios is analysed for the case of an AC bus operating on a contract carriage permit and a non-AC bus operating on a stage carriage permit, the specific assumptions of which are provided in Tables 22 and 23.

Table 22: Key assumptions for TCO analysis-base case scenario

Input variable	Diesel BSVI, 12 m (AC, non-AC)	E-bus (365 kWh, AC)	E-bus (365 kWh, non-AC)	E-bus (395 kWh, AC)	E-bus (395 kWh, non-AC)
Bus length	12 m	12 m	12 m	12 m	12 m
Bus life (in years)	12	12	12	12	12
Battery life (years for replacement)	NA	3	3	3	3
Battery capacity (kWh)	NA	365	365	395	395
Charger type & capacity	NA	Fast (240 kW)	Fast (240 kW)	Fast (240 kW)	Fast (240 kW)
AC or non-AC	AC, non-AC	AC	Non-AC	AC	Non-AC
Annual operating days	350	350	350	350	350
Daily km per bus (contract carriage)	500	500	500	500	500
Daily km per bus (stage carriage)	400	400	400	400	400
Upfront cost of bus (+ battery) (including GST) (INR)	AC: 1.3 Cr Non-AC: 0.7 Cr	1.6 Cr	1.5 Cr	1.9 Cr	1.8 Cr
Applicable subsidy on CAPEX	0	0	0	0	0
Upfront cost of charger (INR)	NA	18,00,000	18,00,000	18,00,000	18,00,000
Unit cost of battery (INR/kWh)	NA	10,000	10,000	10,000	10,000
Annual decrease in battery cost	NA	5%	5%	5%	5%
Insurance cost (% of CAPEX)	1%	0.5%	0.5%	0.5%	0.5%
Energy cost (diesel price (INR/L) or electricity price (INR/kWh))	90	7.5	7.5	7.5	7.5
Electricity price annual growth rate (%/yr)	5%	5%	5%	5%	5%
Energy efficiency ((km/L) or (kWh/km))	3.5 (AC), 5 (Non-AC)	0.9	0.7	0.9	0.7
End of life salvage value of bus (% of original cost)	0%	0%	0%	0%	0%
AMC rate (without battery replacement) (INR/km)	AC:4.5, Non-AC: 4.0	7.5	7.0	7.5	7.0
Charging infrastructure maintenance cost (INR/DLE)	NA	1.5	1.5	1.5	1.5
Other costs per km (staff, tax, and admin)	10.0	10.0	10.0	10.0	10.0

Table 22: Key assumptions for TCO analysis-base case scenario

Input variable	Diesel BSVI, 12 m (AC, non-AC)	E-bus (365 kWh, AC)	E-bus (365 kWh, non-AC)	E-bus (395 kWh, AC)	E-bus (395 kWh, non-AC)
Annual change in other operating costs/year (%)	5%	5%	5%	5%	5%
Charging infra life (years)	NA	20	20	20	20
Cost of depot infrastructure per bus (civil and upstream electrical infrastructure)	NA	INR 20 lakhs per bus	INR 20 lakhs per bus	INR 20 lakhs per bus	INR 20 lakhs per bus
Revenue per km (INR/km)	AC: 45, Non-AC: 40	60	40	45	40
Growth rate of revenue per km (%)	3%	3%	3%	3%	3%

Table 23: Business model-specific TCO assumptions for base case scenario

Variable for TCO estimation	Bus purchased by private operator	Bus purchased by aggregator and leased by operator
Bus cost (relative proportion of a leased bus from an aggregator compared to bus purchased by a private operator)	100%	95%
Charger cost (relative proportion)	100%	95%
Cost of equity	20%	20%
Debt share for CAPEX on e-bus (excl. battery)	75%	90%
Debt share for CAPEX on battery	75%	90%
Debt share for CAPEX on charging infra	75%	90%
Debt share for CAPEX on diesel bus	75%	NA
Loan interest rate for diesel bus	12%	NA
Loan interest rate for e-bus, battery, & charging infra	12%	11%
Loan tenure for diesel bus (yr)	4	NA
Loan tenure for e-bus and battery (yr)	6	6
Loan tenure for charging infra (yr)	6	6

5.3 TCO analysis: Base case scenario results

A summary of the results from the TCO analysis for AC and Non-AC buses is presented in Figures 7, 8, 9 and 10 and explained in the following sections. These are TCO values (costs) anticipated over the 12-year life of the bus, taking into account the annual inflation in various cost items. Therefore, these values should be used to compare different technology and business model alternatives and not be seen as the likely actual cost per km for an operator selecting one of these models.

5.3.1 TCO of contract carriage buses (AC buses, 500 km/bus/day, baseline revenue of INR 60/km):

- The TCO of a typical Tata/Ashok-Leyland AC diesel bus is compared to the typical AC e-buses being used by intercity operators in India. Figure 7 presents the TCO in INR per km and Figure 8 presents the percentage contribution of various cost components for AC buses.
- The AC e-bus TCO is estimated to be 12%-15% lower than that of AC diesel buses over their 12-year life. In case the ICE bus considered is a Volvo bus, this differential would be higher, given the higher capital and operational costs of these buses compared to Tata/Ashok Leyland buses.
- The TCO per km is projected to be INR 56.4 per km for diesel buses and ranges from INR 47.3 to 49.9 per km for e-buses based on the battery capacity (365/395 kWh) and business model adopted (own/lease).
- These results are driven by the relatively lower lifecycle fuel/energy cost for e-buses (INR 18 per km) compared to diesel buses (INR 39 per km), as reported by Tata/Ashok Leyland bus operators.
- The e-bus TCO is 0.7% lower in the case of the leasing model compared to the ownership model, primarily because of the lower interest rates obtained by leasing companies compared to cost of commercial finance for private operators.
- The TCO of e-buses with 365 kWh batteries is ~5% lower than those with 395 kWh batteries, indicating the significant impact of additional battery capacity and the need for operators to ensure batteries are correctly sized for their purpose.
- The comparison of revenue per km also indicates that e-buses will be more profitable for operators across business model and battery size choices, given the reduction in TCO thanks to lower OPEX.

In summary, AC bus operators are likely to accrue substantial financial benefits from a technology shift from diesel to electric buses. The leasing model is likely to be marginally cheaper for the operator, given the leasing entities' ability to obtain a lower cost of finance compared to private operators. However, the appropriate choice of battery size according to operating requirements is likely to deliver more savings than the choice of leasing model or various financing terms.

Figure 7: 12-year TCO (INR/km) of 12 m AC diesel & electric buses (contract carriage: 500 km/day)

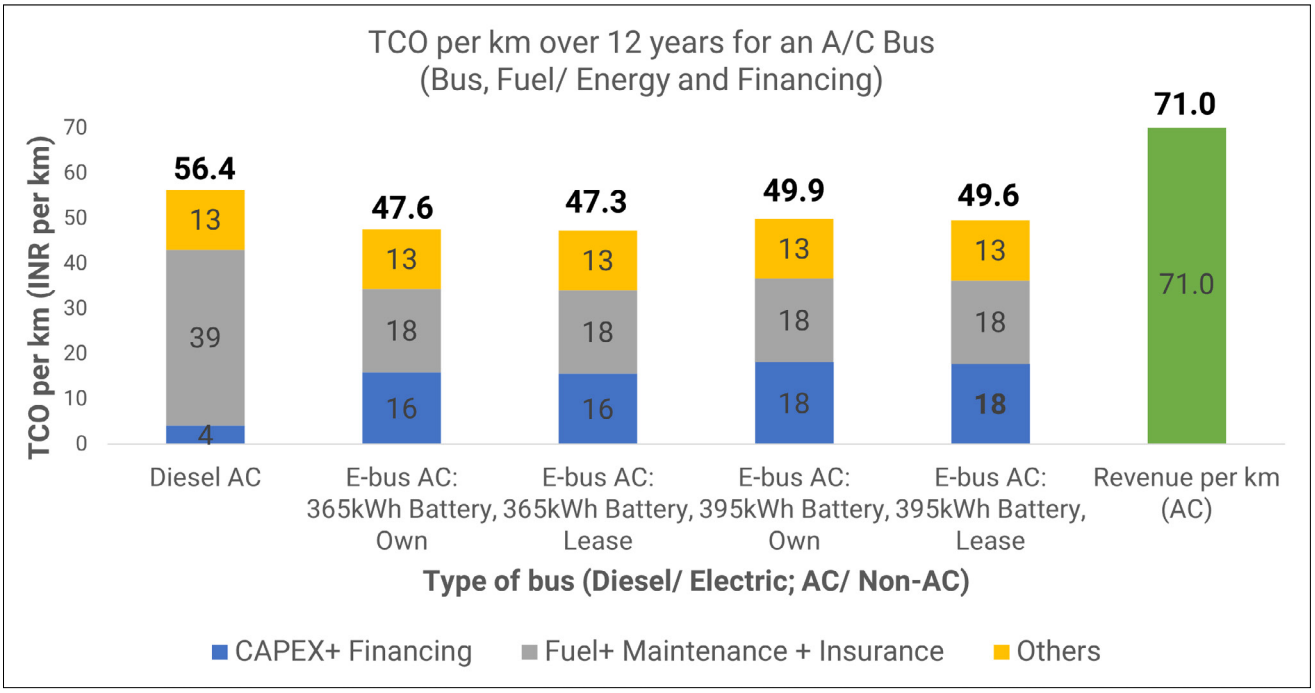
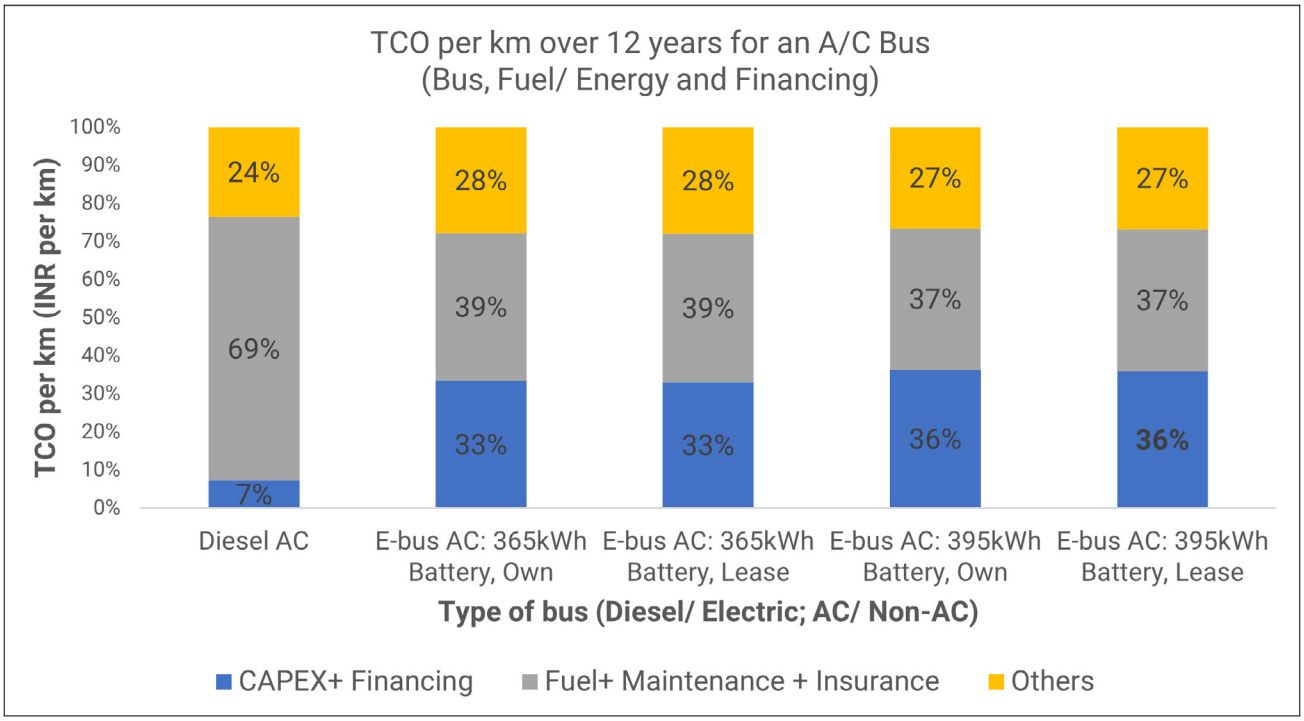


Figure 8: 12-year TCO (%) of 12 m AC diesel & electric buses (contract carriage: 500 km/day)



5.3.2 TCO of stage carriage buses (non-AC buses, 400 km/bus/day, baseline revenue of INR45/km):

- The TCO of non-AC e-buses is estimated to be around 6-13% higher than that of non-AC diesel buses over their 12-year life at the current bus purchase costs. Figure 9 presents the TCO in INR per km and Figure 10 presents the percentage contribution of various cost components for non-AC buses.
- The TCO per km is projected to be INR 45.3 per km for diesel buses and is in the range of INR 48.1.5-51.3 per km for e-buses based on the battery capacity (365 kWh/395 kWh) and business model adopted (own/lease).
- The higher TCO for e-buses is primarily due to the capital cost differential between the two vehicle types. Non-AC diesel buses are currently available at a cost of around INR 65 lakhs, whereas non-AC e-buses with 365 kWh batteries cost INR 1.5 Cr and those with 395 kWh batteries, INR 1.8 Cr.
- The fuel efficiency of non-AC diesel buses at 5 kilometres per litre (kmpl), is higher than that of AC diesel buses (3.5 kmpl), which adds to the cost competitiveness of non-AC diesel buses.
- Reducing the bus cost to around INR 1.1 Cr would bring TCO parity between non-AC electric and diesel buses for both the abovementioned e-bus battery sizes.
- It is crucial to reduce e-bus capital expenditure (CAPEX) for the non-AC bus segment to achieve TCO parity.
- Within the e-bus models, an additional 30 kWh in battery capacity can potentially increase the TCO by about 6% in the case of non-AC buses, compared to 5% in the case of AC buses, due to the relatively higher share of battery cost for non-AC buses.
- The impact of the business model choice (ownership vs. leasing) on the TCO is in the range of 0.8-0.9%, similar to the trends observed with AC buses.

In summary, non-AC e-buses operating in stage carriage operations (400 km/day) are yet to reach TCO parity with diesel buses across battery size and ownership models. High e-bus CAPEX, along with fewer km operated by the buses daily, is the main reason for higher e-bus TCO in the case of stage carriage operations compared to contract carriage operations.

Reducing the purchase price from ~1.5 to 1.1 Cr per bus will allow e-buses to achieve TCO parity with diesel buses.The leasing model continues to be cheaper for the operator in this scenario, given the favourable financial terms obtained by leasing entities.

The impact of a larger battery is higher for non-AC buses, and, hence, operators may choose to opt for smaller-sized batteries, given the higher energy efficiency delivered by these buses.

However, despite the higher TCO in the baseline scenario, it is still lower than the revenue, meaning that operators would continue to make a profit if they shifted to non-AC e-buses.

Figure 9: 12-year TCO (INR/km) of 12 m non-AC diesel & electric buses (stage carriage: 400 km/day)

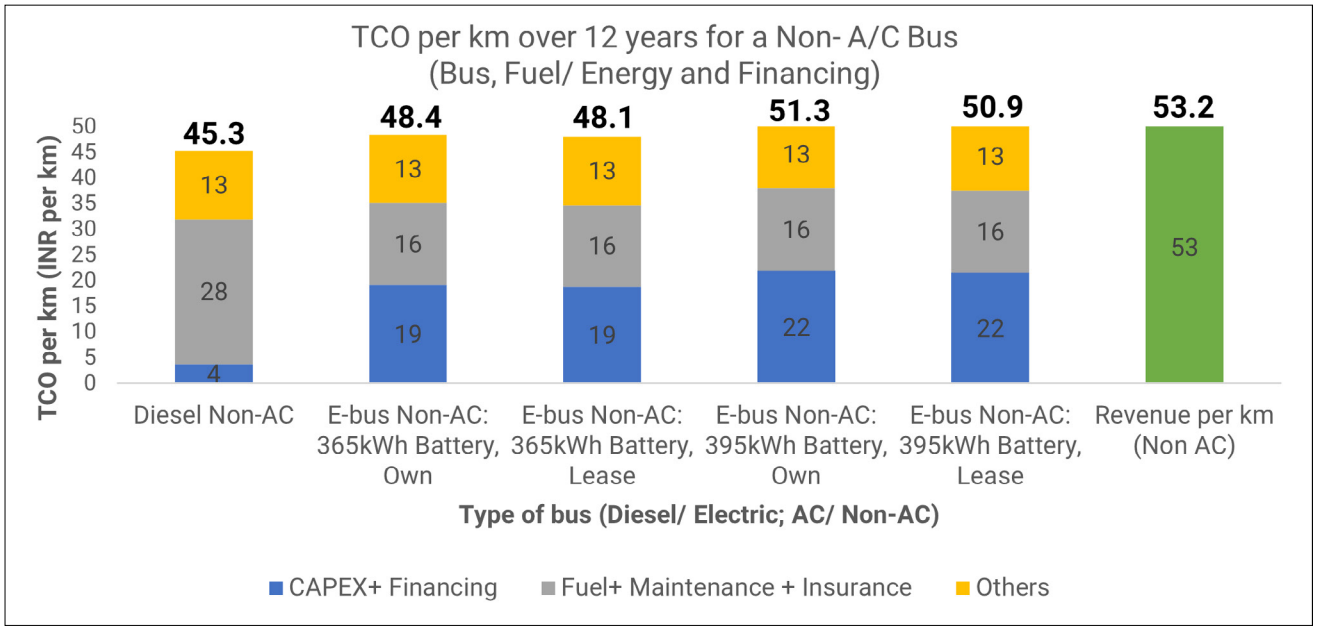
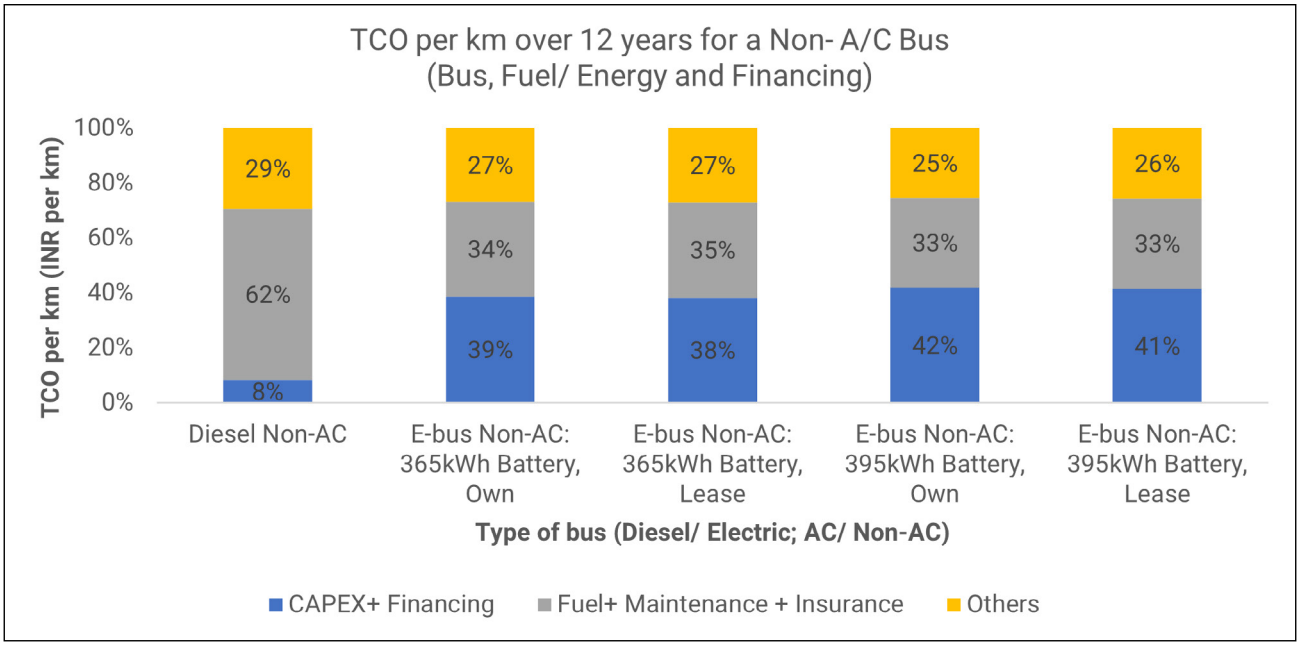


Figure 10: 12-year TCO (%) of 12 m non-AC diesel & electric buses (stage carriage: 400 km/day)



5.3.3 Cashflow impact of technology and business model choices

The TCO analysis allows for the comparison of the trade-off between the higher CAPEX and lower OPEX of e-buses versus the lower CAPEX and higher OPEX of diesel buses. Consultations with operators revealed that they typically evaluate costs and revenue on a monthly basis. Hence, the cashflow comparisons have been conducted at a monthly level. The per-km costs have been converted to monthly expenses based on capital and operational expenses covering the following:

- The EMI or monthly lease payment by operators covers the cost of the bus, battery, replacement of two batteries during the bus life, and the interest cost of financing.
- The OPEX covers the cost of diesel/electricity, maintenance, and insurance.
- Additional costs, such as those related to staff, taxes, and administration, are similar between diesel and e-buses and have consequently been excluded from this analysis.

Table 24 presents the cash flow impact of switching from diesel to electric buses across the battery and business model choices for AC buses, while Table 25 presents these results for non-AC buses.

- The AC bus cashflow analysis shows that the CAPEX is likely to increase by 286-349% for EMIs/ lease payments, while the OPEX will decrease by 53 percent. However, the total cost to the operator still decreases by 15-21% across the different scenarios, as the OPEX share is higher than the CAPEX share of the overall cost, even for e-buses.
- In the case of non-AC buses, e-bus CAPEX is 398-482% higher, while OPEX is 43% lower. Such a large increase in CAPEX results in the e-bus TCO being 9-19% higher than that of diesel buses. In this case, e-bus CAPEX is so high that the lower OPEX would still not result in a reduction in overall expenses to the operator.

In summary, the cash flow analysis shows that the share of OPEX is higher than the CAPEX share in the case of AC e-buses, with significantly lower OPEX compared to that of diesel buses. The significantly lower e-bus OPEX results in a lower overall TCO in the case of AC e-buses. In contrast, in the case of non-AC e-buses, the CAPEX is very high and negates the operating cost savings. Therefore, there is a need for policy and advocacy measures to reduce non-AC e-bus CAPEX in order for the sector to witness accelerated e-bus uptake.

Table 24: Monthly cost and revenue patterns for contract carriage buses (AC+ 500 km/day) *

Type of bus, battery, & ownership	CAPEX (EMI)		OPEX		CAPEX + OPEX	
	Actual	% difference vs. diesel	Actual	% difference vs. diesel	Actual	% difference vs. diesel
Diesel non-AC	59,000		5,69,000		6,28,000	
E-bus non-AC: 365 kWh battery, own	2,33,000	295%	2,68,000	-53%	5,01,000	-20%
E-bus non-AC: 365 kWh battery, lease	2,28,000	286%	2,68,000	-53%	4,96,000	-21%
E-bus non-AC: 395 kWh battery, own	2,65,000	349%	2,70,000	-53%	5,35,000	-15%
E-bus non-AC: 395 kWh battery, lease	2,60,000	341%	2,69,000	-53%	5,29,000	-16%

Table 25: Monthly cost and revenue patterns for stage carriage buses (non-AC+ 400 km/day) *

Type of bus, battery, & ownership	CAPEX		OPEX		CAPEX + OPEX	
	Actual	% difference vs. diesel	Actual	% difference vs. diesel	Actual	% difference vs. diesel
Diesel non-AC	55,000		4,12,000		4,67,000	
E-bus non-AC: 365 kWh battery, own	2,80,000	409%	2,33,000	-43%	5,13,000	10%
E-bus non-AC: 365 kWh battery, lease	2,74,000	398%	2,33,000	-43%	5,07,000	9%
E-bus non-AC: 395 kWh battery, own	3,20,000	482%	2,35,000	-43%	5,55,000	19%
E-bus non-AC: 395 kWh battery, lease	3,14,000	471%	2,35,000	-43%	5,49,000	18%

5.4 Sensitivity analysis of key TCO variables

The base case TCO results presented in Section 5.2 are based on certain fixed values for different variables. The TCO model analyses the base case scenario of a 12 m diesel-based ICE bus owned and operated by the private operator and an e-bus with a battery capacity of 365 kWh-for owned and operated as well as leased and operated scenarios. While the baseline scenario provides a useful comparison, several alternative scenarios have been tested to assess the impact of variables that contribute the TCO and the likely changes over a certain period of time due to emerging operational, technological, and market-related developments.

Therefore, a sensitivity analysis has been carried out on the key variables to evaluate their relative impact, as well as the indicative impact on the overall e-bus TCO. The variables tested in the sensitivity analysis are briefly described below, while Table 26 provides the specific values of these variables:

- Type of bus-contract carriage and stage carriage buses
- Daily vehicle utilisation – km operated per bus per day (500 km/bus/day for contract carriage and 400 km/bus/day for stage carriage in the base case)
- Revenue earned by the operator per km (INR 60 per km for contract carriage and INR 45 per km for stage carriage in the base case)
- Upfront bus cost (including battery)
- AC vs. non-AC buses and their associated capital cost, maintenance costs, and energy costs for ICE and electric bus variants
- E-bus battery sizes
- Cost of depot, charging, power supply, and land rental for depot + charging
- Battery purchase price
- Electricity tariff
- Terms of financing, i.e. LTV ratio (the share of vehicle cost financed), loan interest rate, and loan tenure

Table 26: E-bus TCO sensitivity analysis variables & scenarios

Variable	Scenarios tested	Type of service
Bus type	Diesel/electric	12 m AC contract carriage bus (500 km/day) & 12 m non-AC stage carriage bus (400 km/day)
Bus ownership model	Owned (financed)/leased	
AC	AC/non-AC	
E-bus battery size	365/395 kWh	
Owned vs. leased buses	LTV: owned-75%/leased-90% Interest rate: owned-12%/leased-11% Tenure: 6 yrs for both owned and leased	
Daily vehicle utilisation	400/500/600 km/bus/day	
Upfront bus purchase price	AC: INR 1.4/1.6/1.8 Cr Non-AC: INR 1.3/1.5/1.7	
Cost of depot, power, & land	INR 20/7/2 lakhs per bus	
Battery purchase price	USD 120/150/180/kWh	
Electricity tariff	INR 7.5/10/12/kWh	
Financing terms	LTV: 75/90% Interest rate: 9/12% Loan tenure: 6/8 yrs	

5.4.1 TCO sensitivity analysis results.

Figure 11 presents a summary of the results from the sensitivity analysis, presented as TCO per km. The analysis has been carried out for the case of an AC e-bus with a battery size of 365 kWh as the representative vehicle type and procured on purchase by the operator as the reference business model. The two bus use cases examined in the previous TCO analysis sections, i.e. an AC contract carriage bus with a typical daily utilisation of 500 km/day and a non-AC stage carriage bus operating 400 km/day, have also been used for the sensitivity analysis. The following are the key results for each of the variables tested.

i. **The daily vehicle utilisation** (km operated per bus per day) of intercity buses varies significantly based on the route and demand patterns. Higher vehicle utilisation would lead to lower TCO per km, as fixed costs like the capital cost of the vehicle and charging infrastructure would get distributed over more km. While the TCO analysis in Section 5.2 derived the TCO for a vehicle utilisation of 500 km/bus/day for AC contract carriage buses and 400 km/bus/day for non-AC stage carriage buses, the sensitivity analysis tested TCO for 400, 500 and 600 km/bus/day for both AC and non-AC buses. A 50% increase in daily bus-km from 400 to 600 km/day will reduce TCO by 13-14 % per km for AC and non-AC buses.

ii. **AC vs. non-AC TCO:** The above analysis also presents the TCO for AC and non-AC buses for each vehicle utilisation scenario (400/500/600 km/bus/day). For a given vehicle utilisation scenario, the TCO of AC e-buses is INR ~3.0-3.3 per km, i.e. 6.8-7.2% higher than that of non-AC e-buses. In comparison, the ICE AC bus TCO is ~INR 11 per km, i.e. ~24-25% higher than that of non-AC ICE buses. The lower price of electricity compared to diesel, combined with the higher energy efficiency of EVs compared to ICE vehicles, results in the lower TCO. Since the average revenue per km for AC services is INR 15 per km higher than that of non-AC services, it is likely that the AC share of vehicles will increase in the future to benefit from significantly higher revenue at a marginal cost increase (INR 3-3.3 per km).

iii. **Bus life:** The base case scenario assumes the bus lifespan to be 12 years, similar to the intercity e-bus contracts being issued by public transport authorities in India. However, some operators and financing entities expressed concern regarding e-bus and battery life and OEMs' willingness to service the assets beyond a certain point, due to the rapidly evolving nature of the technology. To analyse the impact of a shorter life on the TCO, figures of 6 and 10 years for the bus life have been analysed to reflect the operators' current perception of e-buses. Lower bus life leads to amortisation of the fixed costs over fewer km of operation, resulting in a higher TCO per km. The TCO of an AC e-bus (contract carriage) with a 6-year life is 9% higher than that of a similar bus with a 12-year life, while the TCO of a non-AC e-bus (stage carriage) with a 6-year life is 12% higher than that of a similar bus with a 12-year life.

iv. **Bus purchase price:** The baseline TCO estimates assumed a purchase price of INR 1.6 Cr for AC and INR 1.5 Cr for non-AC e-buses with a 365 kWh battery. Two scenarios where the price of the bus either decreases or increases by INR 0.2 Cr have been analysed to observe the change in TCO. The results indicate that a 13% increase/decrease in bus cost will result in a 3% increase/decrease in TCO. This is because the bus CAPEX accounts for less than 10% of its TCO in the case of AC buses.

v. **Battery price:** Lithium-ion battery pack prices have been steadily declining over the past two decades, but have also increased in recent years[17]. Fears of increases in e-bus battery prices, leading to higher TCO, persist. To address this concern, the impact of an increase in battery prices from a base price of INR 10,000 per kWh (~USD 120 per kWh - based on a recent purchase) to INR 12,000 per kWh (~USD 150 per kWh) and INR 14,400 per kWh (~USD 180 per kWh) was assessed. The cost of the replacement batteries to be purchased at the end of three years of e-bus operations has been estimated using these prices and an assumed price reduction of 5% per annum. The 25% and 50% increase in the battery's unit price modelled is estimated to increase the TCO by 2.0-2.4% and 4.3-5.3%, respectively, across AC and non-AC buses. Therefore, while batteries are a key cost component of buses, even a 50% increase in battery price would have a maximum of 5.3% impact on the bus TCO, indicating that this will not significantly impact the overall e-bus economics and transition timeline.

vi. **Electricity tariff:** The baseline electricity tariff is assumed to be INR 7.5 per kWh, which is a representative price for electricity tariffs being levied on e-bus operators across states, including incentives under state-level EV policies. Two scenarios of increasing electricity tariffs to commercial tariff levels have been analysed, for tariffs of INR 10 and 12 per kWh. The tariff increase to INR 10 per kWh, i.e. a 33% hike, is estimated to result in a 5-6% TCO increase across AC and non-AC buses. The increase to INR 12 per kWh, i.e. a 60% increase, would lead to a TCO increase of 9-11 percent. Therefore, e-bus TCO is highly sensitive to electricity tariffs, and the continuation of subsidised tariffs for e-buses will be crucial to promoting the shift to e-buses.

vii. **Cost of depot, power supply, & land leasing for depot & charging station:** The lack of access to public depot and charging infrastructure for private buses compels private bus operators to develop their own depot infrastructure, which entails leasing land, securing power supply, and installing chargers. Based on a recently developed large-scale e-bus charging facility for 500 e-buses, which cost ~INR 100 Cr to the developer, a baseline estimate of INR 20 lakhs/bus was used for the reference TCO estimate. Operators who do not need capacity for 500 buses may incur a lower expenditure on the fixed power infrastructure, bringing the cost down to INR 7 lakhs per bus. Furthermore, development of government-supported depots and power supply can bring the cost down to ~INR 2 lakhs per bus. Hence, two alternative scenarios of INR 7 lakhs/bus and INR 2 lakhs/bus were analysed and compared with the reference TCO values. It is estimated that reducing the cost to INR 7 lakhs/bus will reduce the TCO by 1.7-2.0%, and reducing it to INR 2 lakhs/bus will reduce the TCO by 2.3-2.8 percent.

[17] https://www.iea.org/data-and-statistics/charts/average-pack-price-of-lithium-ion-batteries-and-share-of-cathode-material-cost-2011-2021

viii. **Financing terms** such as the LTV ratio, loan interest rate, and loan tenure have been analysed in the following alternative scenarios:

1) LTV increases from the base case of 75% to 90%;

2) The interest rate improves from the current 12% to 9%;

3) The interest rate increases from the current 12% to 15%; and

4) The tenure of loans on buses and charging infrastructure increases from the current 6 years to 8 years.

a. A 15% increase in LTV will lead to a 1% increase in TCO due to higher interest payments incurred by the operator. However, this will also reduce the equity contribution required from the operator, which is valued at 20%, and will therefore improve the overall returns for the operator.

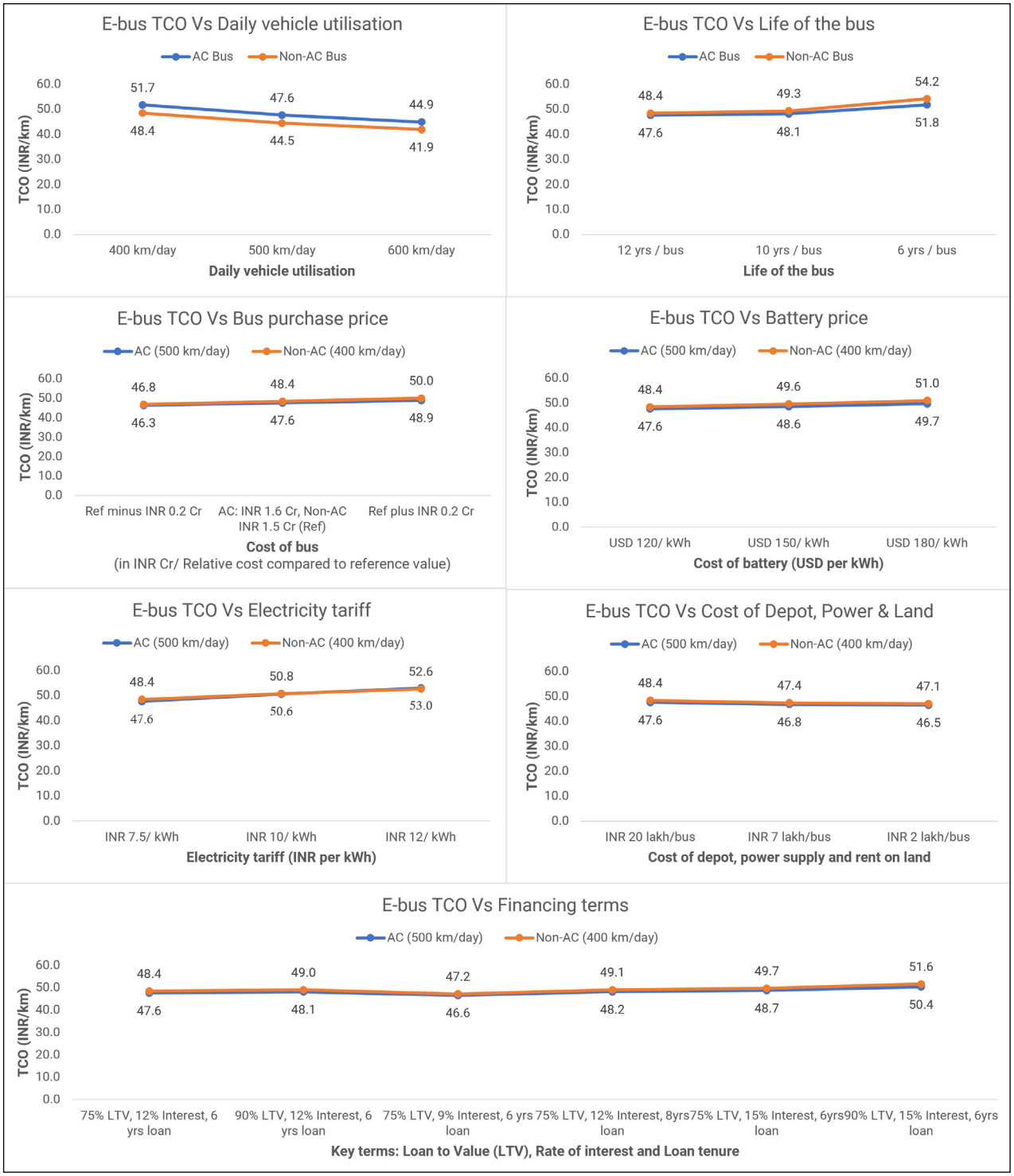
b. A 3% reduction or increase in interest rate will lead to a 2.2% TCO reduction or increase for AC buses and 2.6% reduction or increase for non-AC buses, indicating the significant impact of interest rates on TCO.

c. Increasing the loan tenure by 2 years will marginally increase the TCO by 0.1 percent.

d. The combined impact of increasing the LTV to 90%, interest rate to 15%, and loan tenure to 8 years will lead to a net 5.7% increase in TCO for AC buses and a net 6.6% increase in TCO for non-AC buses.

e. In summary, the LTV and loan interest rate have been identified to be the financing terms that need the most attention to improve access to finance for e-buses.

Figure 11: Sensitivity analysis results for key variables impacting AC e-bus (365 kWh battery) TCO



5.5 TCO analysis: Base case vs. conservative scenario

The base case TCO analysis and the sensitivity analysis for various key variables established that the TCO for AC e-buses is lower than ICE buses across scenarios. Despite this, the consultations with operators indicated limited interest in e-bus adoption in the short term due to the perceived 'higher cost' involved in the transition. Therefore, a 'conservative scenario' that combines the worst-case combination of the input variables reported across operators and financing entities has been analysed to present the most conservative e-bus TCO. Table 27 presents the key input variables used to compare the base case and conservative TCO scenarios.

Table 27: TCO assumption variance between base case and conservative scenario

Variable	Base case scenario		Conservative scenario	
Bus type (AC/ Non-AC)	AC	Non-AC	AC	Non-AC
Bus ownership model	Owned	Owned	Owned	Owned
E-bus battery size	365 kWh	365 kWh	365 kWh	365 kWh
Daily vehicle utilisation	500 km/bus/day	400 km/bus/day	500 km/bus/day	400 km/bus/day
Upfront bus purchase price	INR 1.6 Cr	INR 1.5 Cr	INR 1.8 Cr	INR 1.7 Cr
Life of the bus	12 yrs	12 yrs	6 yrs	6 yrs
Battery purchase price	USD 120 / kWh	USD 120 / kWh	USD 180 / kWh	USD 180 / kWh
Electricity tariff	INR 7.5 / kWh	INR 7.5 / kWh	INR 12 / kWh	INR 12 / kWh
Financing terms	LTV: 75% Interest rate: 12% Loan tenure: 6 yrs	LTV: 75% Interest rate: 12% Loan tenure: 6 yrs	LTV: 75% Interest rate: 15% Loan tenure: 6 yrs	LTV: 75% Interest rate: 15% Loan tenure: 6 yrs

Figure 12 presents the summary of the TCO comparison. The conservative scenario TCO is estimated to be 31% more than the base case for AC buses and 34% more for non-AC buses. Such a substantial increase in TCO is due to the following reasons:

i. **Higher bus purchase costs** due to the currently limited manufacturing capacity of OEMs occupied by the recent orders from public transport authorities. The GoI FAME II subsidy determines the per bus subsidy in proportion to its purchase price. As a result, OEMs tend to quote a higher purchase price for the bus to be eligible for the full subsidy. Such escalation in price translates to the intercity market, as the same bus cannot be priced lower for a different market. Since bus purchase price and its associated financing constitute the largest TCO share among all cost components, ensuring greater transparency in the purchase price of e-buses is crucial to ascertaining realistic TCO values.

ii. **The bus life** is being estimated as 6 years by some operators, similar to the life of a firsthand diesel bus, when evaluating a bus's payback period. The operator surveys revealed that even diesel buses have a life of 10 years or more when their secondhand usage is also considered. E-buses are typically expected to last longer than diesel buses due to fewer components and less vibration, making the 6-year life scenario unlikely - only a hypothetical scenario in a high-risk operation. Supporting financing entities in determining realistic end of life values for e-buses and batteries, along with provision for adequate warranties on components, is likely to reduce the risk attributed to bus lifespan. This would lead to more realistic assumptions regarding bus life, as assumed in the base case scenario.

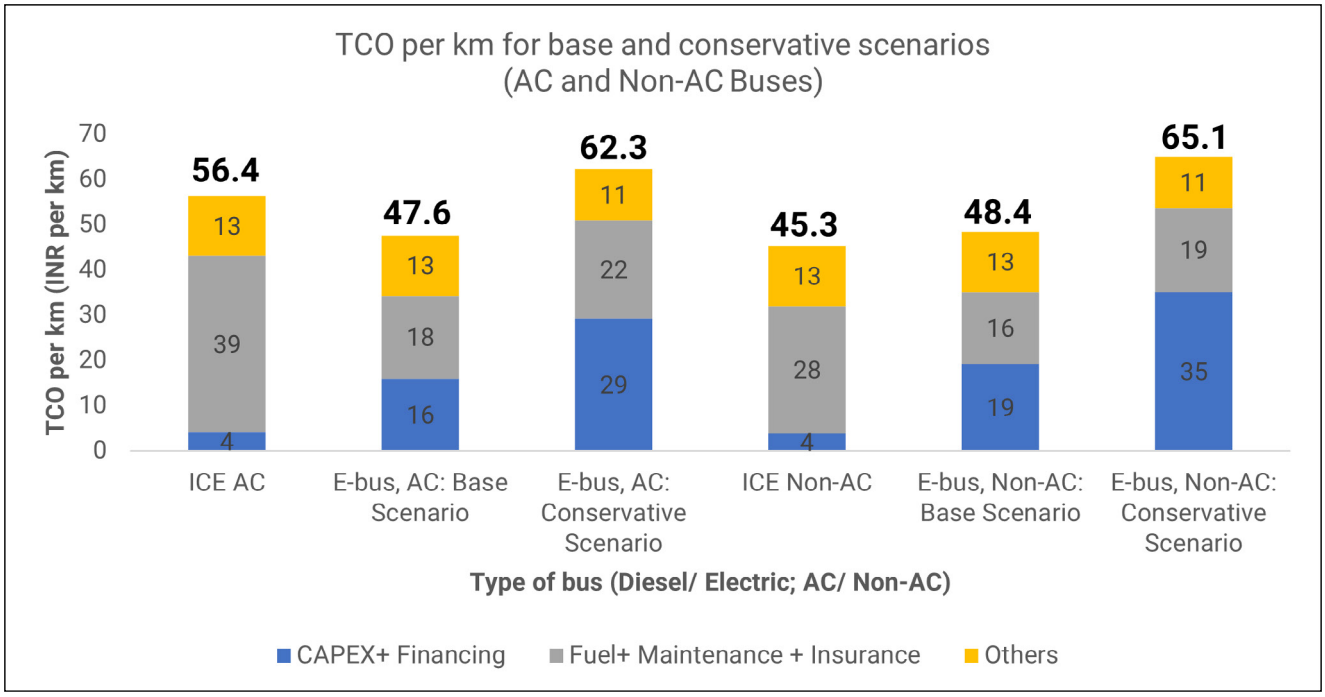
iii. **Financing e-buses with an LTV of 75%** is a practice continuing from diesel buses, despite the higher upfront investment of e-buses and lower operating costs. While this leads to a lower EMI for the operator, the higher equity share, corresponding to 25% of the e-bus cost, would result in many operators being unable to mobilise the necessary resources. While the TCO analysis assumes this LTV for the purchase model of procurement, the leasing model provides the opportunity to mobilise 90% of the bus cost from the leasing company, requiring lower upfront investment by the operators.

iv. **Interest rates of 15%** are observed in the case of e-bus operators raising finance from NBFCs, with higher capital costs compared to banks, which have traditionally been the source of finance for diesel buses. Encouraging more banks to finance e-buses would reduce interest rates to the base case scenario of 12% at high perceived risk, or even 9%, as tested in the sensitivity analysis in cases where the investment is considered bankable.

v. **Electricity tariffs increasing to INR 12 per kWh**, despite the current average being around INR 7.5 per kWh for EVs, is another scenario emanating from the risk perceived by operators and financiers that the subsidised tariffs for EVs may not remain throughout the 12-year bus life. Long-term policy clarity from governments on EV tariffs can mitigate this risk and make e-buses more cost-competitive.

The significant TCO impact of these variables indicates the need to address the perceived risks related to e-bus ownership, operation, and financing and thereby achieve more realistic costs and, ultimately, enable accelerated e-bus adoption.

Figure 12: TCO comparison: base case vs. conservative scenario



5.6 Summary of TCO analysis findings

The TCO analysis compares the lifecycle costs of ICE (diesel) buses with e-buses under alternative bus, operational, and business model scenarios. This covers AC and non-AC e-buses with 365 kWh and 395 kWh batteries, contract carriage and stage carriage operations, and owned and leased business models. A base case scenario with TCO inputs of a large-scale operator with a fleet of more than 100 e-buses, a sensitivity analysis on key variables, and a conservative scenario reflecting the perceived risk attributed by operators and financiers to various TCO variables have been analysed to estimate the relative e-bus TCO across different scenarios.

TCO of AC and non-AC buses: The TCO analysis shows that AC e-buses are a financially viable choice for intercity operators, even without any capital subsidy. In the case of non-AC buses, the stage carriage (400 km/bus/day) operators may witness 6-13% higher TCO for e-buses compared to diesel buses, while contract carriage operators (500 km/bus/day) are likely to observe 11-16% lower TCO for e-buses.

TCO components for electric and diesel buses: The capital costs of the bus, batteries (including replacements), and chargers and interest paid on their financing adds up to 33-36% of the TCO for AC e-buses on contract carriage permits (~500 km/bus/day) and 39-43% in the case of non-AC e-buses on stage carriage permits (~400 km/bus/day), as the fixed costs are distributed over fewer km. Expenditure on electricity and maintenance contribute about 37-39% of AC e-bus TCO and 31-33% of non-AC e-bus TCO, while the remainder of the TCO consists of costs incurred on staff and administrative expenses. This is fundamentally different from ICE (diesel) bus TCO, where the capital costs contribute 6-7% of the TCO across AC and non-AC buses, and the fuel and maintenance costs constitute 62-69 percent. The change in TCO structure requires operators to identify suitable business models for procurement that will allow them to amortise the capital costs over the life of the bus and benefit from the operational cost savings of e-buses.

Benefits of the leasing model: Among e-buses, adopting the leasing model is likely to result in a marginally lower TCO compared to the traditional model of purchase by operators, given leasing companies' access to cheaper finance. However, the ability to procure buses on such favourable terms will depend on several factors, including the operators' creditworthiness, financial track record, and profitability on the routes of operation, which will be evaluated by the leasing company. Irrespective of the cost savings, the key advantage of leasing is that it improves operators' ability to procure e-buses, as operators typically only have to pay 10% of the capital cost of the bus and chargers under the leasing model, whereas the current financing terms by banks and NBFCs require them to pay 25% as an equity contribution.

Variables impacting TCO:

i. **Bus cost and maintenance cost**, assumed based on current AMCs, are the largest cost components within the overall TCO and are both determined by the OEM selling the vehicles. The high costs of e-buses and AMCs being reported by some operators may be due to a combination of cost inflations caused by limited manufacturing capacity in India and high price benchmarks set by some OEMs to qualify for government subsidies. Reducing these costs through benchmarking for various e-bus components and ensuring transparency in the e-bus prices offered to different operators is crucial to reducing overall e-bus TCO.

ii. **Battery size and price** have a significant impact on e-bus TCO, as intercity buses need 3-4 batteries over their 12-year life. A 30 kWh increase in battery capacity can result in a 4.1-4.9% increase in TCO, and a 50% increase in battery price will lead to a ~4.3-5.3% increase in TCO. However, neither will increase the TCO to the extent that it affects the choice of e-buses over ICE buses.

iii. **Vehicle utilisation and electricity tariffs** have the greatest TCO impact among variables impacting operational expenditure. Improving e-bus energy efficiency to enable e-buses to operate on longer-distance routes with more than 500 km/bus/day using a 365 kWh battery will lead to substantial TCO benefits. Furthermore, extending the current subsidies on EV electricity tariffs and providing long-term commitment for their continuation will provide adequate comfort to investors.

iv. Affordable access to **depot and power infrastructure** and financing variables like the **LTV ratio and interest rate** on loans are other items with significant TCO impact.

5.6.1 Need for de-risking e-bus financing

The conservative TCO scenario demonstrated how the risk perception of variables like bus life, future electricity tariffs, and operators' repayment capability leads to e-bus TCO being ~30% higher than the base case scenario, making e-bus TCO higher than that of ICE buses and thereby limiting e-bus adoption. Alternative mechanisms to de-risk e-bus technology and financing are crucial to addressing various perceived and real risks. India's progress in developing two-wheeler and three-wheeler de-risking mechanisms provide valuable lessons for similar potential platforms for e-buses[18].

E-bus technology-related risks may be addressed through measures like longer-term warranties, an improved maintenance ecosystem and supply chain for spares, performance evaluation of operational e-buses, and transparent sharing of performance data of various vehicle models based on their homologation certificates and real-world performance data captured by operators.

Financial risks may be addressed through systematic efforts to address risks associated with e-bus operators' fluctuating revenues through reserve pools of funds, risks associated with the operators through partial credit guarantee instruments, and risks associated with value of used buses through the adoption of measures to accurately determine the residual value of the e-bus and battery based on their age and operational track record.

These de-risking measures are only indicative, and a more in-depth analysis of the various risks and their mitigation measures is needed to identify a priority order and institutional framework for their implementation, which is beyond the scope of this report.

[18] https://rmi.org/insight/de-risking-lending-for-a-brisk-ev-uptake

6. Conclusions & Recommendations

Image courtesy : Rohit Dhende

India's bus market is estimated to grow from 23 lakh (2.3 million) buses in 2023 to 31.6 lakh (3.16 million) buses by 2030. This involves procuring 20 lakh (2.0 million) buses for fleet replacement and augmentation needs. Achieving Government of India's EV 30@30 goal, i.e. reaching an electric bus (e-bus) share of 30% in overall bus sales by 2030, will require deployment of 3.15 lakh (0.315 million) e-buses in total, out of which about 2.52 lakh (252,000) are estimated to be in the private bus market, most of them in the rural and intercity market.

The report presents a first of its kind analysis of the intercity bus market in India and the market assessment for electric bus adoption among these services. The analysis presented provides the following inputs to facilitate accelerated e-bus uptake in the private operator-driven rural and intercity market:

i. A comprehensive assessment of the intercity bus market in India based on secondary data

ii. The market outlook regarding the total number of intercity buses in India and the projected share of e-buses up to 2030

iii. National-level market prioritisation for intercity e-bus deployment, i.e. identification of the organised market, key routes, their operational needs, and the current operators' characteristics

iv. Operational and financial characteristics of intercity bus operators based on surveys

v. Key barriers to e-bus adoption and potential solutions identified through consultations with operators and OEMs

vi. TCO analysis to estimate the financial implications of various technological and business model alternatives for e-buses

vii. Recommendations on technological, policy, regulatory, and financing measures to accelerate e-bus uptake.

viii. The key recommendations emerging from the study and a potential way forward in implementing them are summarised below.

6.1 Key recommendations for large-scale e-bus adoption in intercity operations

A mix of solutions addressing the institutional, policy, financial, and technological barriers identified in the study needs to be designed based on appropriate market consultations to develop a practical roadmap for large-scale electrification of the intercity bus market. An ecosystem of aggregators, operators, charging infrastructure providers, and financiers needs to be created to co-create appropriate mechanisms for large-scale e-bus deployment on the Indian market.

The key recommendations identified to advance e-bus adoption among private buses are summarised below under the following categories:

1. Institutional mandate,
2. Product improvement and cost reduction,
3. Policy and funding support from the Government and
4. Alternative business models and de-risking mechanisms.

6.1.1 Institutional mandate

i. **Need for an institutional anchor within the government to drive e-bus adoption through regulations:** The BOCI, by virtue of being an industrial body, has been instrumental in voicing the various challenges faced by private operators over the years and has initiated efforts towards e-bus induction among private operators. However, BOCI has its limitations in advancing policy and regulatory reforms. Fulfilling the mandate of inducting more than 2,50,000 intercity e-buses by 2030 and attracting investments of more than INR 3 lakh Cr (~USD 37.8 billion) would require institutional backing from GoI and state governments.

   a. Intercity buses are regulated by the state road transport authorities (RTAs) at the state level and the Ministry of Road Transport and Highways (MoRTH) at the national level. These entitites' involvement has thus far been limited to issuing permits and licences, as well as ensuring compliance, with limited to no focus on infrastructure provision and overall service enhancement.

   b. MoRTH and state RTAs need to play a more proactive role in the intercity bus service segment in terms of implementation of the policy and regulatory reforms identified in the study, such as long-term clarity on permit exemption for e-buses, harmonisation of the permit ecosystem and taxation across states, and facilitating provision of land and infrastructure for e-bus charging and maintenance along the highways.

   c. Ministry of Heavy Industries (MHI), by virtue of being the nodal ministry for electric mobility and with its past experience of driving PTA e-bus adoption through successive phases of the FAME scheme, would be ideally positioned to be the government institutional anchor to support private bus operators in nudging the OEMs to develop high-quality e-buses for intercity services and improve transparency in costs, as well as mobilise the government subsidies and de-risking instruments needed to enhance financing. Therefore, future phases of the FAME scheme, along with other incentive mechanisms for buses, may include private intercity buses within their scope and mobilise financial resources for infrastructure development, capital incentives, and de-risking programmes for e-buses.

ii. **Prioritising contract carriage vs. stage carriage buses for electrification:** Stage carriage buses have greater technology readiness and are also larger in scale compared to contract carriage buses. The comparison between contract and stage carriage operations shows that stage carriage operators have fewer km per day and are likely to find more vehicle models with adequate range, but their lower daily-km has kept them from achieving TCO parity thus far. Contract carriage services have better unit economics than stage carriage operations due to the higher daily-km of operation and higher tariff per passenger. As a result, contract carriage operations are likely to witness faster uptake of e-buses than stage carriage operations. Government initiatives and financing institutions may prioritise contract carriage services in their short-term investment plans.

6.1.2 Product improvement and cost reduction

i. **Increasing the number of available vehicle models for intercity buses and improving their ability to serve long-range routes**: The limited number of e-buses currently operational in the intercity market are running on the 200-220 km long routes providing seater services, which constitute about 8% of the overall market. The vehicle models available to serve this market segment are currently offered by 2-3 OEMs, compared to the 6-7 OEMs active in the urban bus market. About 85% of the intercity market is made up of sleeper and sleeper cum seater buses, which have average route lengths in the range of 400-430 km. Increasing the number of vehicle models available for intercity operations across vehicle segments and improving the vehicle, battery, and charger configurations to serve longer distance routes is paramount to the advancement of the sector. Vehicle homologation norms, as well as future subsidies for intercity buses, may facilitate e-bus development and adoption for such long-range operations. Increasing the number of models can also result in a reduced purchase price per bus due to increased competition in the market.

ii. **Transparency in private intercity bus costs:** CAPEX on e-buses, batteries, and chargers and their financing constitute 33-43% of e-bus TCO across vehicle models and operating conditions. Higher CAPEX compared to ICE (diesel/CNG) buses is the primary barrier to e-bus adoption. It is perceived in the industry that OEMs are pricing the e-buses higher to be eligible for national and state-level subsidies, which are proportional to the capital cost of the bus. The lack of outright purchase-based e-bus procurement is also leading to a lack of clarity on market-based bus prices. At the same time, the fact that the existing manufacturing capacity is being used to fulfil e-bus contracts for public bus agencies is also leading to limited interest in the intercity bus market, which contributes to the higher prices quoted for the market. Hence, it is important to bring in transparency around the capital cost through government- or industry-driven efforts to publish the costs and specifications of various models of e-buses, batteries, and chargers in an open forum. This would allow individual operators and financing entities to compare the specifications across OEMs and ascertain the costs of a new e-bus purchase.

iii. **Cost reduction through demand aggregation and standardisation:** Reducing e-bus CAPEX from the current INR 1.5-1.6+ Cr to about INR 1.1 Cr would provide a significant impetus to the market to transition to these vehicles. Public bus agencies have witnessed significant financial benefits through demand aggregation and standardisation[19] thanks to the economies of scale, standardisation of products and business models, and clarity in procurement terms. A similar consolidated procurement effort across private operators, subject to predefined screening criteria to identify quality demand, can potentially provide the much-needed initial push and clarity in business models for intercity buses. The initial procurement may be piloted and treated as the basis for further rounds of procurement that follow a similar business model.

[19] https://www.convergence.co.in/public/images/electric_bus/Grand-Challenge-Case-Study-Final-Web-Version.pdf

iv. **Improving the supply chain to reduce AMC costs:** Private operators rely on the AMC to address their technology-related concerns, by ensuring maintenance support from the OEM and supply of necessary components throughout the life of the project. The AMC costs currently offered by OEMs constitute up to 19% of TCO in some cases, excluding the cost of battery replacement, making maintenance more expensive than electricity. Therefore, reducing AMC costs through local supply chain development for spare parts and pricing them realistically based on data from existing operations are two strategic areas that have a significant impact on the achievement of long-term e-bus transition goals.

v. **Transparent reporting of the performance of intercity buses across India:** The lack of transparent private bus-specific data on the likely operational and financial performance of various routes and operators has been repeatedly highlighted as a source of risk while assessing the financial risk of investments and financing. Therefore, independent efforts to develop information sharing portals and publication of periodic reports on key indicators concerning intercity e-buses like route-wise bus allocation, fleet utilisation, vehicle utilisation, occupancy, fares, revenue, etc., across operators, similar to the annual reports published by the Central Institute of Road Transport (CIRT) for public bus agencies, can be of significant value in de-risking the market for financing entities. While the above applies to ICE buses, data on the performance of currently operational e-buses is also missing. Therefore, it is important for OEMs to publish the product specifications being offered and buses' current performance to assuage market concerns.

6.1.3 Policy and funding support from the Government

i. **Shared infrastructure for parking, charging, and maintenance:** Operator surveys highlighted the significant gaps in infrastructure for parking and maintenance, even for diesel buses. The issue is further exacerbated for e-bus operators, as they need adequate charging facilities with high-quality power. The current e-bus deployments rely on captive charging created by operators, which is not a scalable model for the many small fleet operators who cannot afford it. Therefore, creating shared parking, charging, and maintenance facilities with high-quality power is a key prerequisite for large-scale e-bus adoption. Public-private partnerships (PPPs) where the government provides land resources on which private players establish the bus depots and maintenance centres may be taken up across India.

ii. **Interest subvention programmes** to provide discounts on vehicle loans will reduce the cost of financing and therefore the TCO of e-buses. At the same time, these programmes have significant costs as well and also run the risk of subsidising procurements that would have happened anyway, rather than attracting new finance.

Therefore, interest subvention programmes with a certain upper limit on the number of e-buses receiving the benefit may be designed to improve access to finance for the early adopters of intercity e-buses.

iii. **Extending electricity tariff subsidies for EVs for several more years:** Electricity costs contribute 14-19% of the e-bus TCO, and therefore electricity tariffs have a significant impact in determining the feasibility of transitioning from diesel/CNG buses to e-buses. The subsidised tariffs being provided by many states as a part of their EV policies need to be continued for a few more years, until the capital costs reduce to the breakeven point mentioned above. The lack of long-term clarity on the number of years the current subsidised tariffs will remain is another key area of concern that can be addressed by long-term EV policies across states. Harmonising the tariffs across states would also allow operators to plan better for their cost dynamics. However, given that operators are used to differential fuel costs for ICE buses, continuation of EV tariff subsidies may be prioritised over their harmonisation across states.

iv. **Long-term clarity on permits and taxes:** Similar to electricity tariffs, the lack of long-term policy clarity on the timeframe of relaxed permit requirements and taxation norms is a cause for concern for operators and financing institutions. Policy advisories by GoI and state EV policies may include a timebound action plan, including the current relaxation of permits and taxes on e-buses and their end of tenure.

6.1.4 Alternative business models and de-risking mechanisms

i. **Business models to attract capital for private operators:** Outright purchase of the bus and charger from the OEM and leasing assets from a third-party aggregator or financing company are the two most promising business models for e-bus adoption. Both the outright purchase model and leasing model require significant capital investment from operators to procure e-buses, which they are currently unable to mobilise. However, the increased net revenues from lower energy costs in the case of e-buses can potentially cover these investments. Therefore, developing the right business models to infuse the initial capital that can be recovered from operators over the bus life, with adequate safeguards, is crucial to attracting large-scale financing to the sector. The currently available business models like outright purchase, operating lease, and financial lease are all prone to various risks identified in the study, which need to be mitigated through active consultations with the industry.

ii. **Factors determining the choice between leasing and outright purchase:** The leasing model will address the significant barrier faced by private operators to obtain e-bus finance by covering up to 90% of the CAPEX cost, compared to 75% CAPEX currently being financed in the outright purchase model. The leasing model can potentially be marginally cheaper for operators by allowing access to lower financing costs through large-scale aggregators who have access to cheaper capital. However, operators with adequate access to capital may continue to prefer the outright purchase model despite the marginally higher TCO, because operators traditionally prefer owning the bus, operating it for 4-6 years, and selling it on the secondhand market. In the case of leasing, they do not own the bus until the end of the 6-8-year lease tenure, and the secondary value of e-buses at that point in their operational life is unknown. The currently offered leasing models include restrictions on the bus routes, as well as minimum and maximum daily-km of operation, thus limiting operators' operational flexibility. Therefore, operators with limited financing capabilities are likely to choose the leasing model, while larger operators will continue to seek finance for outright purchase.

iii. **Mitigating technology risks through warranties and technical evaluation of standard products:** Mitigating technology risks would improve operator confidence in adopting e-buses while also attracting better financing terms due to a reliable asset. The current battery warranties are typically for 5,00,000 lakh km of e-bus operations, which leads to 3-4 battery replacements during the 12-year life of the bus. Extending the timeframe of these warranties would substantially reduce e-bus TCO, as well as de-risk the product, thereby improving its financial valuation at different points of its life, which, in turn, Other measures for technology risk mitigation include:

   a. Improved maintenance ecosystem and supply chain for spares

   b. Performance evaluation and reporting of operational e-buses across use cases

   c. Transparent sharing of performance data of various vehicle models based on their homologation certificates and the real-world performance data captured by operators

   d. Adoption of methods to accurately determine the residual value of the e-bus and battery based on their age and operational track record

iv. **De-risking e-bus financing through payment guarantees:** The diversity of private bus operators and emerging nature of e-bus technology will continue to make e-buses a risky investment for financiers. The TCO analysis demonstrated how risk perception of attributes like bus life, future electricity tariffs, and operators' repayment capability can increase e-bus TCO by ~30% thereby limiting e-bus adoption. Hence, it is important to de-risk e-bus investments for financing entities to improve loan terms and encourage operators to switch to e-buses. Banks and NBFCs would require some form of third-party intervention, preferably backed by the government, to de-risk the private bus market. The following de-risking mechanisms are recommended:

   a. **Creating a loss-pool for batteries and other key components:** The technology risk associated with e-bus components can be partially mitigated through the creation of a separate pool of funds to be maintained by the operators, which will be used in the case of component failure, thereby ensuring adequate funds for replacement of expensive components like batteries, traction motors, and power controllers.

   b. **Payment guarantees for loans on purchased vehicles:** Financing products to ensure guaranteed payback to financing entities in the case of private operator default can significantly de-risk e-bus financing. The Small Industries Development Bank of India (SIDBI) provides a template for de-risking electric two-wheelers and three-wheelers that can be translated to de-risk e-buses, as well18. A de-risking facility can enhance loan availability and encourage lower-cost loans through partial credit guarantees and on-lending opportunities, technical evaluation of OEMs to ensure reliable products, and establishment of accurate end of life values, thereby reducing the perceived risk associated with e-buses.

   c. **Short-term payment security to safeguard against revenue fluctuations:** Private bus operators face significant seasonal and daily variation in demand and revenue. Hence, payment security mechanisms to safeguard against short term payment delays would significantly enhance financiers' confidence in the market. This would be separate from payment guarantee mechanisms to safeguard the overall loan repayment on the assets. As mentioned above, the leasing model is more likely to succeed in the case of e-buses due to its lower capital requirement. In such cases, financing entities may need payment guarantees for short-term

delays in monthly payments rather than loan default. Therefore, a payment security fund to absorb short-term payment delays, which would be replenished with payments from operators & financing entities and government funds, can significantly reduce the risk profile of the private e-bus market. The Payment Security Mechanism (PSM) being developed by Government of India for operators engaged by public bus agencies provides a good template to extend such a mechanism to private bus services.

6.2 The way forward

This report presented a roadmap for the intercity e-bus market through a detailed baseline market assessment of intercity buses in India, future projections, barriers faced in e-bus adoption, and TCO-based analysis to identify the key policy levers to encourage e-bus adoption among private intercity bus operators. Several actionable recommendations were proposed for the government, financing entities, operators, and OEMs to work on together to address the barriers faced in e-bus adoption. However, there are still several areas of work that require further study and development. This includes identifying mechanisms to standardise and aggregate e-bus financing, leasing, and procurement terms, creating a roadmap for developing interoperable public charging infrastructure across India, addressing the perceived risks of operators and financiers in e-bus adoption, and establishing improved transparency and trust building in the sector through transparent performance reporting of various e-bus and charger technologies, along with operators' performance metrics like demand patterns, vehicle utilisation, route speed, etc. We hope that this report enables informed decision making to facilitate large-scale e-bus adoption in India.

Annexure 1: Top destinations and operators for intercity buses from 17 cities

Table A1: City-wise breakdown of service types

City	AC sleeper	Non-AC sleeper	AC seater + sleeper	Non-AC seater+ sleeper	AC semi sleeper	AC seater	Non-AC seater	Non-AC semi sleeper	AC seater (electric)	Total
Bangalore	49%	23%	8%	11%	7%	1%	0%	1%	0%	**100%**
Chennai	60%	6%	8%	15%	7%	1%	1%	1%	0%	**100%**
Mumbai	50%	15%	10%	5%	1%	10%	9%	0%	0%	**100%**
Delhi	24%	2%	37%	4%	20%	11%	1%	0%	0%	**100%**
Jaipur (Rajasthan)	32%	8%	38%	19%	1%	1%	2%	0%	1%	**100%**
Ahmedabad	42%	25%	22%	8%	0%	2%	1%	0%	0%	**100%**
Surat	33%	40%	19%	7%	0%	1%	0%	0%	0%	**100%**
Kolkata	5%	0%	23%	10%	9%	49%	3%	0%	0%	**100%**
Lucknow	30%	4%	54%	4%	0%	8%	0%	0%	0%	**100%**
Patna (Bihar)	16%	0%	47%	4%	0%	10%	22%	0%	0%	**100%**
Bhubaneswar	2%	0%	74%	5%	7%	7%	5%	0%	0%	**100%**
Guwahati	38%	0%	25%	13%	0%	13%	13%	0%	0%	**100%**
Bhopal	29%	8%	5%	10%	0%	22%	7%	0%	19%	**100%**
Chandigarh	8%	0%	16%	0%	64%	10%	0%	0%	2%	**100%**
Indore	42%	25%	3%	13%	0%	6%	6%	0%	5%	**100%**
Pune	57%	14%	10%	5%	1%	7%	5%	0%	0%	**100%**
Hyderabad	39%	5%	13%	36%	2%	0%	4%	0%	1%	**100%**
Total	**44%**	**13%**	**15%**	**13%**	**6%**	**5%**	**3%**	**1%**	**0%**	100%

Table A2: Cities with highest demand for intercity bus services, starting from the top 17 cities

S. no	City	Number of services terminating in city
1	Pune	**1117**
2	Mumbai	**892**
3	Coimbatore	**710**
4	Lonavala	**689**
5	Karad	**581**
6	Bengaluru	**555**
7	Satara	**555**
8	Salem	**514**
9	Surat	**508**
10	Ahmedabad	**488**
11	Hubli	**432**
12	Erode	**391**
13	Indore	**389**
14	Delhi	**385**
15	Dharwad	**385**

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S. no	City	Number of services terminating in city
1	Pune	**1117**
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9	Surat	**508**
10	Ahmedabad	**488**
11	Hubli	**432**
12	Erode	**391**
13	Indore	**389**
14	Delhi	**385**
15	Dharwad	**385**
16	Angamaly	**363**
17	Chitradurga	**342**
18	Vijayawada	**331**
19	Ajmer	**322**
20	Udaipur	**314**
21	Hyderabad	**301**
22	Avinashi	**300**
23	Beawar (Rajasthan)	**300**
24	Chandigarh	**289**
25	Anantapur (Andhra Pradesh)	**286**
26	Nashik	**284**
27	Pali (Rajasthan)	**274**
28	Solapur	**274**
29	Jaipur	**271**
30	Anakapalle	**251**
31	Gorakhpur (Uttar Pradesh)	**251**
32	Nathdwara	**242**
33	Margao	**241**
34	Madurai	**238**
35	Kurnool	**231**
36	Davanagere	**227**
37	Rajkot (Gujarat)	**211**
38	Vellore	**211**
39	Katpadi (Tamil Nadu)	**203**
40	Mathura	**197**
41	Haridwar	**195**
42	Kolkata	**193**
43	Nagpur	**193**
44	Manali	**191**

Table A2: Cities with highest demand for intercity bus services, starting from the top 17 cities

S. no	City	Number of services terminating in city
45	Krishnagiri	**188**
46	Nellore	**182**
47	Kullu	**179**
48	Ahmednagar	**177**
49	Rishikesh	**177**
50	Aurangabad (Maharashtra)	**174**
51	Goa	**171**
52	Ongole	**171**
53	Haveri	**169**
54	Attur (Salem)	**168**
55	Shirdi	**168**
56	Hosur	**160**
57	Dehradun	**154**
58	Bhopal	**152**
59	Malegaon (Nashik)	**147**
60	Sojat	**145**
61	Kavali	**143**
62	Sankeshwar	**142**
63	Eluru	**141**
64	Humnabad	**134**
65	Harihar	**133**
66	T.P Gudem	**132**
67	Chennai	**127**
68	Hanuman Junction	**127**
69	Gannavaram	**126**
70	Muzaffarpur (Bihar)	**126**
71	Umerga	**125**
72	Ranebennur	**124**
73	Asansol (West Bengal)	**122**
74	Guntur (Andhra Pradesh)	**122**
75	Tirupur	**120**
76	Bhavani	**119**
77	Chilakaluripet	**115**
78	Jalandhar	**115**
79	Laxmangarh	**112**
80	Singarayakonda	**111**
81	Tirunelveli	**110**
82	Rajanagaram (Andhra Pradesh)	**108**
83	Kankroli	**105**
84	Ludhiana	**105**
85	Nagercoil	**103**
86	Kadapa	**101**
87	Burdwan	**100**
88	Jammu (Jammu and Kashmir (J&K))	**99**

Table A2: Cities with highest demand for intercity bus services, starting from the top 17 cities

S. no	City	Number of services terminating in city
89	Bhimadolu	**98**
90	Dindigul	**98**
91	Kundapur	**94**
92	Namakkal	**93**
93	Hath Kamba	**92**
94	Chalakudi	**91**
95	Marthandam	**90**
96	Perambalur	**90**
97	Ratangarh	**90**
98	Virudhnagar	**90**
99	Bangla	**89**
100	Bhim	**89**
101	Ravulapalem	**89**
102	Tanuku	**89**
103	Villupuram	**88**
104	Mahabaleshwar	**87**
105	Tirumangalam	**87**
106	Udupi	**87**
107	Tanguturu	**86**
108	Gundugolanu	**85**
109	Kadaiyanallur	**85**
110	Karur	**85**
111	Surathkal	**85**
112	Yanam	**85**
113	Bikaner	**84**
114	Naidupeta	**83**
115	Jalna	**82**
116	Thuvarankuruchi	**82**
117	Amritsar	**81**
118	Visakhapatnam	**81**
119	Mulki	**80**
120	Padubidri	**80**
121	Kovilpatti	**78**
122	Latur	**77**
123	Thrissur	**77**
124	Annavaram	**74**
125	Bhavnagar	**73**
126	Chiplun	**73**
127	Tuni	**72**
128	Hospet	**71**
129	Katra (J&K)	**71**
130	Valliyur	**71**
131	Pondicherry	**70**
132	Bathalagundu	**68**

Table A2: Cities with highest demand for intercity bus services, starting from the top 17 cities

S. no	City	Number of services terminating in city
133	Ernakulam	**68**
134	Udumalpet	**68**
135	Miraj	**66**
136	Nippani	**66**
137	Ichalkaranji	**65**
138	Nandyal	**65**
139	Proddatur (Andhra Pradesh)	**65**
140	Jaggampeta	**63**
141	Armoor	**62**
142	Sangameshwar	**61**
143	Allagadda	**60**
144	Ayyampettai	**60**
145	Durgapur (West Bengal)	**60**
146	Gandhidham	**60**
147	SriKalahasthi	**60**
148	Honavar	**59**
149	Melur	**59**
150	Sagar (Madhya Pradesh)	**58**
151	Sangli	**58**
152	Sindhnur	**58**
153	Addanki	**57**
154	Narayanapuram	**57**
155	Bhuj	**56**
156	Dungargarh	**56**
157	Burhanpur (Madhya Pradesh)	**56**
158	Ilkal	**55**
159	Thane	**55**
160	Ranchi	**54**
161	Pudukottai	**53**
162	Chirala	**52**
163	Shahapur (Karnataka)	**52**
164	Siliguri	**52**
165	Chittoor (Andhra Pradesh)	**51**
166	Jaysingpur (Kolhapur)	**51**
167	Manipal	**51**

Table A3: Operators with highest number of OD pairs covered originating from the 17 cities analysed

S. no.	Operator name	No. of cities covered out of the 17	No. of trips originating from the 17 cities
1	VRL Travels	5	**888**
2	IntrCity SmartBus	8	**660**
3	Orange Tours And Travels	4	**619**
4	Anand Travels	3	**439**
5	SRS Travels	3	**419**
6	Kallada Travels	3	**404**
7	Mahadev Travels	6	**397**
8	Gujarat Travels	6	**376**
9	Neeta tours and travels	2	**351**
10	V Kaveri Travels	2	**340**
11	M R Travels	7	**330**
12	Morning Star Travels	2	**317**
13	Sugama Tourist	1	**298**
14	Sri Krishna Travels	2	**289**
15	Vetri Travels	1	**286**
16	Laxmi holidays	2	**247**
17	NueGo	5	**227**
18	YBM Travels (BLM)	1	**224**
19	KKaveri Travels	1	**203**
20	Hans Travels (I) Private Limited	4	**193**
21	Sea Bird Tourist	2	**184**
22	City Land Travels	2	**178**
23	Shri Bhagiyalakshimi Travels (SBLT) (MAARA)	1	**168**
24	Yolo Bus	3	**167**
25	YAS TOURS AND TRAVELS	3	**161**
26	Chartered Bus	3	**159**
27	Parveen Travels	1	**159**
28	Manish Travels	4	**147**
29	Raj Ratan Tours And Travels	4	**146**
30	Tranz king travels	1	**140**
31	BSR Tours And Travels	1	**134**
32	Royal Travels	1	**134**
33	Murahara Travels	1	**124**
34	Jai Bajrang Travels	4	**123**
35	JaiSai Roadlinks (JSR)	1	**123**
36	National travels	1	**123**
37	Konduskar Travels Pvt. Ltd	2	**122**
38	Kerala lines	1	**120**
39	Ashok Travels Mandsaur Group	4	**111**
40	Orange Tours and Travels Platinum	2	**109**
41	Tranzindia Travels	1	**109**
42	Indu Travels	2	**107**

Table A3: Operators with highest number of OD pairs covered originating from the 17 cities analysed

S. no.	Operator name	No. of cities covered out of the 17	No. of trips originating from the 17 cities
43	MRM Travels	1	**104**
44	National Travels CHN	1	**102**
45	NueGo (partnered by Verma Travels)	2	**102**
46	Mayuri Travels	1	**101**
47	Dolphin travel house	2	**99**
48	SBM TRAANSPORTS	1	**91**
49	Jakhar Travels	4	**90**
50	Ramana Tours And Travels	1	**89**

Table A4: Top operators city-wise

The top operators in each city are listed below. In cities with fewer operators, operators with a minimum of 5 trips are listed. In cities with numerous operators, the list of the top 25 operators or all those with at least 50 trips are listed.

S. no. per city	City of origin	Operator name	Number of trips
1	Bengaluru	VRL Travels	**371**
2	Bengaluru	SRS Travels	**319**
3	Bengaluru	Sugama Tourist	**298**
4	Bengaluru	Kallada Travels (Suresh Kallada)	**204**
5	Bengaluru	Sea Bird Tourist	**158**
6	Bengaluru	IntrCity SmartBus	**134**
7	Bengaluru	Royal Travels	**134**
8	Bengaluru	Orange Tours And Travels	**129**
9	Bengaluru	Murahara Travels	**124**
10	Bengaluru	JaiSai Roadlinks (JSR)	**123**
11	Bengaluru	National travels	**123**
12	Bengaluru	Kerala lines	**120**
13	Bengaluru	Morning Star Travels	**96**
14	Bengaluru	Anand Travels	**94**
15	Bengaluru	Dream Line Travels Pvt Ltd	**75**
16	Bengaluru	No 1 Air Travels	**75**
17	Bengaluru	Svkdt travels	**75**
18	Bengaluru	Yolo Bus	**74**
19	Bengaluru	Indu Travels	**68**
20	Bengaluru	Lakshmi Gayatri Travels	**68**
21	Bengaluru	Orange Tours and Travels Platinum	**68**
22	Bengaluru	YAS TOURS AND TRAVELS	**68**
23	Bengaluru	Abhishek Bus	**67**
24	Bengaluru	KMS Travels	**67**
25	Bengaluru	Kukkeshree Travels	**66**

Table A4: Top operators city-wise

The top operators in each city are listed below. In cities with fewer operators, operators with a minimum of 5 trips are listed. In cities with numerous operators, the list of the top 25 operators or all those with at least 50 trips are listed.

S. no. per city	City of origin	Operator name	Number of trips
26	Bengaluru	MaNa Travels	**65**
27	Bengaluru	Sharma Transports	**65**
28	Bengaluru	Jihan luxury travels	**64**
29	Bengaluru	Pragathi Tourist Corporation	**64**
30	Bengaluru	Bharathi Travels	**61**
31	Bengaluru	Mahadev Travels	**61**
32	Bengaluru	NueGo	**57**
33	Bengaluru	RKT Tours and Travels	**56**
34	Bengaluru	SHREEKUMAR TRAVELS	**56**
35	Bengaluru	Punchiry Travels and Holidays	**55**
36	Bengaluru	V Kaveri Travels	**54**
37	Bengaluru	Jabbar Travels	**52**
38	Bengaluru	Sri Durgamba Travels	**52**
1	Chennai	Vetri Travels	**286**
2	Chennai	IntrCity SmartBus	**263**
3	Chennai	YBM Travels (BLM)	**224**
4	Chennai	Shri Bhagiyalakshimi Travels (SBLT) (MAARA)	**168**
5	Chennai	Parveen Travels	**159**
6	Chennai	Kallada Travels (Suresh Kallada)	**141**
7	Chennai	Tranz king travels	**140**
8	Chennai	Sri Krishna Travels	**106**
9	Chennai	MRM Travels	**104**
10	Chennai	National Travels CHN	**102**
11	Chennai	SBM TRAANSPORTS	**91**
12	Chennai	Yolo Bus	**84**
13	Chennai	Rathimeena Travels A	**77**
14	Chennai	Vignesh TATranscars	**74**
15	Chennai	VKV Travels	**71**
16	Chennai	Essaar	**68**
17	Chennai	Thirumalaivasan Transports	**68**
18	Chennai	LION Travels	**63**
19	Chennai	JB Connect	**60**
20	Chennai	RKK Travels	**59**
21	Chennai	SK Balu Bus	**59**
22	Chennai	Orange Tours And Travels	**58**
23	Chennai	S R T	**58**
24	Chennai	NueGo	**54**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
25	Chennai	YAS TOURS AND TRAVELS	**50**
1	Hyderabad	Orange Tours And Travels	**401**
2	Hyderabad	V Kaveri Travels	**286**
3	Hyderabad	Morning Star Travels	**221**
4	Hyderabad	KKaveri Travels	**203**
5	Hyderabad	Sri Krishna Travels	**183**
6	Hyderabad	BSR Tours And Travels	**134**
7	Hyderabad	Tranzindia Travels	**109**
8	Hyderabad	Mayuri Travels	**101**
9	Hyderabad	Ramana Tours And Travels	**89**
10	Hyderabad	IntrCity SmartBus	**78**
11	Hyderabad	Ajay Bus	**76**
12	Hyderabad	Jayanthi Travels	**76**
13	Hyderabad	Puri Jagannadh Tours And Travels	**73**
14	Hyderabad	SAMANVI CITICONNECT	**72**
15	Hyderabad	Mahi Trans Solutions	**64**
16	Hyderabad	DMR Travels	**62**
17	Hyderabad	Kallada Travels (Suresh Kallada)	**59**
18	Hyderabad	Sri Rama Travels	**59**
19	Hyderabad	KVR Tours and Travels	**58**
20	Hyderabad	Sri Sai Anjana Tours and Travels	**54**
21	Hyderabad	Dharani Tours and Travels	**53**
22	Hyderabad	YAS TOURS AND TRAVELS	**43**
23	Hyderabad	Ramesh Travels	**42**
24	Hyderabad	Orange Tours and Travels Platinum	**41**
25	Hyderabad	Indu Travels	**39**
1	Mumbai	VRL Travels	**253**
2	Mumbai	Neeta tours and travels	**235**
3	Mumbai	Anand Travels	**152**
4	Mumbai	Mahadev Travels	**79**
5	Mumbai	Humrahi Travels	**75**
6	Mumbai	Gujarat Travels	**74**
7	Mumbai	Dolphin travel house	**68**
8	Mumbai	Vaibhav travels	**65**
9	Mumbai	M R Travels	**56**
10	Mumbai	SRS Travels	**49**
11	Mumbai	IntrCity SmartBus	**47**
12	Mumbai	National travels ntsb	**44**
13	Mumbai	Manish Travels	**43**
14	Mumbai	Sai travels chembur	**41**
15	Mumbai	Purple Metrolink	**40**
16	Mumbai	Jai Bajrang Travels	**39**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
17	Mumbai	Mahalaxmi Bus (Lokre Bandhu)	**39**
18	Mumbai	Kaveri Travels and Tourist	**33**
19	Mumbai	Konduskar Travels Pvt. Ltd	**32**
20	Mumbai	PVS Tours and Travels	**32**
21	Mumbai	Golden	**30**
22	Mumbai	Jaguar KGN Travels	**30**
23	Mumbai	Reshma Tourist	**30**
24	Mumbai	Sanjay Travels	**29**
25	Mumbai	Konkan Tours & Travels	**28**
1	Pune	VRL Travels	**234**
2	Pune	Anand Travels	**193**
3	Pune	Neeta tours and travels	**116**
4	Pune	Konduskar Travels Pvt. Ltd	**90**
5	Pune	M R Travels	**74**
6	Pune	Gujarat Travels	**73**
7	Pune	Mahadev Travels	**68**
8	Pune	IntrCity SmartBus	**60**
9	Pune	Sanjay Travels	**57**
10	Pune	SRS Travels	**51**
11	Pune	Hans Travels (I) Private Limited	**40**
12	Pune	MB Link Travels	**37**
13	Pune	Mahalaxmi Bus (Lokre Bandhu)	**37**
14	Pune	Manish Travels	**35**
15	Pune	Shri Sairam Travels	**35**
16	Pune	Humsafar Travels	**32**
17	Pune	Dolphin travel house	**31**
18	Pune	National travels ntsb	**31**
19	Pune	Orange Tours And Travels	**31**
20	Pune	Paulo travels	**29**
21	Pune	Raj Ratan Tours And Travels	**29**
22	Pune	Jakhar Travels	**28**
23	Pune	Saini Travels Pvt. Ltd.	**28**
24	Pune	Jai Bajrang Travels	**26**
25	Pune	Kaveri Travels and Tourist	**26**
26	Pune	Sea Bird Tourist	**26**
1	Delhi	Laxmi holidays	**144**
2	Delhi	City Land Travels	**112**
3	Delhi	NueGo	**93**
4	Delhi	IntrCity SmartBus	**55**
5	Delhi	Ashok Travels Mandsaur Group	**45**
6	Delhi	SHRI KRISHNA TRAVELS (JAI SHREE GA-NESH YATRA CO.)	**34**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
7	Delhi	India Tours & Travels (GetBookCab)	**31**
8	Delhi	B R Travels	**30**
9	Delhi	Gola Bus Service	**30**
10	Delhi	Mahalaxmi Travels	**30**
11	Delhi	Shrinath Travel Agency Pvt. Ltd.	**30**
12	Delhi	Crown Travels	**28**
13	Delhi	Gajraj Travels	**26**
14	Delhi	Ashok Travels	**25**
15	Delhi	Northern Travels	**22**
16	Delhi	Shakti Travels	**22**
17	Delhi	Gujarat Travels	**20**
18	Delhi	Shree Hare Rama Travels	**20**
19	Delhi	Deltin Travels	**19**
20	Delhi	Subh Yatri Holidays	**19**
21	Delhi	Taj Express Bus Service Pvt Ltd	**19**
22	Delhi	zingbus	**19**
23	Delhi	SHEKHAR TRAVELS	**18**
24	Delhi	VIKAS TRAVELS	**18**
25	Delhi	Ashok tour and travels	**17**
1	Jaipur	Shrinath Travel Agency Pvt. Ltd.	**80**
2	Jaipur	Kalpana Travels Pvt. Ltd.	**55**
3	Jaipur	Karan Maharaja Travels	**54**
4	Jaipur	Vijay Tour and Travels	**50**
5	Jaipur	Mahadev Travels	**40**
6	Jaipur	M R Travels	**38**
7	Jaipur	Shri Sawriya Travels	**36**
8	Jaipur	Ashok Travels Mandsaur Group	**35**
9	Jaipur	B R Travels	**34**
10	Jaipur	Gujarat Travels	**32**
11	Jaipur	Pooja Travels	**32**
12	Jaipur	Rajat Rides Tours and Travels	**31**
13	Jaipur	Bhawani Travels	**29**
14	Jaipur	Mahalaxmi Travels	**29**
15	Jaipur	Siddharth Travels	**26**
16	Jaipur	SHRI KRISHNA TRAVELS (JAI SHREE GA-NESH YATRA CO.)	**25**
17	Jaipur	Shri Shanti Travels	**25**
18	Jaipur	Safar travels and cargo	**24**
19	Jaipur	Shakti Travels	**24**
20	Jaipur	Goldline Super Deluxe	**23**
21	Jaipur	Jain Shiv Shankar Travels	**21**
22	Jaipur	Shree Mahaveer Travels	**21**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
23	Jaipur	Gajraj Travels	**20**
24	Jaipur	Jain travels regd	**19**
25	Jaipur	PAL BUS (Patel Travels)	**19**
1	Ahmedabad	Gujarat Travels	**109**
2	Ahmedabad	M R Travels	**87**
3	Ahmedabad	Mahadev Travels	**80**
4	Ahmedabad	Shree Parshwanth Travels and Cargo	**54**
5	Ahmedabad	Patel tours and travels	**43**
6	Ahmedabad	Manish Travels	**38**
7	Ahmedabad	Jai Bajrang Travels	**31**
8	Ahmedabad	Jakhar Travels	**30**
9	Ahmedabad	Shrinath Solitaire Premium Class	**30**
10	Ahmedabad	H.k. travels	**28**
11	Ahmedabad	Chartered Bus	**25**
12	Ahmedabad	Rajat Rides Tours and Travels	**23**
13	Ahmedabad	Parshwanath Travel Pvt. Ltd	**22**
14	Ahmedabad	Safar travels and cargo	**21**
15	Ahmedabad	Shri Sawriya Travels	**21**
16	Ahmedabad	GR TRAVELS (RJ)	**19**
17	Ahmedabad	RMB Travel Agency	**19**
18	Ahmedabad	Shri Ganesh Travels	**19**
19	Ahmedabad	STARLINE BUS	**17**
20	Ahmedabad	Bhagyalaxmi Travels (Big Bull)	**16**
21	Ahmedabad	VRL Travels	**16**
22	Ahmedabad	Eagle Express	**15**
23	Ahmedabad	Western Bus	**15**
24	Ahmedabad	Royal Karnavati Travels	**14**
25	Ahmedabad	Shree Rajaram Travels	**14**
1	Surat	Mahadev Travels	**69**
2	Surat	Gujarat Travels	**68**
3	Surat	M R Travels	**53**
4	Surat	Manish Travels	**31**
5	Surat	Jai Bajrang Travels	**27**
6	Surat	Rajat Rides Tours and Travels	**27**
7	Surat	Vardhman Travels	**22**
8	Surat	Jakhar Travels	**19**
9	Surat	Jay khodiyar travels	**19**
10	Surat	Maharaja Paulo Travels	**19**
11	Surat	Shree Savariya Travels & Transport	**18**
12	Surat	Shri Krishna Travels	**16**
13	Surat	STARLINE BUS	**14**
14	Surat	Shri Ganesh Travels	**14**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
15	Surat	VRL Travels	**14**
16	Surat	Shree Rajaram Travels	**12**
17	Surat	Anjaniputra Travels	**11**
18	Surat	Pavan Travels	**10**
19	Surat	Shree Balaji Travels	**10**
20	Surat	Shrinath Travel Agency Pvt. Ltd.	**10**
21	Surat	Bhagyalaxmi Travels (Big Bull)	**9**
22	Surat	Maharudra Travels	**9**
23	Surat	Raj Travels Express	**9**
24	Surat	Samay Travels	**9**
25	Surat	Western Bus	**9**
1	Indore	Hans Travels (I) Private Limited	**97**
2	Indore	Raj Ratan Tours And Travels	**73**
3	Indore	Chartered Bus	**51**
4	Indore	Intercity Travels Indore	**38**
5	Indore	NueGo (Partnered by Verma Travels)	**34**
6	Indore	RTS RoyalStar	**29**
7	Indore	Verma Travels	**29**
8	Indore	Ashok Travels	**27**
9	Indore	Ashok Travels Mandsaur Group	**23**
10	Indore	Dhariwal Travels	**23**
11	Indore	Pawan Travels Indore	**23**
12	Indore	Om Sai Ram Travels	**19**
13	Indore	Chouhan Travels (I) Pvt Ltd	**17**
14	Indore	Citylink Travels	**17**
15	Indore	CITIZEN TRAVELS	**16**
16	Indore	Sutra Sewa (Maa Mekal Travels)	**15**
17	Indore	Jakhar Travels	**13**
18	Indore	M R Travels	**13**
19	Indore	Amardeep Travels	**12**
20	Indore	Citizen Travels	**12**
21	Indore	IntrCity SmartBus	**12**
22	Indore	Om Maa Mahashakti Travel	**11**
23	Indore	Ansari Travels	**10**
24	Indore	H.k. travels	**8**
25	Indore	Jogeshwari Enterprises	**8**
1	Chandigarh	Laxmi holidays	**103**
2	Chandigarh	City Land Travels	**66**
3	Chandigarh	MAHARAJA TOUR & TRAVELS	**25**
4	Chandigarh	Ram Dalal Holidays	**25**
5	Chandigarh	Abtc Tour and Travels	**23**
6	Chandigarh	Kedara Bus	**23**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
7	Chandigarh	Deltin Travels	**21**
8	Chandigarh	Northern Travels	**21**
9	Chandigarh	zingbus	**21**
10	Chandigarh	NueGo	**18**
11	Chandigarh	SHRI KRISHNA TRAVELS (JAI SHREE GA-NESH YATRA CO.)	**18**
12	Chandigarh	PAL Travel Lines	**16**
13	Chandigarh	SPEED BUS	**16**
14	Chandigarh	Jujhar Travels	**15**
15	Chandigarh	IntrCity SmartBus	**11**
16	Chandigarh	Himalayan Nomad KTC	**10**
17	Chandigarh	Yolo Bus	**9**
18	Chandigarh	GK Travels	**8**
19	Chandigarh	HOLIDAY APPEAL PRIVATE LIMITED	**8**
20	Chandigarh	Shree Balaji Travels	**8**
21	Chandigarh	BMS travels pvt.ltd	**6**
22	Chandigarh	Big Bus	**6**
23	Chandigarh	Guardian Tour and Travels	**6**
24	Chandigarh	Guardian Travels	**6**
25	Chandigarh	SAHARA TRAVELS	**6**
1	Kolkata	Shyamoli Paribahan Pvt Ltd	**66**
2	Kolkata	Greenline	**47**
3	Kolkata	SHYAMOLI Pvt. Ltd.(Karunamoyee)	**40**
4	Kolkata	Greenline (Karunamoyee)	**30**
5	Kolkata	Express Line	**28**
6	Kolkata	Express Line (Karunamoyee)	**15**
7	Kolkata	Dolphin tours and travels	**14**
8	Kolkata	JGD Travels Pvt Ltd.	**11**
9	Kolkata	Royal Cruiser	**9**
10	Kolkata	Shyamoli Yatri Paribahan (Karunamoyee)	**9**
11	Kolkata	Pammi Travels	**8**
12	Kolkata	Shivam Travels	**8**
13	Kolkata	Aitiana Airwings	**6**
14	Kolkata	Bengal Tiger	**6**
15	Kolkata	Grand	**6**
16	Kolkata	Pradhan	**6**
17	Kolkata	Raj Bus Services	**6**
18	Kolkata	Sana Travels	**6**
19	Kolkata	Suman sabir	**6**
20	Kolkata	RAUSHAN TRAVELS AND HOSPITALITY	**5**
1	Bhopal	Chartered Bus	**83**
2	Bhopal	NueGo (Partnered by Verma Travels)	**68**
3	Bhopal	Hans Travels (I) Private Limited	**47**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
4	Bhopal	Verma Travels.	**41**
5	Bhopal	Raj Ratan Tours And Travels	**32**
6	Bhopal	Rajveer Transport Service	**14**
7	Bhopal	M R Travels	**9**
8	Bhopal	Ashok Travels Mandsaur Group	**8**
9	Bhopal	Ashok Travels	**7**
10	Bhopal	Braj Travels	**7**
11	Bhopal	Chouhan Tour and Travels	**6**
12	Bhopal	Mishra Transport Co	**6**
13	Bhopal	Barkoti Travels	**5**
14	Bhopal	NueGo	**5**
1	Lucknow	Anshi Raj Shree Travels	**27**
2	Lucknow	Gola Bus Service	**27**
3	Lucknow	Samay Shatabdi Travels Pvt Ltd	**21**
4	Lucknow	GK Travels	**12**
5	Lucknow	Panwar Travels	**12**
6	Lucknow	Raj Ratan Tours And Travels	**12**
7	Lucknow	SHRINET TOUR AND TRAVELS	**12**
8	Lucknow	Shivansh travels	**11**
9	Lucknow	Hans Travels (I) Private Limited	**9**
10	Lucknow	RYS Travels	**9**
11	Lucknow	Indian Auto Wheels	**8**
12	Lucknow	Sethi Yatra Company	**8**
13	Lucknow	Gajraj bus service	**7**
14	Lucknow	Mahalaxmi Travels	**7**
15	Lucknow	Raaj Rath Travels Co.	**7**
16	Lucknow	Babu Travels	**6**
17	Lucknow	LATSAHIB BHAWANI TOUR AND TRAVELS	**6**
18	Lucknow	MJ Bhati Travels JJN	**6**
19	Lucknow	Panwar tour and Travels	**6**
20	Lucknow	R S YADAV SMART BUS PRIVATE LIMITED	**6**
21	Lucknow	Shree Mahalaxmi Travels	**6**
22	Lucknow	Shri Krishna Bus Service	**6**
1	Patna	Rohit Sewa	**44**
2	Patna	JGD Travels Pvt Ltd.	**28**
3	Patna	Raj Bus Services	**25**
4	Patna	VAISHALI TRAVELS	**15**
5	Patna	Maharani Express	**13**
6	Patna	RAUSHAN TRAVELS AND HOSPITALITY	**13**
7	Patna	Bengal Tiger	**11**
8	Patna	Sri Krishna Rath	**10**
9	Patna	Sri Krishna Tours and Travels	**10**
10	Patna	Super Pandav	**10**

Table A4: Top operators city-wise

S. no. per city	City of origin	Operator name	Number of trips
11	Patna	Panwar Travels	**9**
12	Patna	Jai Mata Di Travels	**8**
13	Patna	Dayan And Company	**7**
14	Patna	Aitiana Airwings	**6**
15	Patna	Maa Shanti Travels	**6**
16	Patna	New Travel India	**6**
17	Patna	Arzoo Travels	**5**
1	Bhubaneswar	Dolphin tours and travels	**37**
2	Bhubaneswar	Grand	**15**
3	Bhubaneswar	Pradhan	**15**
4	Bhubaneswar	Shyamoli Paribahan Pvt Ltd	**13**
5	Bhubaneswar	Aryan Travels	**10**
6	Bhubaneswar	Shivam Travels	**10**
7	Bhubaneswar	Shree Nila Madhaba Travels	**10**
8	Bhubaneswar	Greenline	**8**
9	Bhubaneswar	Nilamadhab Travels	**8**
10	Bhubaneswar	Grand Travels	**6**
11	Bhubaneswar	Auroashish Travels	**5**
12	Bhubaneswar	BANKE BIHARI (SNT)	**5**
13	Bhubaneswar	BANKE BIHARI (CHANDAN)	**5**
14	Bhubaneswar	Diana Travels	**5**
15	Bhubaneswar	Jai Mata Di Bus Service	**5**
16	Bhubaneswar	Manika Travels	**5**
17	Bhubaneswar	Mohapatra Travels	**5**
18	Bhubaneswar	Reliance Travels	**5**
19	Bhubaneswar	Sana Travels	**5**
20	Bhubaneswar	Sona Chandi	**5**
1	Guwahati	Raj Bus Services	**5**
2	Guwahati	Chartered Bus - ASTC	**2**
3	Guwahati	GURUNANAK TRAVELS	**2**
4	Guwahati	NETWORK TRAVELS	**2**
5	Guwahati	RAYAN TRAVELS	**2**
6	Guwahati	Sima Five Star Travels	**2**
7	Guwahati	Jai Mata Di Travels	**1**

Annexure 2: Questionnaire for bus operators

Market Survey of Intercity Bus Operators in India – OPERATOR SURVEY

Date:	
Name of the surveyor:	
Location of Survey:	

	Name of the operator **Type of legal entity** **(Pvt. Ltd., LLP, Partnership, Individual, any other)**	
	Number of buses, divided by type of bus	12m AC Diesel 12m Non-AC Diesel 12m AC CNG 12m Non-AC CNG 9m AC Diesel 9m Non-AC Diesel 9m AC CNG 9m Non-AC CNG
	No. of buses by type of permit	Stage carriage Contract carriage School bus Others
	No. of buses by type of operation	Intercity buses Corporate/ Office transport School buses Others (please specify)
Fleet details	**Type of ownership**	Own Rent/ Lease Tie-up to operate under banner
	No. of buses by type of ownership	No. of firsthand vehicles No. of secondhand vehicles Others

Market Survey of Intercity Bus Operators in India – OPERATOR SURVEY

Date:	
Name of the surveyor:	
Location of Survey:	

Fleet Details	**Average age of secondhand buses at the time of purchase**	
	Number of buses by category of bus make	Fully built bus Bus chassis and body separately
Operations	**Average age of fleet**	
	What is the average life of a bus? (firsthand until sale)	
	What is the average life of a bus? (secondhand until sale)	
	Number of staff employed by the organisation	
	Top 5 routes operated	1) Origin-Destination
		2) Origin-Destination
		3) Origin-Destination
		4) Origin-Destination
		5) Origin-Destination
	Avg. no. of hours of operation per day	
	Longest break available for the bus during the day	
	Vehicular km/day	
	Staff per bus	Drivers per bus
		Cleaners per bus
		Mechanics per bus
	Fleet-wide average Occupancy Ratio	
	Location of overnight parking	Govt. bus stand/ Pvt. Parking/ On-road

Market Survey of Intercity Bus Operators in India – OPERATOR SURVEY

Operations	**Total cost of operations per km/ month for intercity buses**	Type of bus
		Staff cost per month
		Diesel cost per month
		Maintenance cost per month
		EMI on loan
		Permit fees per month/ year
		Motor-Vehicle Tax per month
		Toll-road fees per month
		Administrative expenses per month
		Parking fees in cities
		Other costs
	Average Income per day (or per month or per km)	
	Average revenue per passenger	
	Average cost of the vehicle	
	Source of Capital/ Finance/ Loan	Own/ Bank/ NBFC (Mention name)
	Loan to Value (% of bus cost covered by loan)	
	Loan tenure	
	What is the collateral shown for loan?	
	How often do you refinance buses?	Regularly/ Occasionally/ Never
	What is the typical refinance tenure?	

Number of buses planned to be purchased over the next 3 years	
Fuel technology priority order for the future	Diesel/ CNG/ Electric/ Other
Rank the following challenges with diesel/ CNG intercity bus operations (1-Most difficult to 10 least difficult)	Availability of finance
	Cost of finance
	Cost of fuel (Diesel/ CNG)
	Hiring and managing staff
	Vehicle model availability and quality
	Revenue recovery of operations cost
	Availability of permit
	Cost of permit
	MV Tax
Are you planning to induct e-buses in the future?	Yes/ No

Market Survey of Intercity Bus Operators in India – OPERATOR SURVEY

Rank the following barriers to adopt e-buses (1-ost difficult to 10-least difficult)	Inadequate knowledge on their performance
	Lack of vehicle models
	Lack of range required
	High cost of vehicle
	Lack of access to finance
	Inadequate charging infrastructure
	Lack of space to park and charge buses
	Lower permit fees
	Remove toll tax
	Lower MV tax
What is your preferred business model for e-buses?	Own and operate
	Lease/ rent buses from Government with revenue risk
	Lease/ rent buses from private entities with revenue risk
	Operate buses on a fixed income basis (without revenue risk)
Rank the following improvements in financing of intercity buses	
	Increase the loan share of bus cost
	Reduce interest rate
	Increase loan tenure
	Improve ease of access to loan
Questions on transitioning to electric buses	
Cost of bus	
Range needed in single charge	
Time acceptable for overnight charging	
Time acceptable for opportunity charging	
Willingness to pay for overnight parking facility for current buses	
Willingness to pay for overnight parking facility for electric buses	
Location preference for charging: STU depots/ Private parking/ Along highways	
Source of finance	Bank/ NBFC/ Other
Policy reforms needed	Subsidy/ low-interest loan/ Ease of loans

Annexure 3: List of key stakeholders consulted during the study

S. No.	Type of stakeholder	Individual contacted	Designation	Agency name
1	Operator	Prasanna Patwardhan	President	Bus & Car Operators Confederation of India (BOCI) (MD, Prasanna Purple Mobility Solutions)
2	Operator	Vijay Shankar	Executive Director	BOCI
3	Operator	Afzal A	General Secretary	BOCI (MD, Parveen Travels)
5	Operator	Sanyam Gandhi	Director	Chartered Speed
5	Financial institution	Sumit Mittal	COO & Director (Finance)	Green Cell Mobility
6	OEM	Sachin Nijhavan	Chief Commercial Officer	Switch Mobility
7	OEM	Vivek Gupta	Chief Financial Officer	JBM
8	OEM	Saravanan Janarthanan	Head New Ventures	Caussis Mobility
9	Development finance institution	Gerald Ollivier	Lead Transport Specialist	The World Bank
10	Development finance institution	Kartik Gopal	Senior Industry Specialist-Electric Vehicles	International Finance Corporation
11	Financial institution	Mudit Jain	Head of Research	Tata Cleantech
12	Financial institution	Ajay Srinivasan	Senior Vice President, Industry Analytics & Policy Advisory	HDFC Bank
13	Financial institution	Abhishek Kumar	Vice President, Investment Banking Group	HDFC Bank

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S. No.	Type of stakeholder	Individual contacted	Designation	Agency name
14	Financial institution (VC)	Venkatesh Modi	Investment Manager	Blume
15	Financial institution (VC)	Jayant Prasad	Founder	Ckers
16	Financial institution (VC)	Mahua Acharya	Founder	International Energy Transition Platform (INTENT)
17	Financial institution (VC)		Chief Risk Officer	Large conglomerate that also manufactures e-buses
18	Financial institution (VC)		Fund Manager	Well-known performance credit AIF
19	Financial institution (VC)	Kunal Khattar		Advantedge
20	Financial institution (VC)	Shishir Maheshwari	Cleantech Investor	Eversource Capital
21	Financial institution (NBFC)	Nehal Gupta	Managing Director	AMU Leasing
22	EV leasing business	Amit Kumar	CEO	Gensol EV leasing business
23	EV leasing business	Ankit Singhvi		Macquarie Asset Management
24	Operator	Surya Khurana	Managing Director-India	Flixbus
25	Operator	Nataraja Sharma	Chairman	Karnataka Bus Operators Association
26	Operator	Kapil Raizada / Manish Rathi	Founders	IntrCity
27	Operator	Balasaheb Khaire	Chairman	Pune District Bus Operator Association

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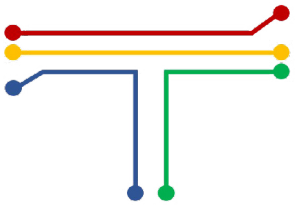
S. No.	Type of stakeholder	Individual contacted	Designation	Agency name
28	Operator	Rohit Pardeshi	Chief Operating Officer	Prasanna Purple Mobility Solutions Pvt. Ltd.
29	Operator	Rajendra Patil	Chief Advisor	Bus Owners Seva Sangh, Mumbai Metropolitan Region (BOSS)
30	Operator	Nataraja Sharma	Convenor	Karnataka Bus Operators Association
31	Operator	Maran	General Secretary	Tamil Nadu Omni Bus Owners Association
32	Operator	Anbalagaan	President	All Omni Bus Owners Association
33	Financing Institution	Kapil Garg	Managing Director	Mufin Green Finance Ltd.
34	Operator	Rohan Dewan	CEO	Leafy Bus



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