



WORKING PAPER

# Assessing financing challenges for implementing the large-scale electric bus program in India

Manish Dutta Pandey, Aswathy KP, and Pawan Mulukutla

## CONTENTS

- Executive summary ..... 2
- Introduction..... 3
- Methodology..... 4
- Setting the context..... 6
- Analysis and findings ..... 9
- The way forward: Policy interventions and suggestions ..... 14
- Appendix A .....17
- Appendix B ..... 19
- Appendix C .....20
- Appendix D ..... 21
- Glossary .....22
- Endnotes.....23
- References.....25
- Acknowledgments.....28
- About the authors.....28

*Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback, and to influence ongoing debate on emerging issues.*

**Suggested Citation:** Pandey, M.D., Aswathy KP and P. Mulukutla. 2024. "Assessing financing challenges for implementing the large-scale electric bus program in India." Working Paper. WRI India. Available online at: <https://doi.org/10.46830/wriwp.23.00087>.

## HIGHLIGHTS

- India is at an early stage of an unprecedented bus fleet transition, aiming to deploy 50,000–60,000 electric buses (e-buses) in the coming years, which will require an estimated US\$7.75 billion (INR 643 billion) in debt financing.
- Unlike earlier models, where buses were usually procured and operated by public transport agencies (PTAs), new e-buses will be deployed through public-private partnership models, where private operators receive gross-cost contracts from PTAs to run e-buses.
- Given the high capital requirements, effective e-bus financing is critical for scaling up India's e-bus program. This working paper aims to understand the early-stage challenges in India's e-bus financing from financier and operator perspectives, drawing from interviews with multiple stakeholders and experts.
- Bus financiers are wary of PTAs' poor financial health and the potential performance risks of new technologies. Therefore, they demand significant collateral from operators through corporate guarantees, making it difficult for operators to bid for many e-bus projects due to the significant debt implications.
- Payment security mechanisms, greater transparency in the financial and operational performance of e-buses, and banking sector reforms could alleviate some of these issues. However, long-term sustainability requires reforms to improve PTAs' efficiency and financial performance.

---

## EXECUTIVE SUMMARY

### Context

Decarbonizing the transport sector is crucial for reducing greenhouse gas (GHG) emissions. To achieve this, the Government of India (GoI) has prioritized electric vehicle (EV) adoption, with a particular focus on buses (PIB 2023a).

The Faster Adoption and Manufacturing of Electric (and Hybrid) Vehicles in India (FAME) scheme provided crucial financial support to PTAs, resulting in the deployment of approximately 8,000 e-buses across India (MoRTH n.d.). This expanded e-bus deployment also marked a departure from conventional bus procurement methods, where PTAs tended to purchase and operate buses themselves. Current and planned fleet augmentation is through public-private partnerships (PPPs) (PIB Delhi 2023), where private operators run buses under a gross-cost contract (GCC). Under GCCs, the private sector is expected to bring in debt and equity financing, with private operators being paid on a per-kilometer operating basis by PTAs under a mobility service agreement. However, the financing terms offered by commercial lenders and PTAs' inability to make timely payments to operators pose significant challenges to the sustainable growth of private operators and expansion of e-bus deployment.

India has ambitious plans to accelerate the e-bus transition through initiatives such as the National Electric Bus Program (NEBP) and the PM-eBus Sewa scheme, aiming to deploy 50,000–60,000 e-buses in subsequent years. It is crucial to understand and address the challenges associated with financing e-buses.

### About this paper

This working paper aims to capture, through focused consultations with stakeholders and a secondary literature review, the challenges in raising finances for public e-bus projects. We conducted discussions with multiple stakeholders (roundtable and one-on-one interactions) involved in the e-bus procurement process. Broadly, stakeholders are classified into primary, secondary, and tertiary stakeholders:

- Primary stakeholders include e-bus original equipment manufacturers (OEMs) and their subsidiaries, traditional bus operators, and new e-bus operators. They are responsible for raising investment for projects.
- Secondary stakeholders include financiers, non-banking financial companies (NBFCs), and other commercial banks supporting bus financing. They are the enablers, providing the capital necessary to procure and deploy e-buses.

- Tertiary stakeholders are officials from PTAs that currently operate e-buses or plan to augment their e-bus fleets. Their role in arranging the initial finance is limited, but they are responsible for paying the per-kilometer monthly fee throughout the contract.

These interactions aimed to provide insights into two key questions:

- What are the current constraints in financing e-bus projects for private operators under the existing model?
- What measures need to be taken to facilitate more favorable financing terms?

The obtained responses helped identify sectoral challenges related to manufacturing capacity scale-up, contract management, bankability, access to financing, financing rates, and loan tenure.

We conducted an extensive literature review to understand how the highway and solar power generation sectors in India evolved and the policy incentives that mobilized private investment in PPP projects. We assessed in depth the hybrid annuity model in the highway sector and the Solar Energy Corporation of India model in the solar power sector because of their relevance to e-bus projects. E-bus projects can leverage learnings from models addressing funding gaps in highway construction (ADB 2022) and mitigating payment risks from loss-making distribution companies (Sharma 2019). These findings will help policymakers assess the challenges involved in attracting large-scale private investment in a sector with financially weak public agencies and facilitate private financing for PTAs to enable them to transition to electric fleets.

### Key findings

This study identified the following key findings:

**E-bus projects rely heavily on commercial banks for debt financing; however, the high collateral demanded by financiers limits private operators' ability to scale up deployment in line with the demand for electrification.** Debt for e-buses is predominantly secured against corporate guarantees and assets beyond the project, rather than being tied directly to project cash flows. The requirement of high collateral limits operators' ability to secure additional debt for new projects. The cost of guarantees and other financing risks are reflected in the higher bid rates quoted by operators.

**Short repayment tenures resulting in negative cash flows, coupled with delayed payments from PTAs, create financial stress, increasing the need of private operators for higher working capital.** E-bus projects typically have long concessions of up to 12 years, whereas financing is offered for tenures

extending up to 7 years. Mismatches between loan tenures and concession tenures result in negative cash flows and a greater reliance on working capital. Moreover, payment delays by PTAs have a cascading effect, impacting the operators' capacity to service debt and maintain sufficient working capital.

**According to the concession terms offered to operators, PTAs are responsible for payments. However, payment delays and defaults are shouldered by operators, limiting debt financing based on project revenues and necessitating guarantees from operators.** In the infrastructure sector, because the public agency bears the project revenue risks, including it as a party to lending agreements gives lenders the reassurance to invest. The public sector must safeguard payments or project revenues in e-bus projects to lower the lenders' requirement of debt collaterals, unblocking capital for the private sector. Such mechanisms can play a pivotal role in unlocking private investments in the e-bus sector.

**Stakeholders emphasized that a long-term payment security mechanism (PSM) to reduce e-bus operators' financial risk and improved transparency regarding PTAs' financial health and e-bus performance would enable private investments in the sector.** As in the solar power generation sector, if concessions are backed by a PSM, operators will be able to access payments promptly in case of delays by the contracted PTA, facilitating timely debt servicing. Because lenders lack credible financial data on PTAs and their payment history, they cannot assess counterparty payment risks and hence rely on the borrower's collateral. Including the sector in the infrastructure sub-sector list and providing priority sector lending would ease the availability of finance. These measures can help the sector develop lending regulations, obtain alternative funding from institutional and retail investors, and access low-cost capital for e-bus projects.

## INTRODUCTION

### Background

Over the past decade, India has made significant investments to facilitate bus electrification, channeling substantial resources into this initiative. The country has implemented various fiscal and regulatory measures to accelerate electric vehicle (EV) manufacturing and adoption across vehicle segments. Two flagship schemes, Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) and PM-eBus Sewa, launched in 2017 (for e-buses) and 2023, respectively, aim to incentivize public transport electrification (MoHUA 2023).

Public sector fleets, managed by public transport agencies (PTAs), currently operate 0.15 million buses across states and union territories (PIB 2020), of which 8,200 (as of September

2024) are e-buses (MoRTH n.d.). Through schemes such as the National Electric Bus Programme (NEBP) and PM-eBus Sewa, the Government of India (GoI) plans to increase the number of e-buses to 60,000 within a couple of years. Though the deployment is currently focused on urban bus services, scaled procurement for intercity and mofussil services are underway. These e-buses will be procured under a gross-cost contract (GCC) model, where PTAs compensate private operators on a per-kilometer basis.<sup>1</sup> Private operators are expected to procure and operate the buses, marking a shift from the conventional operating models in which PTAs procure and operate most buses themselves.

Although e-buses have lower operating costs, their up-front capital requirement is significantly higher, 200–300 percent more than diesel buses. The estimated cost of deploying 60,000 e-buses, including the supporting charging infrastructure, is US\$7.75 billion (INR 643 billion).<sup>2</sup> Under the GCC model, private operators (including manufacturers and their subsidiaries, traditional and new operators) are responsible for acquiring finance for these buses. Given the risks of constantly evolving technology and counterparty payment risks by loss-making PTAs, operators face challenges in obtaining equity and raising commercial debt for e-bus projects.

The e-bus industry's nascent stage and the associated risks hinder e-bus project financing in multiple ways, which must be addressed to achieve the ambitious national targets. Globally, studies have highlighted procurement hurdles for e-bus fleets, such as financing challenges, financing time horizons, inflexible financing instruments, the need for credit guarantees, and the imperative for risk sharing by third parties (Li et al. 2019; Moon-Miklaucic et al. 2019; Sclar et al. 2019). However, India faces unique challenges due to the scale of the deployment, its strong domestic manufacturing ecosystem, and the lack of a private operator ecosystem to address its national ambitions. China's large-scale e-bus deployment relies heavily on subsidies and incentives despite strong domestic demand and supply (*Times of India* 2023; UITP 2021; Yiyang and Fremery 2022; You 2023).

India is at a critical juncture where accelerating the e-bus procurement process is essential to meet its ambitious climate targets. The current bus fleet size and the significant number of overaged buses (about 0.6 million buses are expected to be 15 years old by 2030) necessitate urgent fleet expansion to meet the rising demand. Despite several initiatives, including large-scale procurement efforts, the participation rate in recent tenders has been low, slowing the procurement pace. During the pre-bid meetings, in which WRI India also participated, stakeholders expressed concerns about investing in scalable procurement programs.

Reports published in India have highlighted the need to financially incentivize e-bus adoption scale-up (Gadepalli et al. 2019), develop alternative business models to improve GCC contract conditions (World Bank 2022), and use public-private partnerships (PPPs) to finance public buses, including e-buses (ADB 2023; ASRTU and ITDP 2023). However, they have not fully addressed these challenges from borrowers' and lenders' perspectives. Because the envisioned e-bus procurement relies on PPP arrangements and the scale of investment, it is crucial to understand the perspectives of all the major parties involved in the process to ensure its success.

## Objectives and scope of the study

This study aims to identify the key challenges in financing e-bus projects and obtain preliminary insights into short- and medium-term approaches that could yield an impact, through a stakeholder participatory approach and secondary research. The objectives are as follows:

- Identify the existing primary challenges in financing e-bus projects.
- Review PPP arrangements in other public sectors to identify suitable interventions that can be used to unlock private financing and abate financial risks in the public transport sector.
- Synthesize regulatory and policy interventions that stakeholders in the field recommend to facilitate financing for e-bus projects in the short and medium terms.

This study aims to assess the financial requirements related to the GoI's recently announce plans for the public sector over the next few years (MoHUA 2023). Although it employs stakeholder interactions for the assessment, it restricts itself to the perspectives of lenders, borrowers, and OEMs (see Figure 1). Further, the study does not examine existing business model case studies within the bus sector, because numerous peer-reviewed papers and reports have covered them (ASRTU and ITDP 2023; MoHUA 2021; Swamy 2014; Swamy and Patel 2014; Gadepalli et al. 2019). Finally, because multiple studies (DIMTS 2016; MoHUA 2019; SSEF and Janaagraha 2020; WRI India 2021b, 2022b) have covered long-term public sector reforms in national and state funding programs, fare regulations, institutional arrangements for implementation, and other measures to improve PTAs' operational and financial efficiencies, this paper does not cover policy reforms for strengthening PTA performance.

## Limitations

This study is subject to certain limitations.

First, reliance on the personal opinions and perceptions of stakeholders introduces the potential for bias in the responses.

To address this, we conducted multiple interactions with the same set of experts using similar questions to cross-verify perspectives and information. Also, because these stakeholders primarily represent urban operations<sup>3</sup> (mostly metropolitan cities), a regional bias may arise when the study is extended to suburban/rural areas. Further, challenges may differ in smaller and medium-sized cities, and the consulted experts may not have fully addressed these regional differences. Second, commercial lending to large-scale projects involves detailed project evaluation and risk analysis by lenders, which may differ for financing institutions; moreover, the finer details of recourse requirements, interest rates, and other conditions remain confidential between the borrowers and lenders. Therefore, the study relied on publicly available information and assumptions shared by experts. Finally, the paper does not suggest any long-term policy reforms to strengthen PTA performance.

## METHODOLOGY

Although information on the bus sector is widely understood within the industry, it is not always thoroughly documented in the existing research. This gap highlights the importance of stakeholder consultations in capturing nuanced insights and practical experiences that are not readily available in published studies. Because large-scale e-bus procurement under PPPs is relatively new, these consultations are crucial for addressing real-world challenges not fully explored in the academic literature or industry reports. Hence, we qualitatively assessed the PPP model through stakeholder interactions and a secondary literature review covering related sectors. A detailed description of the methodology follows.

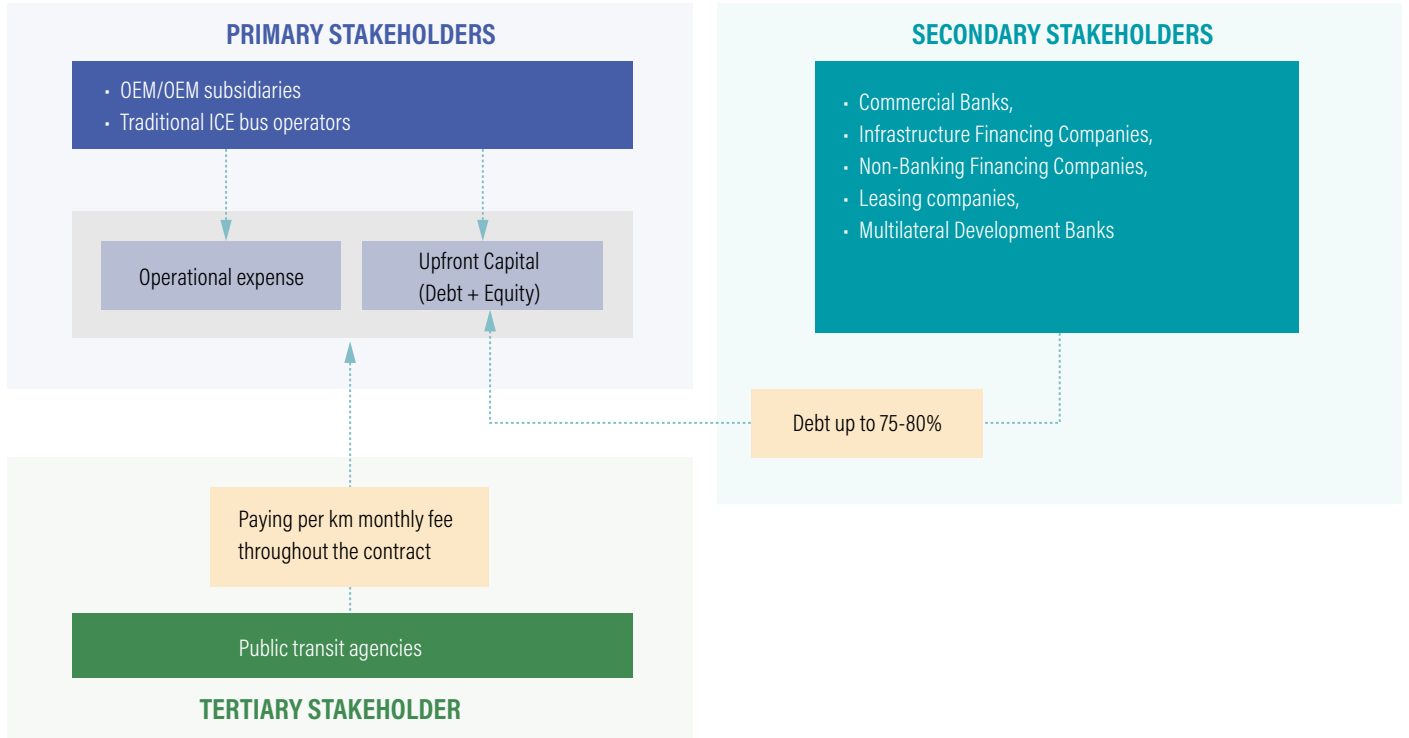
## Stakeholder interactions

### Mapping the stakeholders

Various stakeholders, ranging from manufacturers to operators to investors and transit agencies, play essential roles in e-bus financing. To understand the dynamics of, and interactions among, these stakeholders more effectively, we classified them into primary, secondary, and tertiary categories (Figure 1). This classification enabled us to capture perspectives, insights, and challenges in a structured manner, facilitating a better understanding of the ecosystem.

Under the existing structure, private operators bear significant risks, including raising investment for projects, and the flow of financing largely depends on their ability to raise capital, both debt and equity. Hence, the study considered original equipment manufacturers (OEMs) and their subsidiaries, specifically established for execution, along with traditional bus operators, as the primary stakeholders. Traditional bus operators, with their regional and operational expertise, can facilitate large-scale nationwide e-bus operations. However,

Figure 1 | Stakeholder mapping



Note: ICE = internal combustion engine. OEM = original equipment manufacturer.

Source: Created by WRI India authors.

they have been largely absent due to the qualifications<sup>4</sup> stipulated in the tender clause. All OEMs that procured e-buses or participated in tendering were considered for inclusion in our interactions.

The main secondary stakeholder identified was lenders to such projects, predominantly represented by the commercial banking sector. Infrastructure financing companies (IFCs), including non-banking financial companies (NBFCs), were also included in the stakeholder group. In addition, EV leasing companies, multilateral development banks (MDBs), and sector experts were also identified as secondary stakeholders. These stakeholders are already involved in or interested in investing in bus financing.

Although PTAs procure services, they are often not directly involved in financing agreements and play a limited role in raising commercial financing for projects. PTAs have, therefore, been identified as tertiary stakeholders in the research. The PTAs that participated in the aggregated tenders were invited to roundtable discussions, with active participation from Delhi and Mumbai—the cities with the largest e-bus fleets in the country—along with other cities that have long-term plans for electrifying their bus fleets.

### Stakeholder meetings and interactions

WRI India conducted three roundtable discussions to identify the challenges faced by lenders and borrowers in financing e-bus projects. A brief description of the roundtables and stakeholders (organizations) is provided in Appendix A. Subsequently, multiple semi-structured one-on-one interviews were conducted with the same set of stakeholders with a similar set of questions. Ten OEMs/traditional bus operators and six commercial banks and NBFCs were interviewed during this process. Also, multiple officials from five PTAs participated in these interactions. Table 1 describes the focus areas of the discussions held with the stakeholders.

### Literature review: Learnings from other infrastructure sectors and PPP projects

We also conducted a literature review of PPP projects in India, focusing on highway and solar projects. We reviewed a range of sources, including policy documents, government orders, circulars and amendments, peer-reviewed reports from the Council on Energy, Environment and Water (CEEW), the Asian Development Bank (ADB), and the World Bank, and gray literature such as newspaper articles. This literature

Table 1 | **Focus areas of discussions with stakeholders**

STAKEHOLDER	FOCUS AREA OF DISCUSSION
Primary stakeholder	<ul style="list-style-type: none"> <li>▪ Ability to scale up manufacturing</li> <li>▪ Issues with contract bankability</li> <li>▪ Access to debt and equity financing for e-bus projects</li> <li>▪ Policy support required to improve financing conditions</li> </ul>
Secondary stakeholder	<ul style="list-style-type: none"> <li>▪ Current debt offering, including financing rates</li> <li>▪ Tenures offered to e-bus projects and commercial ICE fleet finance</li> <li>▪ Factors affecting the bankability of contracts</li> <li>▪ Asset and counterparty risks in public e-bus projects</li> <li>▪ Risk mitigation measures</li> <li>▪ Impact of selected policy measures</li> <li>▪ Banking directives to enhance financing conditions</li> </ul>
Tertiary stakeholder	<ul style="list-style-type: none"> <li>▪ Current challenges for scale-up and possible solutions</li> </ul>

Note: ICE = internal combustion engine.

Source: Created by WRI India authors.

review examined various aspects of PPP models, including agreement structures, concessional tenures, roles and responsibilities of stakeholders, project funding and financing structures, private financiers’ contributions, and policy initiatives that facilitated private investment in these sectors.

Although we examined the highway and solar sectors in depth, metro projects were also initially reviewed. Two metro PPP projects—Rapid Metro Gurgaon and the Delhi Airport Metro Express Line—were prematurely taken over by DMRC due to flawed concessions, overestimated ridership, and financial challenges. Both projects, based on net cost contracts (NCC),<sup>5</sup> failed because although the fares were regulated by public agencies, the private sector bore all the revenue risk. PPP projects under The Metro Rail Policy, 2017, which real-locates risks to the public sector, are yet to be operationalized, limiting the sector’s ability to learn from policy evolution.

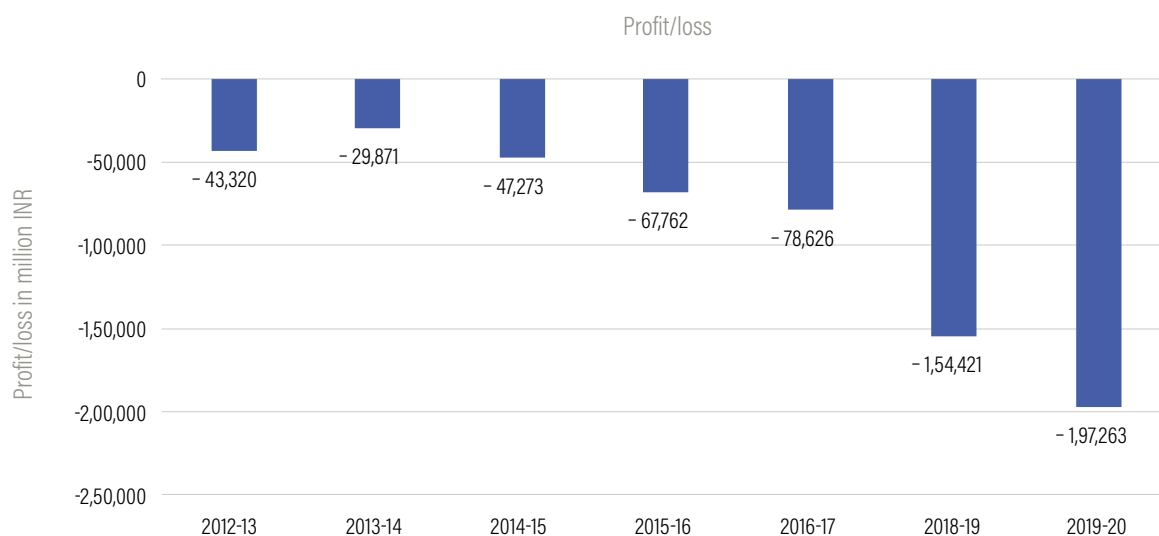
Highways and solar power development projects have witnessed the highest flow of private capital among the infrastructure sub-sectors, with stakeholders citing clear policy learnings. Although the highways and solar sectors differ from e-bus projects (in terms of technology performance, operational and maintenance costs, etc.), they depend on private sector debt leveraging<sup>6</sup> for project construction and a mix of project revenues and/or government funding to service debt (Roy 2015). A review of these sectors identified learnings from policy interventions that have mitigated risks for lenders and successfully catalyzed private investments.

## SETTING THE CONTEXT: FUNDING AND FINANCING PUBLIC BUS TRANSPORT IN INDIA

Publicly managed bus-based systems are traditionally owned and operated by PTAs. PTAs either operate buses themselves or through a PPP model. For PTAs that operate buses themselves, state governments provide capital funding for bus procurement and related infrastructure, including maintenance facilities and passenger amenities such as terminals and bus shelters. A few PTAs also use commercial debt to finance capital for bus fleets. The operational expenditure, which includes fixed costs (such as human resources, cost of capital, taxes, and administration costs) and variable costs (such as fuel and other consumables),<sup>7</sup> is primarily funded through user fares<sup>8</sup> regulated by the state. However, farebox revenues are often insufficient to cover the full operational expenditure. Therefore, state governments provide additional grants to bridge the viability gap between farebox revenues and operational costs (CIRT 2022).

PTAs face significant challenges due to stagnating ridership and revenues and escalating operational costs, widening the gap between revenue and expenditure. A summary of this gap for all PTAs providing urban bus services from 2012–13 to 2019–20 is depicted in Figure 2. It illustrates a substantial

Figure 2 | Cumulative losses of reported by PTAs



Note: INR = Indian rupee. PTAs = public transport agencies.

Sources: CIRT 2022, MoHUA 2019.

deterioration in financial performance, with the gap widening from INR 29.87 billion in 2013–14 to INR 197.26 billion in 2019–20. Such a pronounced disparity between revenue and expenditure severely hampers the PTAs' ability to deliver efficient services to their customers, procure new fleets, replace aging vehicles, establish supporting infrastructure, and implement modern technology-based interventions.

## PPP arrangements in public bus transport in India

PPPs are adopted in bus operations to reduce the financial burden on PTAs and improve cost efficiency by leveraging the private sector's ability to access finance for up-front investments. This involvement meets the sector's investment needs, which was the primary reason for introducing PPPs (WRI India 2021a). The first formal PPP in urban bus services was implemented in Indore in 2006 (Atal Indore City Transport Services Limited n.d.). Between 2006 and 2013, the urban operation market witnessed the growth and pilots of various PPP models such as NCC, GCC, and hybrid models (MoHUA 2021). During this period, cities also received financial support from the Jawaharlal Nehru National Urban Renewal Mission<sup>9</sup> (JNNURM, 2006–14) to introduce city bus services under the PPP model (WRI India 2021a).

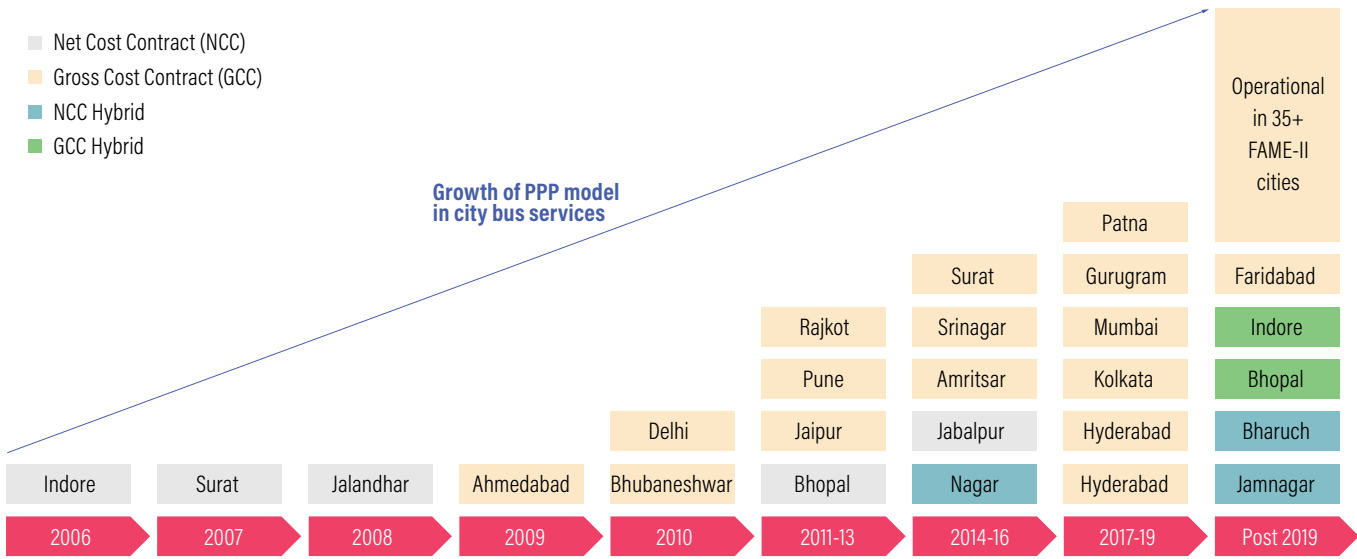
Although the NCC (Indore) model was first introduced in India, it was not widely adopted due to issues with service quality and reliability (ASRTU and ITDP 2023; Swamy 2014; WRI India 2021a). The high revenue risks associated with regulated fares for private operators made large-scale

private participation in urban operations financially unviable. Hence, cities, including Indore, later switched to the GCC model. The GCC model has emerged as the dominant model because it allows PTAs to monitor and control service quality, linking operator payments to performance metrics. By transferring the revenue risk to the PTAs, the GCC model has facilitated greater private sector participation. PPPs, with support from the JNNURM, which brought large-scale investments into the sector, have seen some success, with the private sector acting as service providers under GCC agreements (Swamy 2014). Figure 3 depicts the expansion of GCC models across Indian cities.

## PPP arrangements in e-bus deployment in India

In 2017, the Department of Heavy Industries (DHI) included demand incentives for e-buses under the ongoing FAME scheme. In the first phase of this scheme, cities were authorized to procure e-buses outright or under the GCC model. However, the second phase of the FAME scheme (2019) mandated the GCC model, allocating technology and performance risks to the private sector. Demand incentives supporting the deployment of 6,862 e-buses across 64 cities (PIB 2023b) were initially allocated. However, the lack of standardized operational parameters, varying technical specifications, variation in the volume of buses, and the lack of capacity in cities for adoption of the GCC model led to low uptake of e-buses despite central incentives of up to INR 5 million<sup>10</sup> per bus (WRI India 2022a). In response, the DHI focused on deployment in only nine cities with populations exceeding 4 million.

Figure 3 | Growth of PPP models in Indian cities



Note: FAME = Faster Adoption and Manufacturing of Hybrid and Electric Vehicles. PPP = public-private partnership.  
 Source: MoHUA (2021), with further revisions by WRI India.

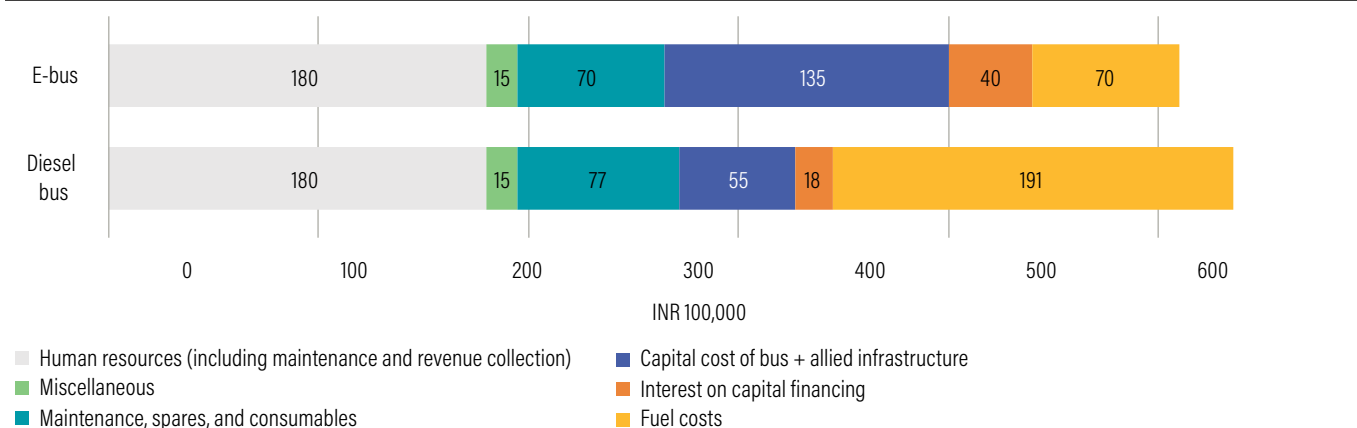
To facilitate this, Convergence Energy Services Limited (CESL), a fully owned subsidiary of Energy Efficiency Services Limited, was nominated to aggregate demand from these eligible cities. CESL launched the Grand Challenge (GC), with standardized contracting terms and e-bus specifications, which led to reductions in bid rates that were up to 25 percent lower than those for comparable internal combustion engine (ICE) buses (CESL 2022a).

Figure 4 provides a lifecycle cost<sup>11</sup> comparison between 12 meter (m) standard diesel buses and e-buses for operation in urban conditions over a 10-year period.<sup>12</sup> The figure shows

that the lifetime cost of operating e-buses is lower than that of diesel buses, primarily due to fuel cost savings.

This success led to the launch of the NEBP, which targeted the aggregated procurement of 50,000 e-buses, and later the PM-eBus Sewa scheme, which provided central assistance in the form of viability gap funding (VGF) for 10,000 e-buses across medium and small cities.<sup>13</sup> The PM-eBus Sewa scheme, in particular, targets 169 medium- to small-sized cities with populations ranging from 4 million to less than 0.5 million (MOHUA 2023). Figure 5 depicts a timeline of policy reforms in India’s public bus system.

Figure 4 | Cost of operating 12 m e-buses and diesel buses in urban conditions

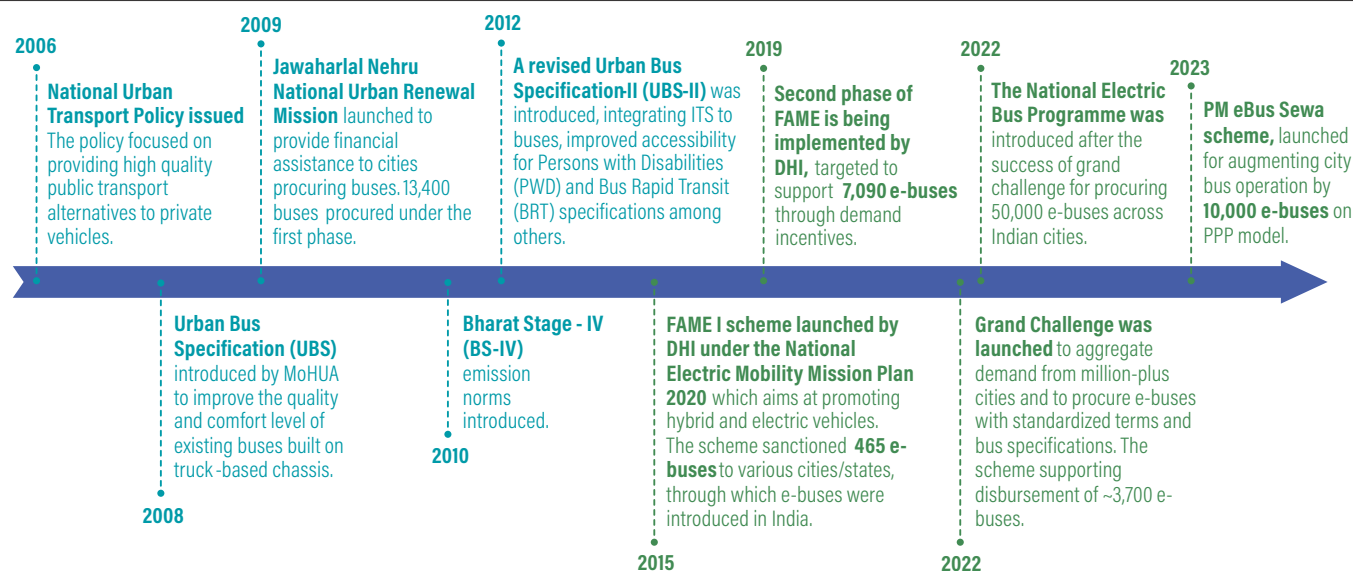


Note: ICE = internal combustion engine. INR = Indian rupee. m = meter.

Source: Estimated by WRI India authors based on tender conditions, bid price under the National Electric Bus Programme NEBP, and consultations with industry experts. Calculation assumptions—capital cost of e-buses and ICE buses: INR 13.5 million (including allied infrastructure) and INR 0.55 million, respectively; fuel cost for e-buses and ICE buses: 9 INR/kWh and 90 INR/liter, respectively; and maintenance cost for e-buses and ICE buses: 10 INR/km and 11 INR/km, respectively. The miscellaneous cost is taken as INR 0.15 million for both types of buses.



Figure 5 | Timeline for policy and financial reforms in India's public bus systems



Note: DHI = Department of Heavy Industry. FAME = Faster Adoption and Manufacturing of Hybrid and Electric Vehicles. ITS = Intelligent Transportation System. MoHUA = Ministry of Housing and Urban Affairs. PPP = public-private partnership.

Source: Compiled based on policy documents and ministry webpages/documents (CESL 2022a, 2022b; MHI 2019; MoHUA 2023; PIB 2021).

## ANALYSIS AND FINDINGS

### Stakeholder perspectives on the e-bus financing ecosystem

Individual stakeholder interviews and roundtables held by WRI India captured the current challenges and concerns regarding financing e-bus projects from the perspectives of lenders and borrowers. Traditional operators have been unable to participate in aggregated tenders because they are unable to meet the financial qualifications for projects. The market currently has only one sizable true operating company, Greencell Mobility,<sup>14</sup> which participates directly as bidders and operates buses manufactured by multiple OEMs. The other bidders include operating companies set up by e-bus OEMs, relying on the parent OEM's financial credentials to participate in tenders.

Debt for e-bus projects is offered by a few commercial banks and NBFCs such as the Power Finance Corporation (PFC) and the Rural Electrification Corporation. Private operators must provide 25 to 30 percent equity, with the remaining 70 to 75 percent requiring bank guarantees and collateral (ADB 2023). Project financing is available for up to seven years, with interest rates based on the Marginal Cost of funds-based Lending Rate (MCLR) (8.5–9 percent per annum) plus a risk premium of 1.5 to 2.5 percent per annum<sup>15</sup> (ADB 2023). The high cost of e-buses and infrastructure has increased the entry barrier for traditional operators, raising equity requirements from 10 percent for ICE buses to 30 percent for e-buses. In addition, commercial debt is challenging due to small balance sheets and collateral needs.

The following subsections summarize the perspectives of different stakeholders on the business model and contracting terms for implementing e-bus-based public transit projects, financing conditions, and constraints (both internal and external).

#### Lender's perspective and challenges

- Financiers have highlighted that the sector's ecosystem is underdeveloped, and asset performance in line with the contractual terms poses significant risks.
- The GCC model of e-bus deployment for public services is the preferable model because farebox revenue risks are covered by the counterparty in the service contracts. However, the credit rating or financial status of the contracting agencies is largely unavailable, and PTAs have historically faced financial losses. The counterparty payment risks for public e-bus projects are significant.
- The performance of e-buses with constantly changing battery technology through the life of 10- or 12-year contracts is not tested in any of the contracts. The residual value of the buses and batteries remains undetermined due to the lack of a secondary market.
- Commercial banks offer project financing for 70 percent of the project cost and working capital to operators or OEM subsidiaries. The tenure varies between 5 and 7 years, and second batteries for e-buses are not financed.
- Debt is offered against the balance sheets of the parent OEMs or group companies against collateral, often through corporate guarantees. The collateral value depends on the project size and multiple financial parameters.

---

## Borrower's perspective and challenges

### Traditional bus operators

- Financiers have highlighted that the sector's ecosystem is underdeveloped, and asset performance in line with the contractual terms poses significant risks.
- The GCC model of e-bus deployment for public services is the preferable model because farebox revenue risks are covered by the counterparty in the service contracts. However, the credit rating or financial status of the contracting agencies is largely unavailable, and PTAs have historically faced financial losses. The counterparty payment risks for public e-bus projects are significant.
- The performance of e-buses with constantly changing battery technology through the life of 10- or 12-year contracts is not tested in any of the contracts. The residual value of the buses and batteries remains undetermined due to the lack of a secondary market.
- Commercial banks offer project financing for 70 percent of the project cost and working capital to operators or OEM subsidiaries. The tenure varies between 5 and 7 years, and second batteries for e-buses are not financed.
- Debt is offered against the balance sheets of the parent OEMs or group companies against collateral, often through corporate guarantees. The collateral value depends on the project size and multiple financial parameters.

### OEMs and subsidiaries

- OEM subsidiaries have cited contracting terms requiring OEMs to be part of the executing consortium and high financial qualification criteria excluding traditional bus operators; as a result, subsidiaries are forced to bid and arrange financing for public tenders.
- OEMs currently have manufacturing capacities for large orders, but assets remain on their books for the concession tenure, making companies asset heavy. This model makes it increasingly difficult for OEMs to participate in new tenders.
- Operating subsidiaries form new special purpose vehicles (SPVs) for executing projects, but financing for projects is based on the health of the parent OEMs' balance sheets.
- Currently, project financing offered by commercial banks is not based on project cash flows but against collateral by the parent OEM. This reliance on recourse-based lending limits the scaling up of e-bus deployment to meet the national targets set by the GoI.
- Scaling up of e-bus deployment will require newer models where leasing companies can own assets, relieving OEMs and their subsidiaries of this burden and enabling

them to focus on manufacturing and operating buses. However, viable leasing offerings that address market needs are absent.

- OEM subsidiaries highlighted the high risks borne by them in contracts and their obligation to service debt despite payment delays by PTAs. This has raised working capital requirements and impacted the overall cost of providing services under the model.

## Sectoral challenges in financing e-bus projects

National and state policies for electrification of public transport and the lower operational costs of EVs than those of traditional ICE vehicles imply that electric fleet augmentation will continue to be spearheaded by PTAs, who will need to replace their aging fleets and reduce operational costs to improve their financial health. However, to scale up the deployment of e-buses in line with the demand of PTAs under the established GCC model, where assets are financed by private operators, the following challenges must be addressed.

The first challenge is that in the absence of non-recourse-based project financing, collateral is required from parent OEMs, which significantly impacts the capacity of operating subsidiaries to scale operations. Each new project's debt reduces OEMs' debt service coverage ratio (DSCR) and hampers their ability to arrange financing at favorable interest rates for the new projects envisaged by the national programs and schemes. Increasing debt impacts the financial health of companies and may impact capital flow for other functions, such as manufacturing e-buses. The absence of financing options, with only a limited number of commercial banks and NBFCs offering debt to e-bus projects, constrains private investment, hindering the pace of e-bus project deployment.

Second, e-bus projects continue to pose significant counterparty risks. PTAs, a key stakeholder of projects, do not participate as counterparties in financing agreements, and the project revenue risks are borne by the operators. The existing payment security mechanisms (PSMs), such as escrows, have been implemented inconsistently across contracts, with operators relying on working capital for operational expenses and debt repayment in case of payment delays. Extended periods of payment delays by PTAs hamper the ability of operators to service debt consistently. Lenders have limited data to assess the financial health of PTAs issuing contracts due to the unavailability of audited financial reports or credit ratings, reducing their confidence in such projects.

Third, the shorter financing tenure for the 10–12-year concession period for e-bus projects impacts cash flows during the repayment period. Non-infrastructure project financing is offered by public and private banks for a maximum tenure

of 84 months (7 years), whereas infrastructure loans can be extended for a period 2 years lower than the project concession tenures. To reduce the performance risks of assets, lenders typically offer debt based on the first life of buses or battery packs. The monthly debt repayment is highly sensitive to the tenure, with shorter tenures leading to unsustainably high repayment liabilities for operators. Currently, operators refinance existing projects by extending repayment tenures and reducing outflows for debt servicing.

Cash flow models developed using NEBP tender conditions and factoring in operators' expected expenditures indicate significant negative cash flows for the debt repayment years. Figure 6 presents the estimated cash flows for air-conditioned 12 m e-bus operation.

OEM subsidiaries that form SPVs for project execution often rely on capitalization by their parent companies and/or working capital loans to cover the shortfall. Operators often repay the interest on debt up front to better manage debt repayment and project cash flows. The flow of capital to the operating subsidiary is often decided by the parent

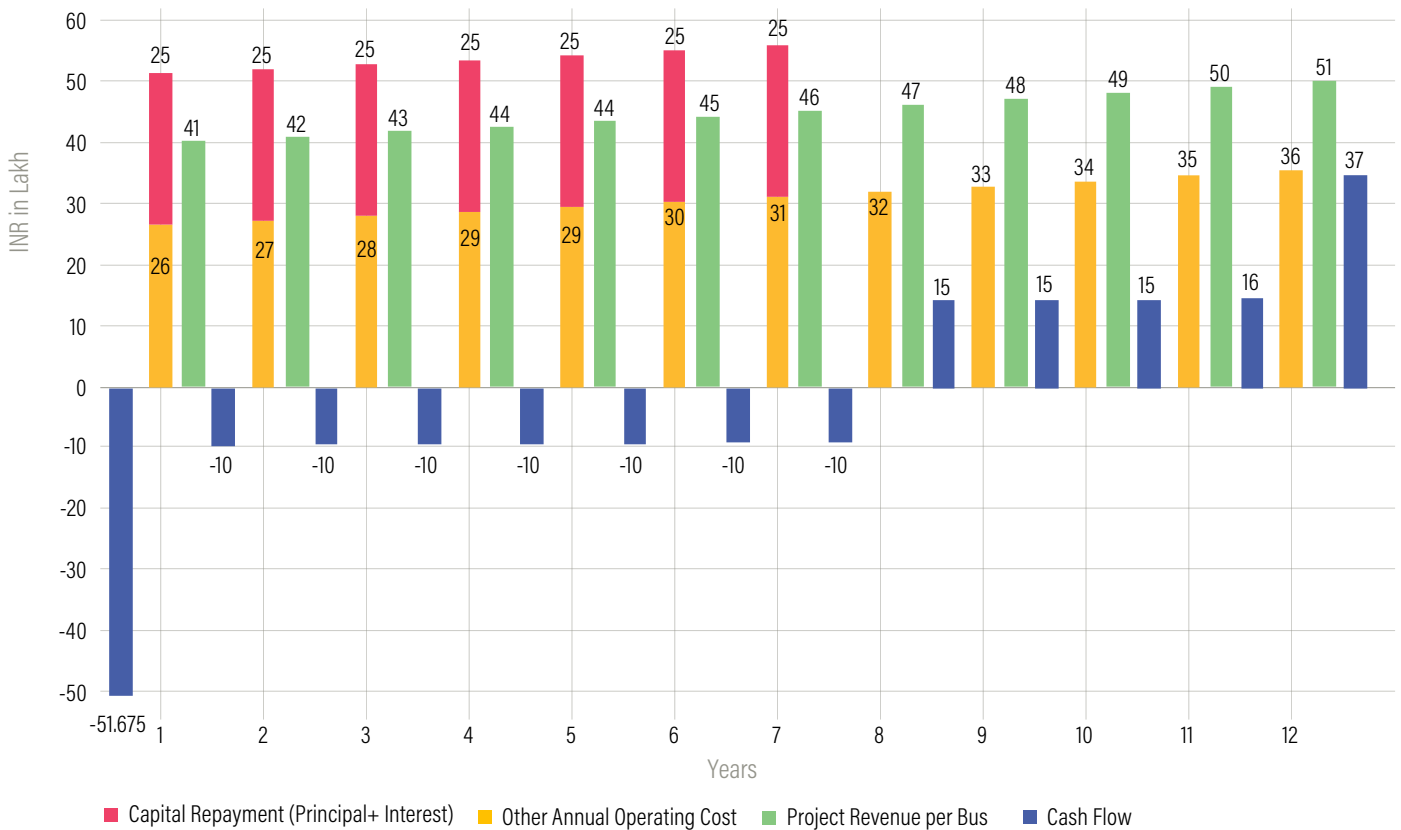
manufacturing company, which impacts participation in tenders and manifests as a premium in bid rates and reluctance to participate in a new bid.

### Policy learnings enabling private financing for infrastructure projects

We reviewed the development of the highway construction and solar power generation sectors to gather insights into effective policy interventions that promote private investment. By examining the supportive lending regulations, innovative business models, and dependable default and guarantee structures in these sectors, we aimed to extract valuable learnings to encourage private investment.

Infrastructure projects are often unable to cover project costs from direct user fees and are therefore dependent on government funding, because governments are best placed to capture the indirect benefits from these projects. Enabling private financing remains a key aspect of scaling up infrastructure in developing countries such as India. Investment barriers, however, often limit the scale and pace of private sector investment

Figure 6 | Estimated project cash flow per bus for 12 m AC e-bus operation



Note: AC = air-conditioned. m = meter.

Source: Estimated by WRI India authors based on tender conditions, bid price under the National Electric Bus Programme (NEBP), and industry expert consultations.

in infrastructure projects. Governments play a crucial role in mitigating project risks and streamlining project cash flows, such as capital expenditure, revenues, and VGF, to encourage private commercial financing in different sectors. Appendix B explains the context of government support for infrastructure projects and PPP financing in India.

### PPP and private investments in highway construction

The road sector was one of the first sectors to implement PPP in highway construction and has witnessed over three decades of ecosystem evolution. Although public spending has been the key driver of highway development, the highways sector has witnessed the highest inflow of private capital in the country. Garg and Dayal (2020) describe the evolution of the sector in two phases: the initial experiment phase (1996–2006) and the maturity phase (2007–2016).

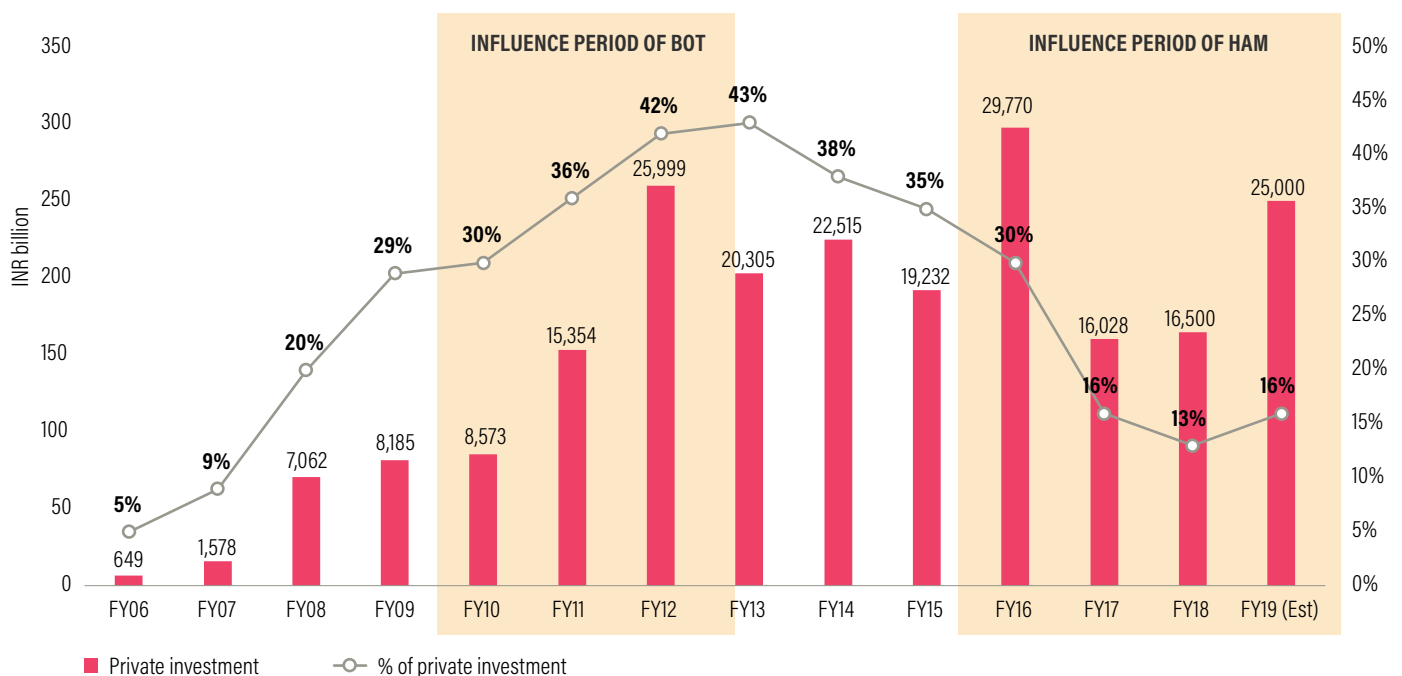
Early adoption of PPP in the sector was limited to small upgrade projects, with 20 highway projects awarded between 1996 and 2000. A national program for 13,000 km of four-lane highways was launched in 1999. However, with limited competition and an immature market, of the 322 road projects undertaken to upgrade the highways under the

program, only 22 projects for toll-based concessions and 27 annuity-based concessions were awarded (Ramakrishnan and Raghuram 2012).

In 2006, model concession agreements for toll-, grant-, and annuity-based highway projects incorporating past learnings were approved by the central government. This marked the beginning of the maturity phase, which witnessed the growth of private investment from INR 6.49 billion in financial year (FY) 2006 to INR 259.99 billion in FY2012. This phase witnessed a staggering growth in build-operate-transfer (BOT)<sup>16</sup> projects despite multiple challenges. Delays in land acquisition and environmental clearances leading to cost escalation and aggressive bidding by developers with optimistic traffic projections and external economic shocks led to several stalled projects and non-performing assets (NPAs) in the sector. With significant equity and debt capital locked in stalled projects, the flow of money into highway projects slowed to a trickle (Garg and Dayal 2020).

In response, the hybrid annuity model (HAM) (MoRTH 2016) for highway construction was introduced. Appendix C explains this model, which is a cross between engineering, procurement, and construction (EPC)<sup>17</sup> and BOT (annuity). It reallocated risks between developers and the authority, and succeeded in reviving investments in the sector. Since its introduction in 2016, the share of HAM projects quickly grew

Figure 7 | Increase in private sector investment under PPP model



Note: Figures in INR crores. BOT = build-operate-transfer. FY = financial year. HAM = hybrid annuity model. PPP = public-private partnership. Source: CRISIL and FICCI 2019.

Another measure to attract private investment to the sector was the introduction of the toll-operate-transfer (TOT)<sup>18</sup> model, which allowed monetization of operational road assets for long-term investors. Projects under TOT have established revenue streams and attracted private players, including sovereign funds, wealth funds, and private equity players, who have the option of exiting in two years. Also, infrastructure investment trusts (InIvTs) offer a divestment platform that the private sector can use to leverage existing assets and source capital for other projects.

### Learnings from the highway sector

The above mentioned policy interventions were key to funding the ambitious Bharatmala Pariyojana, which aims to develop and upgrade 34,800 km of national highways. Thus far, under Bharatmala, 46.9 percent of projects have been awarded as EPC, 1.4 percent as BOT, and 51.7 percent as HAM (NHAI 2023). In comparison, the e-bus sector has reached a mature stage, with a defined business model under GCC and standardized contracts. However, learnings from the highways sector can inform proactive policymaking for the e-bus sector. The HAM model allocated traffic growth and toll revenue risks to the NHAI, with the government covering 40 percent of the bid project cost (BPC) during construction and providing semiannual annuity payments thereafter. Private investors covered the remaining 60 percent through equity and debt (ADB 2022). The reduced private investment requirement and a strong counterparty, the NHAI, significantly lowered risks for financiers and boosted private investment in the sector.

Road projects are included in the harmonized list of infrastructure sectors by the Reserve Bank of India (RBI). This allows the government and the private sector to access long-term institutional capital (patient capital) and retail investors through Securities and Exchanges Board of India (SEBI)-regulated instruments such as infrastructure debt funds. Inclusion of e-bus projects under the infrastructure sub-sector could allow the sector access to liberalized lending norms by banks for the infrastructure sector and other market-based instruments to fund equity for projects. The highway sector has also leveraged innovative financing mechanisms such as raising investments from Life Insurance Corporation and Employees Provident Fund Organization and raising masala bonds.<sup>19</sup> Other monetization models such as 100 percent equity divestment<sup>20</sup> (AZB & Partners 2023; PIB 2015) and harmonious substitution for concessionaires have helped revive financially stressed projects and boosted interest in new road projects.

### Private investments in solar power generation

As of March 2024, the installed solar energy capacity in India had increased 30 times in the last nine years and stood at 81.81 GW (Manohar 2024). The National Solar Mission,

launched in 2010, initially set a target of 20 GW by 2022. The first large-scale solar park, a 250 MW facility, was inaugurated in 2012 at Charanka in Gujarat, with a base tariff of INR 15/kWh for the first 12 years, supported by subsidies for distribution companies (DISCOMs) due to the high cost of power. Since then, solar power costs have dropped significantly, with aggressive bids dropping to as low as INR 1.99/kWh. Single bids often target mega-scale projects, with tenders of 1,000 to 2,000 MW issued by Solar Energy Corporation of India (SECI).

The Indian experience draws attention to the importance of the state's active involvement in accelerating the first generation of investments for developing solar power (Palit 2018). States provided subsidies in the form of viability gap arrangements up to a third of the project cost. Banks were initially hesitant to lend to the sector, partly due to the outstanding stress on the thermal power sector and reservations about the technology, performance, and high costs. Banks demanded sizable recourse and lending tenures of 10 years, significantly less than the expected financial viability of projects aligned to 25-year power purchase agreements (PPAs) (as explained in Appendix D). Traditionally, DISCOMs in India are owned by states and have been suffering from fiscal losses because they operate in a highly regulated market. This makes it difficult for them to make timely payments to power producers. The poor financial health of DISCOMs raises the price at which power producers can raise capital due to the risk on receivables. Private NBFCs took advantage of the absence of banks and dominated the sector in its initial years of growth (Palit 2018).

To reduce both the perception and the quantum of this risk for investors, the government has ensured multiple levels of payment security in renewable energy (RE) PPAs, such as letter of credit, default escrow agreement, payment security fund, tripartite agreement, and state government guarantee (Sharma 2019). In 2017, the GoI established a payment security fund (PSF) worth \$220 million (INR 15 billion), administered by SECI, to mitigate counterparty payment delays and defaults.

Since 2017, solar power developers have reduced their reliance on bank debt by tapping into alternate financing sources, especially bonds from the international market. Financing through green bonds costs significantly less than financing through bank loans. Domestic bonds also entered the market soon after, in 2016. Now flush with unprecedented funds, Indian mutual funds invested in high-rated renewable bonds, helping RE companies by providing lower rates, increasing lender competition, and opening a new avenue for funding operating projects. Other financing sources included infrastructure debt funds (IDFs), a new category of NBFCs.

---

## Learnings from the solar power generation sector

SECI, a nodal agency under the Ministry of New and Renewable Energy (MNRE), serves as a power procurement intermediary, procuring power from developers and selling it to power distribution companies (i.e., DISCOMs) through long-term PPAs. SECI-supported tenders are backed by a tripartite agreement between the GoI, state governments, and the RBI. Under the agreement, in case of a default by DISCOMs, the GoI can withhold financial assistance to state governments. The DISCOM pays the fees (with late charges) to SECI, which then transfers the amount back to the PSF to safeguard the developers against future defaults. This arrangement serves as the strongest deterrent against defaults by DISCOMs. The tripartite arrangement has also improved the credit ratings of SECI and in turn reduced the risk premiums for lenders to RE projects.

Although e-bus projects are inherently more complex due to technological challenges, fluctuating demand and revenue, and high operational costs, the known risks can be mitigated, and the sector's financial attractiveness can be improved through strategies used in other sectors. For example, models that address viability gaps in highway construction and maintenance and structures to mitigate payment risks from loss-making DISCOMs can be applied to public transport. The next section outlines potential interventions to tackle challenges in the e-bus sector and enhance its financial viability and attractiveness.

## THE WAY FORWARD: POLICY INTERVENTIONS AND SUGGESTIONS

Bus-based public transport systems across the world face several challenges: falling ridership, competition from other modes, increasing costs of service provision, and reliance on government subsidies. Bus systems require constant subsidies or VGF to sustain operations; however, states do not use a structured approach to address planning, budgeting, and timely transfer of funds, weakening the financial position of PTAs. The financial attractiveness of a sector is dependent on its financial sustainability and cognizance of sectoral risks.

Addressing long-term sustainability is key if the sector is to attract affordable financing. Road transport being a state subject, the primary role of state governments is to serve as a regulator, ensuring that proper services are provided to the citizens. Other than the farebox revenues, which constitute up to 90 percent of revenues, grants through budgetary provisions or state or national schemes and borrowings through state guarantees are the funding sources of PTAs. The role of state

governments in supporting transport services and determining the financial health of PTAs is crucial. Governments at the national and state levels have become cognizant of the need for sustained VGF to bus transport with central assistance under the PM-eBus Sewa, state schemes, and the Chief Minister's Urban Bus Service Scheme in Gujarat supporting bus services throughout their life. Such schemes address the operational deficit and cash flow issues, improve the creditworthiness of PTAs, and make it easier for private operators to raise finances.

Although the GCC will continue to remain the prevalent model for deploying e-buses in urban areas, regional PTAs with in-house staff will need to look at alternative models such as own-and-operate and leasing models to ensure the utilization of their existing staff. The creditworthiness of PTAs will determine the volumes and terms for financing the scaled transition, which makes state-level reforms for financing bus services essential. In addition, PTAs need to address internal inefficiencies to increase ridership and lower the costs of service delivery, adopt technology, and build capacities to improve their financial health, making the overall sector attractive for commercial financing.

However, given the long-term nature of the sectoral reforms required and the national ambition of scaling up e-bus fleets, stakeholders have suggested various interventions to help the sector attract private investments and improve the bankability of PTA service contracts.

## Data and transparency

All stakeholders have requested that operational and financial data for the sector be made available. Only a few PTAs have been rated previously by credit rating agencies. However, this is not a standard practice, nor is it mandated for PTAs. The absence of such data hampers the ability of bidders and lenders to accurately assess the risks associated with projects. Lenders, in particular, have stressed the need for financial data on PTAs to better assess counterparty risks and appropriately pursue collateral from operators. In the absence of reliable data, payment delays and default risks are borne by the operator. Stakeholders have suggested that credit ratings be assigned for all PTAs, in line with the recommendation in the report 12th Annual Integrated Rating and Ranking of Power Distribution Utilities, under the framework approved by Ministry of Power with the PFC as the nodal agency (PFC 2024).

An intervention by the GoI mandating annual reporting of fiscal performance by PTAs receiving central assistance can give lenders vital inputs that will inform their investment decisions, reducing short-term risks of delays or defaults and making it less likely that projects will become NPAs in the long term.

## Improve the financial ability of PTAs to service contracts

The public transport sector, similar to many other public utility and services sectors that are restricted by regulated tariffs, relies on public funding to meeting its operational costs. PTAs' dependence on the state or ULBs for operational gap funding leads to liquidity issues, which in turn adversely impacts their obligation to make timely payments to operators. Learnings from the solar power generation sector demonstrate that a PSM can provide counterparty payment security to lenders, reducing guarantees and collateral requirements on loans and thus enabling operators to actively participate in future contracts.

The GoI has been actively pursuing PSMs, providing default guarantees through a PSF. A bilateral statement by India and the United States Government to develop a PSM for 10,000 e-buses in India was issued in June 2023 (PIB 2023c). The Ministry of Heavy Industries (MHI) has been tasked with designing the PSM to facilitate investments by the US Government and other philanthropic monies to enable deployments of buses under the PM-eBus Sewa scheme.

The PSM is currently under development, and a favorable structure should include the following features:

- To achieve the long-term vision of transitioning public transport across the country, a permanent but flexible PSF managed by a central entity must be established. This will signal a long-term commitment by the GoI to the sector and strengthen private investments in projects.
- The PSF should be flexible, allowing future contracts safeguarded by the fund.
- The fund should allow for other grants, philanthropic monies, and low-cost capital such as credit guarantee structures provided by MDBs to enhance the PSF's coverage.
- Ideally, the fund should be established as a revolving fund, with defaults being replenished by the state to ensure the health of the fund and enhance the state's fiscal accountability. A similar mechanism in the renewable power generation sector under SECI has decreased defaults and eased private financing for projects.
- Digitization of invoicing, service level agreement (SLA) monitoring, and payment processing should be introduced to ensure monitoring of payments, dispute resolution, and timely payments for e-bus contracts.
- Lack of access to financial data on, and the transaction history of, transit agencies makes it difficult for lenders to assess risks in the sector. The proposed PSM should

aim to set up a database on payment history and possibly credit ratings for participating agencies, enhancing the bankability of projects for lenders through an informed risk assessment framework.

Although it is difficult to estimate the direct impact of the structure in terms of reduced interest rates and in turn reduction in per-kilometer rates, private bidder participation for contracts not safeguarded by a PSM is likely to remain low. In the long term, the intervention will increase the confidence of lenders in offering debt to the sector, attract IFCs, and lower reliance on the banking system for debt.

## Enhancing credit ratings of the counterparty

Given the financial status of PTAs across the country, the incentive for organizations to get themselves rated is low. Their financial position is comparable to that of DISCOMs, who face losses annually and are dependent on state budgetary provisions. The SECI model, where a new entity with sufficient financial backing and high credit rating was created, can be replicated in the public transport sector. Aggregated procurement through a central agency makes it easier to introduce a central counterparty in PTA concession agreements. With an adequate PSM in place and digital monitoring of services, the SECI-like entity can either make payments directly to operators or make payments only in case of delays by PTAs.

## Facilitating availability of financing to the sector through banking reforms and regulations

Commercial banks continue to be the major source of debt for private developers of e-bus projects. Reforms in banking regulations to encourage the flow of capital to a strategically important sector is an important intervention to ease financing. Two of the top regulation changes required by experts and the industry were inclusion of the sector under priority sector lending (PSL) and of urban buses under the infrastructure sub-sector. Inclusion of the sector under PSL would reduce the lending rates of banks by up to 200 bps, which could be passed down to the borrower. Inclusion of e-bus projects under the infrastructure sub-sector, which currently excludes rolling stock for urban transport projects, would permit loans by commercial bank for over 7 years in line with project cash flows for 12- or 10-year concessions. Modification in banking regulations can increase the availability of finance and lower interest rates for operators, and may eventually further reduce the per-kilometer rates offered to PTAs.

---

## Segregating infrastructure from operational risks

As mentioned earlier, traditional operators have largely been excluded from directly participating in e-bus tenders due to high financial qualification requirements. However, it will be difficult for the sector to scale without the inclusion of such operators, who are experienced in handling local human resources and are also familiar with the operating conditions. This can be achieved by separating infrastructure from operations when procuring services. Bogota, Colombia, has procured e-buses directly from a financial leasing company for 15 years and hires operators for shorter tenures of 5 years (Batista and Bastos 2023). This structure reduces operator liability arising from asset ownership. However, the commercial vehicle leasing market in India is underdeveloped and will require favorable business models and access to low-cost capital to meet the scaled-up demand for e-buses. The separation of infrastructure and operations may increase the operational cost of PTAs, but it will ease the deployment of e-buses in smaller cities, which will rely on local operators for service delivery.

The above interventions are critical for addressing the financing concerns of the private sector, which is expected to invest capital for the electrification of public transport fleets. Key financing concerns about technology maturity and battery performance can be documented and addressed through public fleets. Although the measures discussed in this paper can improve the bankability of contracts in the sector, address lenders' concerns, and improve the availability of viable financing options for e-bus contracts, stringent reforms to improve PTAs' internal efficiencies and financial position are required to achieve long-term sustainability in the public transport sector. Electrification of public sector buses is an important pathway to achieving electrification in the private bus sector, which accounts for over 90 percent of India's bus fleet, and is critical for decarbonizing the transport sector.



## APPENDIX A. DETAILS ON ROUNDTABLE DISCUSSIONS AND ONE-ON-ONE MEETINGS

WRI India organized three roundtables in 2023 and 2024 to discuss the challenges in e-bus financing:

- The first roundtable, titled “Risk Mitigation Approaches to Financing of Public Bus Services,” took place at Bus Karo 2023 on March 15, 2023. This roundtable brought together 10 panelists from manufacturers, financial institutions, and multiple public transport agencies (PTAs). WRI India set the context, and a financial expert moderated the deliberations. The discussion centered around the following questions:
  - What innovative financing mechanisms can be adopted to mitigate the financial risks associated with public bus services, particularly in the context of transitioning to electric buses (e-buses)?
  - How can public-private partnerships (PPPs) be structured to balance the risk between stakeholders and ensure the long-term financial sustainability of public bus services?
  - What role can government policy and regulatory frameworks play in reducing financial risks for private investors in public bus services?
- The second roundtable, titled “Unlocking Financing to Revolutionize Electric Bus Adoption,” took place at the Connect Karo 2023 event in Delhi on July 17, 2023. This gathering, attended by 15 participants, focused on addressing the financial risks and challenges associated with large-scale e-bus adoption in India. The discussion mainly centered on the following key questions:
  - How do surplus states benefit at the state level from payment security, and how can they mitigate the risks associated with larger e-bus adoption?
  - What private insurance options are available to deal with the risks of e-bus adoption, and is insurance a mitigatory measure?
- The third roundtable, titled “Creating a Marketplace for Private Operators and Solving the e-Bus Financing Conundrum,” was organized by WRI India along with TruBoard Partners on February 26, 2024. The event aimed to explore the policy interventions needed to overcome financial barriers and promote the widespread adoption of e-buses. It served as a platform to discuss three key challenges in the e-bus ecosystem—financing, operations, and technology—and brought together stakeholders such as original equipment manufacturers (OEMs), private bus operators, multilateral development banks (MDBs), financing agencies,

and think tanks.

The session covered several critical areas:

- The need for policy support to ensure a robust and stable transition to e-buses, including the importance of mandates and both fiscal and non-fiscal approaches to facilitate access to funding and financing.
- The interaction between public and private capital providers and the overall market structure necessary to finance the scaling up of e-bus adoption in India.
- The role of creative financing mechanisms such as grants, equity finance, carbon finance, blended finance, structured finance, and other financial interventions in de-risking investments in e-buses to encourage large-scale investments.
- Innovative strategies to access debt financing for private operators and leverage equity financing as a catalyst to unlock large-scale financing for e-bus operations.

### List of stakeholders present during the roundtable discussions

#### Primary stakeholders

- COO and Director, Green Cell Mobility
- CEO, PMI Electro Mobility
- Chairman, PMI Electro Mobility
- Vice Chairman, JBM Group
- Administration Head, Hansa Travels
- Director, Chartered Speed Ltd.
- COO, Switch Mobility
- CEO, TML Smart City Mobility Solutions Ltd.
- CEO, Sun Mobility
- Co-founder, Cityflo
- Senior Manager, Public Affairs, Flix Bus

#### Secondary stakeholders

- President, Investment Banking, YES Bank
- Senior Vice President, Underwriting Team, Axis Bank
- Senior Operations Officer, International Finance Corporation
- Co-founder, TruBoard Partners
- Head – Research, TruBoard Partners
- Senior Transport Specialist, World Bank
- Investment Officer, Agence Française de Développement (AFD)
- Senior Sector Specialist, Urban Development & Mobility, KfW

---

## Tertiary stakeholders

- Executive Director, Association of State Road Transport Undertakings (ASRTU)
- Managing Directors, Chief Traffic Officers, Chief Mechanical Officers of various PTAs, such as Brihanmumbai Electric Supply & Transport (BEST) Undertaking, Mumbai; Delhi Transport Corporation (DTC), Delhi; Bengaluru Metropolitan Transport Corporation (BMTC), Bengaluru; Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML), Pune; and Ahmedabad Janmarg Limited, Ahmedabad.

## APPENDIX B. THE INFRASTRUCTURE SECTOR AND PUBLIC-PRIVATE PARTNERSHIP FINANCING IN INDIA

India's infrastructure financing ecosystem has undergone a significant transformation since the liberalization of the economy in 1991. From 2012–13 to 2018–19, the central government's share in infrastructure investment increased from 26 percent to 41 percent, while that of the states declined from 45 percent to 32 percent (Subudhi and Bilgrami 2021). This underscores the significant role played by the central government in shouldering the financing burden for large-scale infrastructure projects. The 2023–24 budget earmarked a substantial US\$122 billion (INR 10,000 billion) for infrastructure investment (PIB 2023d), distributed across key sectors such as transport and logistics; energy, water, and sanitation; communication; and social and commercial infrastructure. With the increasing demand for infrastructure development and the growing constraints on public finances, the government has sought to mobilize private investment.

To facilitate private participation in infrastructure projects, various financing vehicles have been established. The India Infrastructure Finance Company Limited, established in 2006, provides financial assistance through debt financing, subordinate debt, and refinancing to public-private partnership projects (Roy 2015). The Reserve Bank of India (RBI) has set specific guidelines for infrastructure finance companies (IFCs) and non-banking financial companies (NBFCs) that operate as non-deposit-accepting loan companies. These guidelines require that at least 75 percent of the total assets of such companies be allocated to infrastructure loans. In addition, infrastructure investment trusts serve as pooled investment vehicles, raising funds from investors for investment in infrastructure assets.

Although urban transport projects are notified as an infrastructure sub-sector, rolling stock in urban transport is excluded, making e-bus projects ineligible to receive the benefits associated with classification under the infrastructure sub-sector.

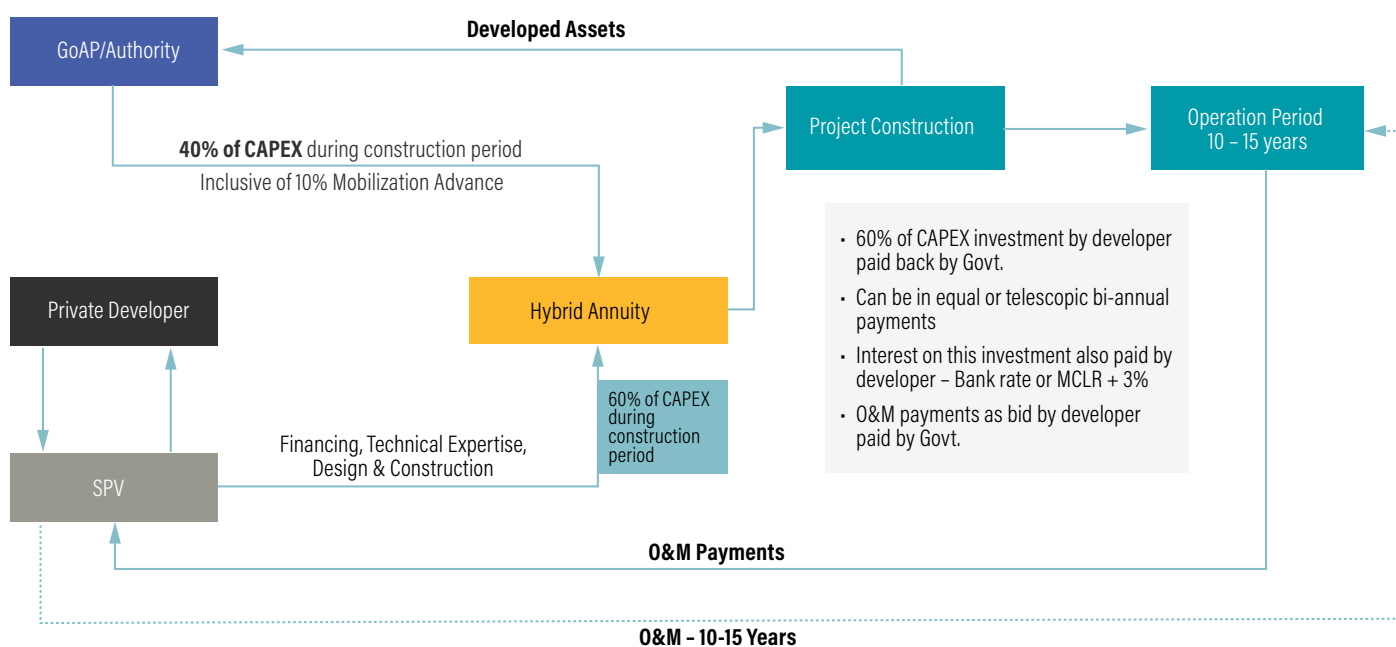
## APPENDIX C. THE HYBRID ANNUITY MODEL FOR HIGHWAY CONSTRUCTION

Projects under the hybrid annuity model (HAM) are awarded based on the lowest life cycle value, which is determined by the net present value of the project bid. This model combines the engineering, procurement, and construction (EPC; 40 percent) and build-operate-transfer (BOT) annuity (60 percent) models, with 40 percent of the project cost provided to the developer during the construction phase and the rest over the operations and maintenance (O&M) phase as annuity payments. The authority is responsible for revenue risks from toll collection (Figure C-1).

The HAM model has mitigated multiple risks for financiers and developers as follows:

- Capital risks at the construction stage: The model supports 40 percent of the cost during the construction phase, which reduces the up-front contribution of equity from developers and commercial debt to 60 percent of the project cost. Construction risks are also mitigated because 80 percent of the cleared site is made available to the developer before commencement of the project, ensuring timely delivery of projects.
- Counterparty and project cash flow risk: Private players are assured annuity payments to cover the remaining 60 percent of the project cost, semi-annually at an interest rate that is 3 percent higher than the applicable bank rates. The entire risk of revenue generation from tolls is borne by the authority, with the National Highways Authority of India (NHAI), an AAA-rated agency, guaranteeing timely payments and boosting projects' credit ratings, easing commercial financing for developers.
- Inflation and cost overrun risk: Price escalation due to a rise in inflation beyond the indexed inflation is provided for by the authority, protecting the concessionaire from inflation. Similarly, the cost of overruns is shared in a 40:60 ratio, with the government bearing 40 percent of the cost of overruns and the concessionaire bearing the remaining 60 percent.
- Change in bank interest rate risk: Developers are assured annuity payments to cover the remaining 60 percent of the BPC, semi-annually at an interest rate that is 3 percent higher than the RBI repo rates.
- Termination risk: HAM provides termination payment to the concessionaire in case of defaults by either the concessionaire or the authority, which includes breaches occurring before the commercial operating date, in turn protecting lenders and improving the bankability of projects.

Figure C-1 | Project structuring for HAM projects under NHAI



Note: CAPEX = capital expenditure. GoAP = Government of Andhra Pradesh. HAM = hybrid annuity model. MCLR = Marginal Cost of funds-based Lending Rate. O&M = operations and maintenance. NHAI = National Highways Authority of India. SPV = special purpose vehicle.

Source: CRISIL and FICCI 2019.

## APPENDIX D. SOLAR POWER PURCHASE AGREEMENTS THROUGH SOLAR ENERGY CORPORATION OF INDIA

Solar Energy Corporation of India (SECI), a nodal agency under the Ministry of New and Renewable Energy, was established in 2011 to oversee the implementation of solar projects in the country. It also serves as a power procurement intermediary, procuring power from developers and selling it to power distribution companies (DISCOMs) through long-term power purchase agreements (PPAs).

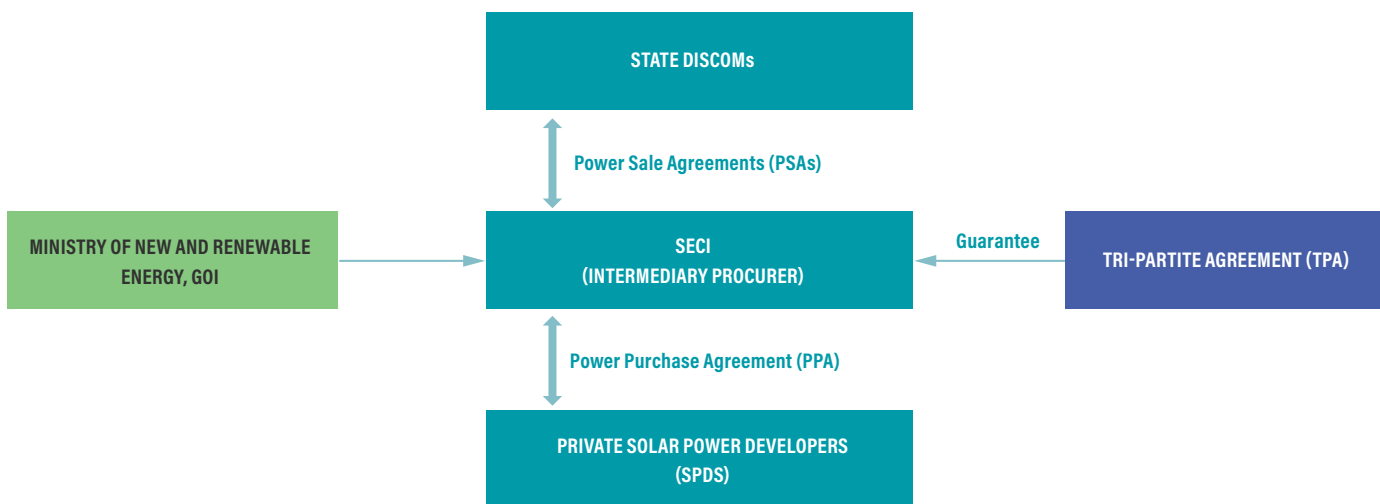
Traditionally, DISCOMs in India are owned by states and suffer from fiscal losses because they operate in a highly regulated market. These losses adversely impact their ability to make timely payments to power producers. The poor financial health of DISCOMs raises the price at which power producers can raise capital due to the risk on receivables. Further, delays in payment to power producers have serious cash flow implications for power producers, hurting their long-term business viability.

SECI has incorporated steps to ensure timely payments by state DISCOMs to power producers, giving private developers the confidence to scale up solar power projects across the country. SECI, which is responsible for nearly half of all renewable energy (RE) tenders in India, has implemented various payment security mechanisms, including escrow arrangements, lines of credit, state

government guarantees, tripartite agreements, and a payment security fund (PSF). Notably, sector experts have emphasized the significance of PSF and tripartite agreements in supporting demand-aggregated procurement by Convergence Energy Services Limited. The arrangement under SECI-procured projects operates as follows:

- **Tripartite agreement:** Since 2017, all SECI-supported tenders have been backed by a tripartite agreement between the Government of India (GoI), state governments, and the Reserve Bank of India (RBI). Under the agreement, in case of a default by DISCOMs, the GoI can withhold financial assistance to state governments. This is the strongest deterrent against defaults and applies only to PPAs between power DISCOMs and SECI. ICRA and other rating agencies have maintained a stable rating of AAA+ for SECI, and because SECI is party to the tripartite agreements, the risks for financiers are mitigated, thus reducing lending rates for RE projects.
- **PSF:** A PSF is a capital reserve that provides interest-free capital to its beneficiary in case of a default in payments. SECI has set up a PSF of INR 5 billion, which it uses to pay to the solar power developer (SPD) in case the DISCOM defaults on the payment (which is typically equivalent to three months of payment for energy sales to the DISCOM). The DISCOM pays the fees (with late charges) to SECI, which then transfers the amount back to the PSF to safeguard the SPD against future defaults.

Figure D-1 | Structure for renewable energy procurement under SECI



Note: DISCOM = distribution company. GoI = Government of India. SECI = Solar Energy Corporation of India.

Source: Author-created infographic based on Sharma (2019).

## GLOSSARY OF TERMS

TERM	DEFINITION
Counterparty	The other party that participates in a financial transaction.
Counterparty payment risk	The likelihood that one of those involved in a transaction might default on its contractual obligation.
Debt service coverage ratio (DSCR)	The DSCR measures the available cash flow a firm can use to pay its current debt obligations. The DSCR tells investors and lenders whether a company has enough income to pay its debts. The ratio is calculated by dividing the net operating income by the total debt service, including the principal and interest.
Gross cost contract (GCC) model	<p>In the GCC model of procurement, the bus is owned and operated by service providers, original equipment manufacturers (OEMs), or a consortium of OEMs and bus service providers for a specific rate and period. In this model, all the earnings of the bus remain with the PTAs. The agency pays a pre-decided sum per unit distance to the service provider. The agency usually provides only the conductor of the bus, and the service provider is responsible for providing the driver. The service provider and the PTA split responsibilities for setting up the charging infrastructure and maintaining both the buses and the ancillary services required for operation. Based on the experience thus far in India, the PTA is best placed to supply the prerequisites for setting up charging infrastructure, such as distribution transformers.</p> <p>The GCC model ensures that the responsibility for efficient service rests with the service providers. Therefore, it is in their best interest to provide the requisite charging infrastructure, maintenance, and other logistics. The agency is responsible for monitoring and data sharing between the two parties to keep track of the service level benchmarks.</p>
Hybrid model	The hybrid model can be either GCC hybrid or NCC hybrid. In the GCC hybrid model, its terms are retained while operators receive supplementary incentives for surpassing the agreed performance benchmarks. Conversely, in the NCC hybrid model, its terms are retained while operators receive predetermined fixed payments for operating selected routes based on their feasibility.
Loan to value (LTV) ratio	The LTV ratio is a metric that lenders use to compare a loan amount to the value of the asset purchased with the loan. Lenders use it to determine how much risk they are taking on with a secured loan.
Marginal Cost of funds-based Lending Rate (MCLR)	The minimum lending rate below which a bank is not permitted to lend. The Reserve Bank of India implemented MCLR on April 1, 2016, to determine the rates of interests for loans. It is an internal reference rate that banks use to determine the interest they can levy on loans. It is calculated based on the loan tenure.
Net cost contract (NCC) model	The NCC model essentially outsources all the activities to the private sector, including bus procurement, procurement and operation of the charging equipment, maintenance, route operation, revenue collection, and passenger service. In this model, the private operator manages and retains the revenue collection and thus bears the revenue risk in the provision of the bus transport services.
Public transit agencies	The urban bus service delivery mechanism in India can be categorized into three types: public-sector-exclusive operations, open market with public sector dominance, and open market with private sector dominance. In the case of public-sector-exclusive operations, the responsibility for providing city bus services is mandated to government-owned and/or government-controlled public transport agencies (PTAs), which enjoy a legal monopoly within the jurisdiction (state or city). The PTAs, however, have no service level agreements or contracts with the government.
Recourse-based and non-recourse-based debt	<p>Recourse-based debt is a type of financing where the lender retains the right to seek additional repayment beyond the collateral pledged, typically including the borrower's personal assets, in the event of default.</p> <p>In contrast, non-recourse-based debt limits the lender's recovery ability to only the assets used as collateral for the loan, shielding the borrower's personal assets from liability.</p>
Viability gap funding	A type of financial support that covers cost-revenue gaps based on system performance.

## ENDNOTES

1. Under this model, the operator/manufacturer issues a contract with the transport authority and is paid on a fixed cost per-kilometer basis.
2. Estimated for 60,000 e-buses with 60 percent 12 m and 40 percent 9 m e-buses and a loan to value ratio (LTV) of 75 percent.
3. In particular, for traditional operators, we interviewed Delhi- and Uttar-Pradesh-based operators.
4. The financial qualification for the bidders is defined by their minimum average annual turnover, which is the revenue from operations over the last three financial years. This threshold may vary depending on the type of bus the bidder is offering. The technical qualification for bidders includes manufacturing qualifications and ownership and operations experience. Bidders should have manufactured and delivered at least 25 e-buses or 1,000 compressed natural gas (CNG) buses in India or abroad. In addition, they should possess ownership or operations experience for at least one year, involving a minimum of 25 e-buses or 1,000 CNG buses in India.
5. In this model, the private sector retained the collected fares and were expected to operate without public funding support.
6. Leveraging of debt by the private sector is not a common practice in the bus sector, including for projects under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), which the government fully supports.
7. As of March 2020, state and central governments provided 57 percent of the total capital and liabilities, whereas banks contributed approximately 20 percent through loans (CIRT 2022).
8. As stated in the state road transport undertaking (SRTU) profile and performance report for 2019–20 (MoRTH 2023), about 92 percent of revenues were generated from traffic revenues, including reimbursement of concessions offered by the state. Additional sources of income include non-traffic revenue streams such as advertisements, rents from commercial spaces, and other miscellaneous sources.
9. Under the JNNURM scheme, adopting a partnership approach, the national government funded 35 percent to 50 percent of the project cost, depending on the city's size. State governments contributed 15 to 20 percent, while local governments covered the remaining 20 to 50 percent.
10. Under the FAME program (which also applies to the Grand Challenge launched by Convergence Energy Services Limited), a subsidy amount of INR 5.5 million per bus or 40 percent of the bus cost and INR 4.5 million per bus or 40 percent of the bus cost (whichever is lower) is granted for 12 meter (m) and 9 m buses, respectively. The eligible subsidy amount is disbursed to selected parties at predefined stages of the procurement process. Initially, 20 percent of the subsidy is granted upon the issuance of the supply order and the signing of agreements. The second installment, comprising 40 percent of the total subsidy amount, is issued upon the delivery of the buses. The remaining 40 percent of the subsidy is disbursed after six months of successful commercial operation of the buses.
11. The cost may vary depending on the city of operation, after factoring in local costs, the procurement model and the cost of capital for assets, and costs modeled on the NEBP rates discovered for 12 m AC buses.
12. Under the PPP model, the concession period for e-buses was increased to 10 years, resulting in a substantially higher contract period than that for ICE bus services.
13. The GC, NEBP, and PM E-Bus Sewa scheme are based on the demand aggregation model, procuring under the GCC framework. Whereas the GC qualifies for the FAME subsidy, the NEBP does not have a national-level subsidy; states can offer subsidies if necessary. Both the GC and NEBP subsidies are for capital purchases, whereas the PM E-Bus Sewa scheme subsidizes operational costs.
14. Greencell Mobility is dedicated to building a platform for eMaaS (Electric Mobility-as-a-Service).
15. The interest rate for the loan is calculated annually based on the bank's marginal cost of funds, plus an additional percentage to account for the risk associated with the loan. For example, if the MCLR is 8.5 percent per annum and the risk premium is 2.0 percent per annum, the borrower would be charged a total interest rate of 10.5 percent per year.
16. In the BOT model, a private entity builds the highway infrastructure, operates it for a specified period (often several decades), and then transfers ownership back to the government. In this model, the private entity secures financing; designs, builds, and operates the highway; and typically collects tolls or user fees to recoup its investment and generate profits.
17. In the EPC model, a single contractor or a consortium is responsible for the entire project. The contractor designs, procures all necessary materials and equipment, and constructs the highway according to specified requirements. Once construction is complete, the project is handed over to the client or the government agency responsible for maintenance and operation. In the EPC model, the contractor bears the risk of cost overruns and delays.

- 
18. Under the TOT model, a private entity or consortium is granted the right to collect tolls and operate the highway for a predetermined concession period, typically ranging from 15 to 30 years. During this period, the private entity manages the day-to-day operations of the highway, including maintenance, toll collection, and traffic management.
  19. A masala bond is a type of bond issued outside India, denominated in Indian rupees (INR) rather than in the local currency of the issuing country. The term was initially coined by the International Finance Corporation. These bonds are issued by Indian entities in international markets, enabling them to raise funds abroad. In 2014, the International Finance Corporation raised INR 10 billion through masala bonds to support infrastructure projects, and in 2015, it raised an additional INR 3.15 billion to finance private sector initiatives aimed at addressing climate change in India.
  20. In 2015, the Cabinet Committee on Economic Affairs permitted 100 percent equity divestment, which would allow the concessionaire to use proceeds from the sale of divested equity in any national highway project (including an incomplete project) or any other infrastructure project.



## REFERENCES

- ADB (Asian Development Bank). 2022. "The Hybrid Annuity Model for Public-Private Partnerships in India's Road Sector: Lessons for Developing Asia." ADB South Asia Working Paper Series. No. 94. <https://www.adb.org/sites/default/files/publication/820206/sawp-094-ham-ppps-india-road-sector.pdf>.
- ADB. 2023. *Resolving Demand-Side Issues in Electric Vehicle Financing in India*. Manila: ADB. <https://www.adb.org/sites/default/files/publication/945841/sawp-099-electric-vehicle-financing-india.pdf>.
- ASRTU (Association of State Transport Undertakings) and ITDP (Institute for Transportation and Development Policy). 2023. *Accelerating Procurement, Operations and Financing of Buses through Public-Private Partnership*. New Delhi: ASRTU and New York: ITDP. [https://www.itdp.in/wp-content/uploads/2023/09/Final-Draft\\_Accelerating-Procurement-and-Operations-of-Buses-through-PPP\\_29082023\\_ITDP-India.pdf](https://www.itdp.in/wp-content/uploads/2023/09/Final-Draft_Accelerating-Procurement-and-Operations-of-Buses-through-PPP_29082023_ITDP-India.pdf).
- Atal Indore City Transport Services Limited. n.d. "Atal Indore City Bus Services." Department of Economic Affairs. <https://www.pp-pinindia.gov.in/bestpractices/best-practice-detail/atal-indore-city-bus-services>. Accessed July 9, 2024.
- AZB & Partners. 2023. "NHAH Circular on Divestment of 100% Equity," March 31. AZB and Partners. <https://www.azbpartners.com/bank/nhai-circular-on-divestment-of-100-equity/>.
- Batista, M., and P. Bastos. 2023. "The Bogotá's Business Model for Deploying Electric Buses." Case Study. Bonn, Germany: Transformative Urban Mobility Initiative (TUMI) Ebus Mission. [https://transformative-mobility.org/wp-content/uploads/2023/05/Business-model-Bogota\\_EN.pdf](https://transformative-mobility.org/wp-content/uploads/2023/05/Business-model-Bogota_EN.pdf).
- CESL (Convergence Energy Services Limited). 2022a. *'The Grand Challenge' for Electric Bus Deployment: Outcomes and Lessons for the Future*. New Delhi: CESL. [https://www.convergence.co.in/public/images/electric\\_bus/Grand-Challenge-Case-Study-Final-Web-Version.pdf](https://www.convergence.co.in/public/images/electric_bus/Grand-Challenge-Case-Study-Final-Web-Version.pdf).
- CESL. 2022b. "Request for Proposal for Selection of Bus Operator for Procurement, Operation and Maintenance of 6465 Electric Buses and Development of Allied Electric and Civil Infrastructure on Gross Cost Contracting under National E-Bus Program (NEBP)." December 2. [https://www.convergence.co.in/public/upload/tender\\_pdf/fwh9aktob8da5lwdjz.pdf](https://www.convergence.co.in/public/upload/tender_pdf/fwh9aktob8da5lwdjz.pdf).
- CIRT (Central Institute of Road Transport). 2022. *State Transport Undertaking Profile and Performance 2019-20*. Pune, India: CIRT. <https://asrtu.org/resource/front/uploads/STUs%20Profile%20and%20Performance%202019-20.pdf>.
- CRISIL and FICCI (Federation of Indian Chambers of Commerce and Industry). 2019. *Rekindling Private Investment in Roads and Highways*. Infrastructure Advisory. Mumbai: CRISIL and New Delhi: FICCI. <https://www.crisil.com/content/dam/crisil/our-analysis/reports/Infrastructure-Advisory/documents/rekindling-private-investment-in-roads-and-highways.PDF>.
- DIMTS (Delhi Integrated Multi-modal Transit Systems). 2016. *Roadmap for Improving City Bus Systems in India*. New Delhi: DIMTS. <https://smarnet.niua.org/sites/default/files/webform/Roadmap%20for%20improving%20City%20Bus%20Systems%20in%20India.pdf>.
- Gadepalli, R., C. Cheriyan, S. Kumar, J. Singh, and R. Nandy. *Fiscal Incentives to Scale Up Adoption of Electric Buses in Indian Cities: Final Report, Volume I*. New Delhi: SSEF (Shakti Sustainable Energy Foundation) and Brussels: UITP (International Association of Public Transport). <https://shaktifoundation.in/wp-content/uploads/2020/01/Fiscal-Incentives-to-scale-up-electric-buses.pdf>.
- Garg, S., and M. Dayal. 2020. "Road Learnings: Evolution of Public-Private Partnerships in the Indian Highway Sector." *Transportation Research Procedia* 48: 2488–2510. <https://doi.org/10.1016/j.trpro.2020.08.259>.
- Li, X., C. Gorguinpour, R. Sclar, and S. Castellanos. 2019. *How to Enable Electric Bus Adoption in Cities Worldwide: A Guiding Report for City Transit Agencies and Bus Operating Entities*. Washington, DC: WRI (World Resources Institute). <https://www.wri.org/research/how-enable-electric-bus-adoption-cities-worldwide>.
- Manohar, A. 2024. "Renewable Energy in India – Indian Power Industry Investment." Invest India. <https://www.investindia.gov.in/sector/renewable-energy>.
- MoHUA (Ministry of Housing and Urban Affairs). 2019. *Report on Review of Regulatory, Institutional & Fiscal Policies (Indian)*. New Delhi: MoHUA. [https://mohua.gov.in/upload/uploadfiles/files/PC1\\_ESCBS\\_Domestic\\_Review\\_Report\\_\(09\\_Jun\\_19\).pdf](https://mohua.gov.in/upload/uploadfiles/files/PC1_ESCBS_Domestic_Review_Report_(09_Jun_19).pdf).
- MoHUA. 2021. *Source Book: PPP Arrangements for Urban Bus Operations in India*. New Delhi: MoHUA. [https://www.linkedin.com/posts/prasad-shekhhar-547a4b2a\\_sourcebook-ppp-arrangements-for-urban-bus-activity-6880156227196780544-Fzvt/](https://www.linkedin.com/posts/prasad-shekhhar-547a4b2a_sourcebook-ppp-arrangements-for-urban-bus-activity-6880156227196780544-Fzvt/).
- MoHUA. 2023. *Guidelines for PM-eBus Sewa Part 1*. New Delhi: MoHUA. <https://mohua.gov.in/upload/uploadfiles/files/PM-eBus-Sewa-Guidelines-Part-1.pdf>.
- Moon-Miklaucic, C., A. Maassen, X. Li, and S. Castellanos. 2019. "Financing Electric and Hybrid-Electric Buses: 10 Questions City Decision-Makers Should Ask." Working Paper. Washington, DC: WRI (World Resources Institute). <https://www.wri.org/research/financing-electric-and-hybrid-electric-buses>.

- MoRTH (Ministry of Road Transport & Highways). n.d. "Vahan Dashboard." Vahan Dashboard. <https://vahan.parivahan.gov.in/vahan4dashboard/vahan/dashboardview.xhtml>.
- MoRTH. 2016. "Hybrid Annuity Model for Implementing Highway Projects." Circular. February 9. <https://morth.nic.in/sites/default/files/implementing.pdf>.
- MoRTH. 2020. *Review of the Performance of State Road Transport Undertakings for 2016-2017*. New Delhi: MoRTH. [https://morth.nic.in/sites/default/files/srtucopy\\_compressed.pdf](https://morth.nic.in/sites/default/files/srtucopy_compressed.pdf).
- MoRTH. 2023. *Road Transport Year Book 2019-20*. New Delhi: MoRTH. [https://morth.nic.in/sites/default/files/RTYB\\_Publication\\_2019\\_20%20\(1\).pdf](https://morth.nic.in/sites/default/files/RTYB_Publication_2019_20%20(1).pdf).
- NHAI (National Highways Authority of India). 2023. "NHAI to Follow HAM and EPC Models for Highway Contracts – Construction Week India." *Construction Week*. <https://www.constructionweek-online.in/business/nhai-to-follow-ham-and-epc-models-for-highway-contracts>.
- Palit, A. 2018. "Financing Solar Energy: Lessons from Indian Experience." Discussion Paper No. 226. New Delhi: RIS (Research and Information System for Developing Countries). <https://www.ris.org.in/sites/default/files/Publication/DP%20226%20Amitendu%20Palit.pdf>.
- PFC (Power Finance Corporation). 2024. *12th Annual Integrated Rating and Ranking of Power Distribution Utilities*. New Delhi: PFC. [https://pfcindia.com/ensite/DocumentRepository/ckfinder/files/GoI\\_Initiatives/Annual\\_Integrated\\_Ratings\\_of\\_State\\_DISCOMs/12%20Annual%20Integrated%20Report\\_Print%20version-compressed2.pdf](https://pfcindia.com/ensite/DocumentRepository/ckfinder/files/GoI_Initiatives/Annual_Integrated_Ratings_of_State_DISCOMs/12%20Annual%20Integrated%20Report_Print%20version-compressed2.pdf).
- PIB (Press Information Bureau). 2015. "Permitting 100 Percent Equity Divestment after Two Years of Construction Completion for All BOT Projects Irrespective of Year of Award." August 26. <https://pib.gov.in/newsite/PrintRelease.aspx?relid=126359>.
- PIB. 2019. "Sanction for 5595 Electric Buses under Fame Phase-II." August 8. <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1581525>.
- PIB. 2021. "Electric Vehicle Operational in Medium and Heavy Passenger Vehicle Category Register an Increase." August 5. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1742666>.
- PIB. 2023a. "Decarbonization of Transport Sector Essential to Reduce GHG Emissions, Achieve Net-Zero Emissions by 2070: Union Environment Minister Shri Bhupender Yadav." December 9. <https://pib.gov.in/PressReleasePage.aspx?PRID=1984578>.
- PIB. 2023b. "Subsidy Amounting to Rs. 5,228.00 Crore Given to Electric Vehicle Manufactures on Sale of 11,53,079 Electric Vehicles till 1st December, 2023." December 5. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1982777>.
- PIB. 2023c. "Cabinet Approves 'PM-Ebus Sewa' for Augmenting City Bus Operations: Priority to Cities Having No Organized Bus Service." August 16. New Delhi: PIB. <https://pib.gov.in/PressReleaseDetail.aspx?PRID=1949429>.
- PIB. 2023d. "Capital Investment Outlay Increased by 33% to ₹ 10 Lakh Crore." February 1. <https://pib.gov.in/PressReleasePage.aspx?PRID=1895289>.
- PIB Delhi. 2023. "Steps to Strengthen Public Transport across the Country." December 4. <https://pib.gov.in/PressReleaseDetail.aspx?PRID=1982362#:~:text=This%20scheme%20aims%20to%20provide,57%2C613%20crore>.
- Ramakrishnan, T.S., and G. Raghuram. 2012. "Evolution of Model Concession Agreement for National Highways in India." IIM Ahmedabad Working Papers WP2012-07-01. <https://ideas.repec.org/p/iim/iimawp/11446.html>.
- Roy, A. 2015. "Innovative Financing: The Case of India Infrastructure Finance Company" Blog. July 9. World Bank Blog Series. <https://blogs.worldbank.org/en/ppps/innovative-financing-case-india-infrastructure-finance-company>.
- Sclar, R., C. Gorguinpour, S. Castellanos, and X. Li. 2019a. *Barriers to Adopting Electric Buses*. Washington, DC: WRI (World Resources Institute). <https://www.wri.org/research/barriers-adopting-electric-buses>.
- Sharma, N. 2019. "How Payment Security Mechanism Works." CEEW Centre for Energy Finance. <https://www.ceew.in/cef/quick-reads/explains/how-payment-security-mechanism-works>.
- Singh, V., and M. Madurwar. 2019. "Hybrid Annuity Projects: 'Study of HAM in Highway Construction Projects-Owner and Contractor Prospective.'" In *Proceedings of Sustainable Infrastructure Development & Management (SIDM) 2019*. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3372915](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3372915).
- SSEF (Shakti Sustainable Energy Foundation) and Janaagraha. 2020. *Sustainable Bus Transport Financing in India*. New Delhi: SSEF and Bengaluru: Janaagraha. <https://www.janaagraha.org/files/Study-on-Sustainable-Bus-Transport-Financing-in-India.pdf>.
- Subudhi, S., and S. Bilgrami. 2021. "It's Time India Sets Up a National Infrastructure Bank." *Mint*, February 4. <https://www.livemint.com/opinion/online-views/its-time-india-sets-up-a-national-infrastructure-bank-11612446340164.html>.
- Swamy, H., and G. Patel. 2014. "PPP Arrangements in Urban Transport." Presented at 2nd Asia BRTS Conference, Ahmedabad, India, September 29 to October 1. <https://www.scribd.com/document/365053516/13-PPP-Arrangements-in-Urban-Transport-HMS-and-Gautam-Patel#>.

Swamy, S. 2014. "Urban Transport Developments in India under NUTP and JnNURM." John Diandas Memorial Lecture delivered on July 30 at the Kingsbury Hotel, Colombo, Sri Lanka. [https://www.researchgate.net/profile/Shivanand-Swamy/publication/287959369\\_Urban\\_Transport\\_Developments\\_in\\_India\\_under\\_NUTP\\_and\\_JnNURM/links/567aa2cd08ae1e63f1df4e12/Urban-Transport-Developments-in-India-under-NUTP-and-JnNURM.pdf](https://www.researchgate.net/profile/Shivanand-Swamy/publication/287959369_Urban_Transport_Developments_in_India_under_NUTP_and_JnNURM/links/567aa2cd08ae1e63f1df4e12/Urban-Transport-Developments-in-India-under-NUTP-and-JnNURM.pdf).

*Times of India*. 2023. "Public Transport: China's Electric Bus Revolution Continues to Advance." *Times of India*, December 5. <https://timesofindia.indiatimes.com/auto/cars/chinas-electric-bus-revolution-continues-to-advance/articleshow/105745951.cms>.

UITP (International Association of Public Transport). 2021. *Large-Scale Bus Electrification*. Knowledge Brief. Brussels: UITP. <https://cms.uitp.org/wp/wp-content/uploads/2021/07/Large-scale-Bus-Electrification-KB-Final.pdf>.

World Bank. 2022. "Improving Bankability of Bus Procurement in India." Working Paper. Washington, DC: World Bank. <https://documents1.worldbank.org/curated/en/099551506152217472/pdf/1IDU0a1555f8407326048dd09f08069157b590e67.pdf>.

WRI India. 2021a. *Public Private Partnership in Bus Operations in Indian Cities: Engaging Private Sector in Improving Public Transport*. WRI India. <https://shaktifoundation.in/wp-content/uploads/2022/01/Annex-5-PPP-in-Bus-Operations-in-Indian-cities.pdf>.

WRI India. 2021b. *National Investment Program for Bus-Based Public Transport Systems in India*. WRI India. <https://shaktifoundation.in/wp-content/uploads/2021/11/Annex-1-National-Investment-program-for-bus-based-public-transport-systems-in-India.pdf>.

WRI India. 2022a. "A Summary of Expert Perspectives on Viable Financing Pathways for Electrifying India's Public Transport." Conference Proceedings. WRI India. <https://wri-india.org/sites/default/files/INSIGHT%20Conference%20Proceeding%20final.pdf>.

WRI India. 2022b. *Fiscal Policies and Taxation Incentives for Improved Public Bus Systems in India*. WRI India. <https://shaktifoundation.in/wp-content/uploads/2022/01/Fiscal-policies-and-taxation-incentives-for-improved-public-bus-system.pdf>.

Yiyang, C., and V. Fremery. 2022. "E-Bus Development in China: From Fleet Electrification to Refined Management." *Mobility Transition in China*. <https://transition-china.org/mobilityposts/e-bus-development-in-china-from-fleet-electrification-to-refined-management/>.

You, X. 2023. "How China's Buses Shaped the World's EV Revolution." BBC, December 6. <https://www.bbc.com/future/article/20231206-climate-change-how-chinas-electric-vehicle-revolution-began-with-buses>.

---

THIS PAGE IS INTENTIONALLY KEPT BLANK

---

## ACKNOWLEDGMENTS

The authors extend their heartfelt gratitude to Madhav Pai (CEO, WRI India) and Avinash Dubedi (Program Head, Transport, WRI India) for their invaluable advice, insights, and unwavering support throughout the research and writing of this paper. We are deeply appreciative of the constructive feedback provided by our internal and external reviewers, whose contributions significantly enhanced the quality of this work.

We extend sincere gratitude to the following reviewers: Dr. O.P. Agarwal (Senior Advisor, WRI India), Daniel Cano Gomez (Project Coordinator, WRI), Chintan Daftardar (Program Head, Transport, WRI India), Adriana Kocornik-Mina (Senior Urban and Regional Economist, Cities Program, WRI), Amit Kumar (Senior Program Associate, Energy Program, WRI India), Michelle Levinson (Senior Manager, E-Mobility Finance & Policy, WRI), Anjali Mahendra (Director of Global Research, WRI), Dr. Champaka Rajagopal (Urbanist, Trustee, International Journal of Urban and Regional Research, UK), Ashim Roy (Program Lead, Energy Finance, WRI India), Ashim Sharma (Senior Partner & Group Head, Business Performance Improvement Consulting, Nomura Research Institute), and Ankit Singvi (Operating Partner, Macquarie).

We would also like to express our gratitude to Shahana Chattaraj, Sudeshna Chatterjee, and Alok Mukherjee for their valuable contributions to the structure and arguments of this paper. Additionally, we are thankful to Emilia Suarez, Renee Pineda, Allison Meyer, Ankita Rajeshwari, and Santhosh Matthew Paul for their support in editing, Ronak Naik for design, layout, and publication at various stages of this project.

Lastly, we acknowledge the assistance of Kshitij Sovanee, Mahak Dawra, Divya Holani, and other colleagues who supported us in the literature review and stakeholder engagements. Their efforts were instrumental in the successful completion of this paper.

## ABOUT THE AUTHORS

**Manish Dutta Pandey** is Consultant, Sustainable Cities & Transport, Cities Program, WRI India.

**Aswathy KP** is Program Manager, Electric Mobility, Sustainable Cities & Transport, Cities Program, WRI India.

**Pawan Mulukutla** is Executive Program Director, Integrated Transport, Clean Air and Hydrogen, WRI India.

## ABOUT WRI

WRI India, an independent charity legally registered as the India Resources Trust, provides objective information and practical proposals to foster environmentally sound and socially equitable development. Our work focuses on building sustainable and liveable cities and working towards a low carbon economy. Through research, analysis, and recommendations, WRI India puts ideas into action to build transformative solutions to protect the earth, promote livelihoods, and enhance human well-being. We are inspired by and associated with World Resources Institute (WRI), a global research organization. Know more: [www.wri-india.org](http://www.wri-india.org)

### Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

### Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

### Our approach

#### COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

#### CHANGE IT

We use our research to inform government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

#### SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.



Copyright 2024 World Resources Institute. This work is licensed under the Creative Commons Attribution 4.0 International License. To view a copy of the license, visit <http://creativecommons.org/licenses/by/4.0/>