ADVANCING PUBLIC TRANSPORT

KNOWLEDGE BRIEF

FINANCIAL PLANNING FOR THE ELECTRIC BUS TRANSITION

A CASE STUDY OF RURAL AND INTERCITY BUS ELECTRIFICATION IN KARNATAKA

DECEMBER | 2022

INTRODUCTION

Government of India's financial support of more than ₹54,000 crore (USD 6.8 billion) in the form of the Faster Adaption of Manufacturing of Hybrid and Electric Vehicles (FAME) scheme along with decreasing battery prices, and economies of scale, reduction in Goods and Services Tax (GST), Motor Vehicle (MV) tax & permit fees, and state-level subsidies have contributed to price reduction and popularity of Electric Buses.

In April 2022, GoI under the largest global tender for an aggregated procurement of 5,450 e-buses for five cities on a Gross Cost Contract (GCC) model[1] realised. 23-27% cheaper prices per km for electric buses compared to their internal combustion engine (ICE) counterparts[2] .

Increasing operating costs of diesel and CNG buses due to fuel price increase, subsidised electricity rates to promote EVs and public transport has led to lower lifecycle costs for e-buses and energy and emission efficiency benefits.

Diesel buses will however continue its presence in fleets as electric buses have range constraints, EV component manufacturing is limited in India and 70% of public bus operations in India concentrated in rural areas[3].

Careful planning of service schedules and charging infrastructure can support electrification of a significant share of rural and intercity services with available e-bus vehicle and charging technologies, as demonstrated in the UITP knowledge brief on 'Planning for electrification of rural and intercity buses' (2022))[4] .

Long-term planning for bus services needs to first focus on estimating the fleet needed to adequately meet the current and future demand and then build in the cost of transitioning these fleets to e-buses.

ROLE OF FINANCIAL PLANNING IN FLEETWIDE E-BUS TRANSITION

Public bus agencies in India has a challenge of increasing service levels and transitioning to e-buses even as they face significant financial constraints due to the COVID-19 pandemic and a subsequent drop in revenue. The e-bus transition also requires a fundamental shift in their financial planning practices and business models from outright purchase of buses through government grants and covering operational expenses through farebox revenues. E-buses have a capital cost but lower operating cost vis-à-vis ICE buses. Therefore, STUs need to attract external capital investments for e-bus fleets and charging infrastructure development, in addition to their traditional budgetary allocation.

In this context, this knowledge brief presents an approach to estimating long-term fleet improvement needs, comparison of the per-km Total Cost of Ownership (TCO) of diesel buses with that of e-buses and the fleet-level financial implications of transitioning to e-buses using alternative business models. The financial constraints to this transition, and recommended solutions to overcome them are also covered. Given that 70% of the public bus fleet in India[5] is concentrated in rural and intercity services, the proposed approach for these activities is applied to the case of regional bus operations in Karnataka, which has one of the largest public bus fleets in India.

APPROACH TO FLEET, TCO, AND FINANCIAL ESTIMATES

APPROACH TO FLEET NEEDS PLANNING

The approach to long-term fleet needs planning for rural and intercity bus systems has not been well-established in the literature. Therefore, we analysed the population growth and vehicular growth trends in our case state as proxies for travel demand growth rates to forecast the likely bus ridership in the future, assuming 2030 as the horizon year. The per bus ridership achieved by the current fleets is taken as the benchmark to estimate the fleet needed to cater to the forecasted ridership. Accordingly, the fleet expansion requirements for public bus agencies to cater to the increased travel demand under alternative population growth rate and public transport ridership scenarios is established. The scenarios were discussed with decision makers to identify the scenario that most effectively balances the public bus ridership targets with the agency's ambition.

APPROACH TO BUS-LEVEL TCO ESTIMATION

Diesel, CNG, and electric buses are the key technology options for STUs to meet the abovementioned projected fleet needs. The choice between these technologies can be made objectively using TCO models that incorporate various capital and operational costs to be incurred throughout the life of the bus. By taking the lifecycle cost approach for evaluation, TCO models help address the fundamental differences in cost structure between e-buses and other buses—e-buses are more capital-intensive but have lower operational costs than diesel/CNG buses. We estimated the TCO at the bus level to compare the per-km costs of diesel and electric buses, as well as the fleet-level estimates to determine the overall financial requirements at the state level.

The total cost of owning and operating an e-bus for public transport applications depends on the technical and operational aspects, as well as the financial conditions associated with the business models available for the tendering of the service. We have used one such TCO model developed by the International Council on Clean Transportation (ICCT) with inputs from UITP India to assess the TCO of electric and diesel buses in the case of Karnataka. A typical e-bus with a battery capacity of 320 kilowatt-hours (kWh), which has previously been deployed in intercity operations in India, is assumed as the technology choice. The model incorporates the replacement ratio (RR) of e-buses needed to meet the current diesel bus operational requirements into the TCO, i.e. the number of e-buses needed to serve the current number of trips served by diesel buses, and the cost associated with it.

The cost component categories of the TCO model are:

Capital costs: Bus, battery, and charging infrastructure costs

Financing costs: Interest payments over the loan period

Operational costs: These include energy/fuel costs, crew

costs, insurance cost on buses where applicable, and other operations & maintenance (O&M) costs (including administrative costs).

APPROACH TO FLEET-LEVEL TCO ESTIMATES

The fleet procurement schedule to meet the projected demand was derived based on the fleet replacement and augmentation needs of each of the STUs according to the current age profile of their fleet. Diesel and electric buses are assumed to be procured in equal proportions, i.e. 50% each.

The financial modelling for this fleet was carried out under four alternative scenarios of procurement, i.e. combinations of outright purchase and GCC models for diesel (BS VI (Euro VI equivalent)) and electric buses (EV). The per-km TCO was converted into fleet-level TCO estimates to meet the fleet growth needs mentioned above. A spreadsheet-based financial model was developed by UITP India in partnership with EcoForge Advisors Pvt Ltd. Table 1 presents an outline of the various components of the financial model.

The model considers inputs for two business models for bus procurement—outright purchase and GCC—, including the operational and financial estimates for each of the models to estimate the fleet-level financials such as income statement, cashflow statement, TCO, and other key metrics such as earnings before interest, taxes, depreciation, and amortisation (EBITDA), debt service coverage ratio (DSCR), etc., which are crucial for financial assessment of the project. Based on these, the debt schedule for the STU, as well as other key financials, are

derived. The model also provides outputs on the viability gap funding (VGF) needed by the STUs in each scenario, but the paper only presents the costs, as the current focus is on attracting capital investments. Table 3 presents the key outputs derived from the financial model and their significance.

The per-km TCO of buses presented in Table 2 shows the capital-intensive nature of e-buses; about 38% of the total costs are related to the capital expenditure on buses and their charging infrastructure and the associated financing costs. Therefore, reducing the TCO of e-buses and making them more attractive to STUs requires decreasing their capital and associated financing costs. The fleet-level financial model was extended to carry out a sensitivity analysis to establish the relative impact of the key financing variables impacting e-bus financing related expenditure. For the sensitivity analysis, the model where all new buses will only be procured on an outright purchase model was analysed to establish the cost implications of financing variables for an operator. The learnings would be applicable even for private operators as the cost elements remain the same irrespective of the bus owning entity.

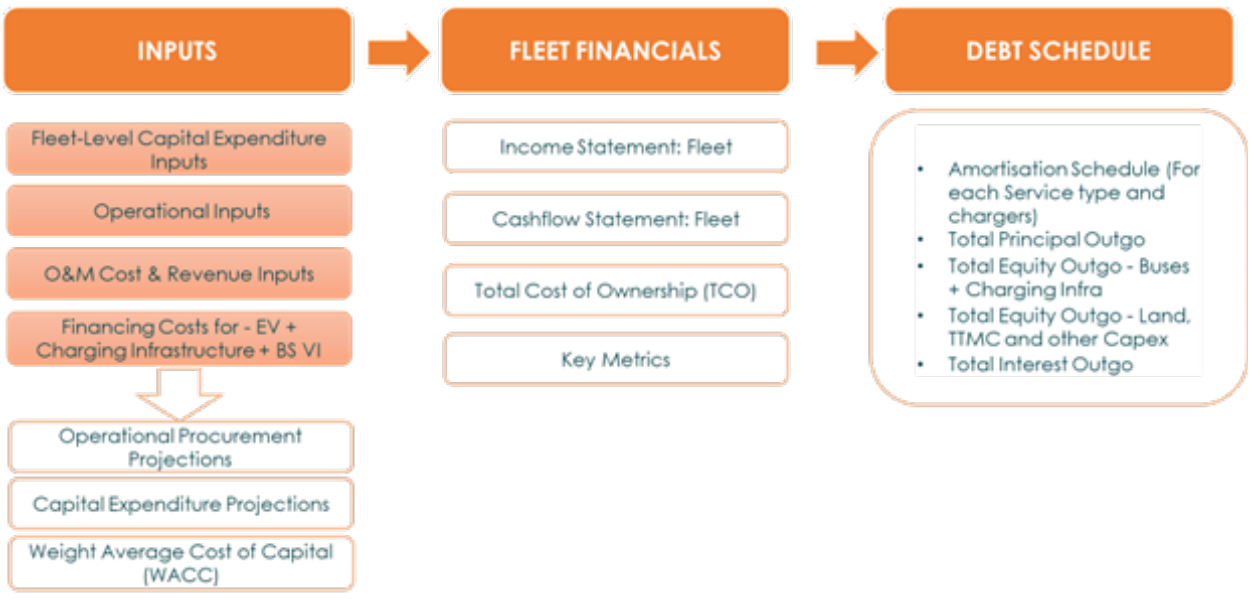

Table 1: Financial model outputs

KEY FINANCIAL MODEL OUTPUT	SIGNIFICANCE OF THE OUTPUT
Estimation of Fleet-Level Investment Needs/Capital Requirements	• Long-term capital budgeting • Articulation of investment needs for e-bus fleet transition • To be used as a decision-making tool to raise investment from investors/lenders/government sources • To also be used as a decision-making tool in comparing direct procurement and GCC
Estimation of Fleet-Level Revenues and Costs	• Assess impact of e-bus transition on fleet-level revenues and costs • Identify key revenue and cost drivers due to transition • To be used as a decision-making tool to implement necessary operational efficiency measures and plan and budget for operating costs
TCO, including Present Value (PV) of Overall TCO and Operational TCO	• Compare operating costs of e-buses and diesel buses • To be used as a decision-making tool to plan % of fleet to be electrified annually during the transition • To also be used as a decision-making tool in comparing direct procurement and GCC
Financing Costs, Weighted Average Cost of Capital (WACC)	• Estimate the cost of financing – cost of equity, cost of debt, and WACC, which combines the cost of equity and debt with tax rates, etc. • To be used as a decision-making tool for optimal debt-to-equity ratio and govt subsidies needed and to negotiate the cost of financing with potential investors/lenders
Internal Rate of Return (IRR), Payback Period, Profitability Ratios	• Estimate financial returns and profitability of electrifying fleet • To be used as a decision-making tool on rate of fleet electrification and the optimal combination of diesel and electric buses during transition phase, raise investment, and negotiate with potential investors/lenders
Sensitivity/Scenario Analysis	• Assess the impact of variations in key input parameters such as cost of financing, loan tenure, debt-to-equity ratio, etc. on TCO and profitability

KARNATAKA AS THE CASE STUDY

Given the predominance of rural and intercity bus services in India[3], an analysis of the case of rural and intercity public bus services in the state of Karnataka is presented here. However, the approach used is applicable to other states and in the case of urban bus services, as well. As in many other states, buses are the mainstay of transport in Karnataka—about 27% of all trips made for work-related non-urban travel in Karnataka are made by buses, both public and private (Census 2011). Regional bus services for rural and intercity connectivity in Karnataka are provided by three STUs: Karnataka State Road Transport Corporation (KSRTC), North-Western Karnataka State Road Transport Corporation (NWKRTC), and Kalyana Karnataka State Road Transport Corporation (KKRTC) (previously known as North Eastern Karnataka State Road Transport Corporation (NEKRTC)), all of which are UITP members. Their operational requirements and financial planning practices are similar to other rural and intercity bus services in India, making them a representative case study to demonstrate the proposed approach to long-term financial planning for bus electrification. UITP India worked with these three corporations between July and September 2022 to carry out the analysis presented in this knowledge brief.

FLEET NEEDS ASSESSMENT FOR REGIONAL BUS SERVICES IN KARNATAKA

The three regional STUs in Karnataka had a combined fleet strength of close to 18,500 buses at the end of March 2020, which decreased to 17,500 buses by the end of March 2022 due to lack of investment in the fleet during the two-year period thanks to the financial crisis incited by the COVID-19 pandemic. The state has witnessed steady population growth over the past decade, with a Compounded Annual Growth Rate (CAGR) of 0.6%, while the economic growth is evident from the Gross State Domestic Product (GSDP) growth rate of

over 10% for the better part of the past decade[5]. During this period, personal vehicles like cars and two-wheelers, as well as commercial transport services like three-wheelers and taxis, witnessed a CAGR of over 10%, indicating a rapid increase in travel demand. Public bus fleet size in the state remained relatively stagnant, while private bus fleet size increased at a CAGR of 5 percent. The overall travel demand in the state will continue to increase in the coming decade in parallel to the improvement in the population's socioeconomic status.

Public bus services provided by STUs need to increase their services commensurately to ensure affordable access to mobility across the state. Two different scenarios, with annual ridership growth rates of 3% and 5%, were analysed to estimate the ridership in 2030. While these growth rates may fall short of the overall travel demand growth rates, as witnessed from the growth rates over the past decade, they would still necessitate a significant growth in public bus services, which have remained stagnant over the past decade.

The March 2020 ridership of 64.4 lakhs (6.44 million) per day was taken as a baseline to estimate the increase in ridership needed to cater to the increasing rural and intercity travel demand in the state. The load factors of all three corporations were already at over 70% in March 2020, indicating limited scope to increase the per bus ridership in the future. Hence, the fleet needed to achieve this ridership was derived assuming that the current ridership per bus per day will continue to be the benchmark in the future. Table 2 summarises the current and projected ridership and fleet needs assessment. The 3% growth rate scenario will require a 34% growth in fleet size compared to 2020 levels, while the 5% growth rate scenario would require a 63% growth rate, which was identified as too ambitious during our consultations with the relevant stakeholders. **Hence, the 3% growth rate scenario was used for further analysis, which requires the STUs to have a combined ridership of close to 25,000 buses by 2030.**

STU	2020 PERFORMANCE			2030 SCENARIO 1: 3% CAGR IN RIDERSHIP		2030 SCENARIO 2: 5% CAGR IN RIDERSHIP	
	DAILY RIDERSHIP	FLEET HELD	PAX PER BUS PER DAY	RIDERSHIP	FLEET NEEDED	RIDERSHIP	FLEET NEEDED
KSRTC	30	8,709	344	40	11,704	49	14,186
NWKRTC	21	5,080	409	28	6,827	34	8,274
KKRTC	14	4,729	288	18	6,355	22	7,703
TOTAL	**64**	**18,518**	**348**	**87**	**24,887**	**105**	**30,163**

Table 2: Projected fleet needs for regional STUs in Karnataka

TCO OF DIESEL AND ELECTRIC BUSES IN KARNATAKA

The bus-level TCO estimate has been undertaken for diesel buses and e-buses for alternative business models for the case of a non-air-conditioned (non-AC) bus, which comprises the majority of the public bus fleet in Karnataka and the rest of India. The base-case TCO was estimated for the case of the STU owning the bus, battery, and charger and operating them in-house. Two alternative business models have been explored in the case of e-buses: GCC and dry-lease. In GCC-based operations, the capital, operations, and maintenance expenditure on the bus, battery, and charger, including the provision of a driver, is taken up by the contracted operator. In the case of dry-lease, it is assumed that the driver is provided by the STU, while the remaining activities are taken up by the private operator, as in the case of GCC operations. Across business models, STUs are in charge of revenue collection, upstream electrical infrastructure, and depot provision. The taxes and overhead expenses are considered to be similar across business models, as they are the responsibility of the STU irrespective of the business model.

Per-km TCO for alternative business models

Table 3 (Annexure 1) presents the key assumptions for diesel buses and e-buses that are common across business models, while Table 4 (Annexure 2) presents business model-specific assumptions. The assumptions for STU-specific variables are based on secondary data from STUs in Karnataka for the month of May 2022, while the remaining assumptions are based on market consultations by UITP India. The technology risks related to the bus, battery, and charger are assumed to be covered by the OEM across business models, through warranties and contractual specifications. The key variables that vary between business models are the financing terms and staff costs.

Financing terms: It is assumed that STUs, by virtue of their government support, would be able to attract better financing terms like interest rates and debt share of total investment, while private operators would get less favourable terms due to the commercial nature of their operations. The fleet-level financial analysis presents more detailed analysis of the impact of these financing terms on the overall project cost.

Staff costs: Staff costs are another key difference between STUs and private operators; private operators have lower staff costs, as well as lower annual growth rates in salaries, compared to STUs, as observed from prevailing market practices. The conductor cost remains the same across business models, as revenue collection is the STU's responsibility.

Table 5 (Annexure 3) presents the TCO summary for a 12m non-AC diesel bus and compares it with an e-bus over its 12-year life. The e-bus considered for analysis with a 320 kWh battery is observed to be able to serve the 350 km/day operational requirement of a non-AC bus at a replacement ratio of 1, i.e. not needing additional buses to serve operational requirements. The diesel buses are compared to continue to be owned and operated in-house, while the e-bus TCO is presented for the three business models described above: in-house ownership and operation, GCC, and dry-lease. The following are the key findings from the TCO analysis:

- The TCO per km for an electric non-AC bus (INR 65.5 per km, ~USD 0.82 per km) is about 8% lower than that of an equivalent diesel AC bus (INR 71.1 per km, ~USD 0.89 per km) assuming both buses are owned and operated by the STU.
- The key differences between the two technologies are the relative cost of fuel/energy and capital investment. At the prevailing e-bus market price of INR 1.5 Cr (~USD 187,500) and financing at a 9% interest rate, the total cost of the bus, battery, and charging infrastructure and the associated interest adds up to INR 15.9/km (USD 0.20/km), compared to INR 2.7/km (~USD 0.03/km) for a diesel bus, which just costs INR 35 lakhs (~USD 43,750). However, the cost of energy translates to INR 26.5/km (~USD 0.33/km) for a diesel bus even at a diesel price of INR 80/L (~USD 1/L), growing at a CAGR of 5 percent. Even though the current price of diesel is close to INR 100/L, the price of diesel from January 2022 was considered to showcase a conservative example. An electricity tariff of just INR 5/kWh (~USD 0.06/kWh) results in close to INR 20/km (~USD 0.25/km) savings for the STU, even if it is assumed to increase at a CAGR of 5%, thereby offsetting the higher capital cost of e-buses.
- Furthermore, adopting e-buses through a GCC model would reduce the TCO to INR 60.6/km (USD 0.76/km), achieving an additional 7% savings compared to in-house operations, primarily through the savings achieved in the form of private operators' lower staff costs, even though their cost of capital is higher.
- The dry-lease model would be more expensive than both in-house and GCC operations because it combines the higher staff costs of STUs with the higher capital costs of private operators. As a result, the per-km TCO for the dry-lease model is estimated to be 12% higher than GCC and 4% higher than in-house operations. Despite the higher costs, STUs may still prefer to adopt the dry-lease model to outsource the technology risk of e-buses to private operators and, at the same time, make use of the already available skilled driver workforce in-house.

- Across bus technologies and business models, staff costs are estimated to account for the largest share of the overall cost of operations—in the range of 35-44 percent. Therefore, the GCC model, with the lowest staff cost, results in the lowest overall cost of service delivery, based on prevailing labour costs in the Indian market.
- The trade-off between electric and diesel technologies is primarily a trade-off between the cost of fuel/energy and the cost of capital, irrespective of the business model adopted. Therefore, rural and intercity applications like the Karnataka case are more likely to result in lower TCO compared to urban applications with lower daily vehicle utilisation and thereby lower savings in energy costs.

In summary, the TCO analysis presented in Table 5 demonstrates that for 350 km/day vehicle utilisation, e-buses are already cheaper on a TCO basis even for non-AC buses where diesel buses are available at less than 25% of the e-bus cost.

The TCO values are presented as the average cost per km over the life of the bus in real terms and are not discounted for inflation. Therefore, the TCO values for diesel buses may appear higher than the current cost per km observed for an equivalent bus. Furthermore, these TCO values are derived based on the cost to the operator and may vary from the actual price they quote at the time of procurement. This is because bid prices are determined based on several other contractual specifications that increase or reduce the costs based on the risk allocation to various parties[6].

TCO SENSITIVITY TO TECHNOLOGY AND COST SCENARIOS

To further evaluate the impact of different variables, a sensitivity analysis has been carried out for alternative technology and cost scenarios. Assuming STU in-house operations as the reference business model, the following scenarios have been evaluated:

Scenario 1 evaluates the TCO for diesel buses in the case where diesel prices are considered at the current price of INR 95/L (~USD 1.2/L) and there is a 5% CAGR, as seen over the five years preceding the significant spike observed from 2021 onwards. The TCO for diesel buses at these prices increases by INR 5/km (~USD 0.06/

km), making e-buses cheaper by 4%, thereby presenting a strong case for the e-bus transition.

In Scenario 2, the battery is assumed to last for only 4 years, instead of the previously assumed life of 6 years, thereby necessitating two replacements over the 12-year bus life, instead of the one replacement assumed above. The TCO in this scenario increases to INR 67.3/km (~USD 0.84/km), which is INR 1.8/km higher (~USD 0.02/km) or 3% higher than the base case e-bus but would still remain 5.4% cheaper than the base case diesel bus.

Scenario 3 evaluates the TCO impact of an increase in non-AC e-bus cost from INR 1.5 Cr (~USD 187,500), as assumed above, to INR 1.8 Cr (~USD 225,000). This would increase the e-bus TCO to INR 68.0/km (~USD 0.85/km), i.e. about a 4% increase compared to the base case e-bus scenario, but still 4.4% cheaper than the base case diesel bus TCO.

Scenario 4 assesses the impact of the electricity tariff increasing from the currently assumed INR 5/kWh (~USD 0.06/kWh), which is the current EV tariff in Karnataka, to INR 8/kWh (~USD 0.10/kWh), which is the current commercial tariff. An annual tariff growth rate of 5% is assumed in this scenario. This scenario would increase e-bus TCO by INR 3.7/km (~USD 0.05/km), 6% higher than the base case e-bus scenario but still 2.7% lower than the base case diesel bus scenario.

In the unlikely event of Scenarios 2, 3, and 4 happening together, the TCO would increase to INR 73.5/km (~USD 0.92/km), i.e. 3% higher than the base case diesel bus TCO, assuming diesel prices at INR 80/L (~USD 1/km), and 3% lower than Scenario 1 with a diesel cost of INR 90/L (~USD 1.13/km).

Scenarios 5 and 6 compare the per-km TCO in the case of AC diesel buses and e-buses, which are typically used to provide premium intercity services. The AC diesel bus cost is assumed to be approx. INR 1 Cr (~USD 125,000), while the AC e-bus cost is assumed to be INR 2 Cr (~USD 250,000). The fuel economy of the diesel bus is assumed to be 2.5 km/L, whereas the e-bus energy efficiency is assumed to be 1.3 kWh/km. Given the higher energy consumption, the e-bus's range decreases, thereby requiring up to 20% more buses to perform the same number of trips. Therefore, a factor of 1.2 is applied on the TCO to derive the diesel equivalent TCO of an AC e-bus. The TCO of both diesel and electric buses increases by ~30% in this scenario, primarily driven by the fuel cost increase in the case of diesel buses and an increase in all cost components in the e-bus case due to the increase in the number of buses needed to perform the trips. Despite the increased costs, AC e-bus per-km TCO is observed to be 10% lower than that of an AC diesel bus.

In summary, the TCO and its sensitivity analysis demonstrates that e-buses offer a lower TCO compared to diesel buses at the currently prevailing market conditions and are a commercially viable technology choice for Indian bus operators.

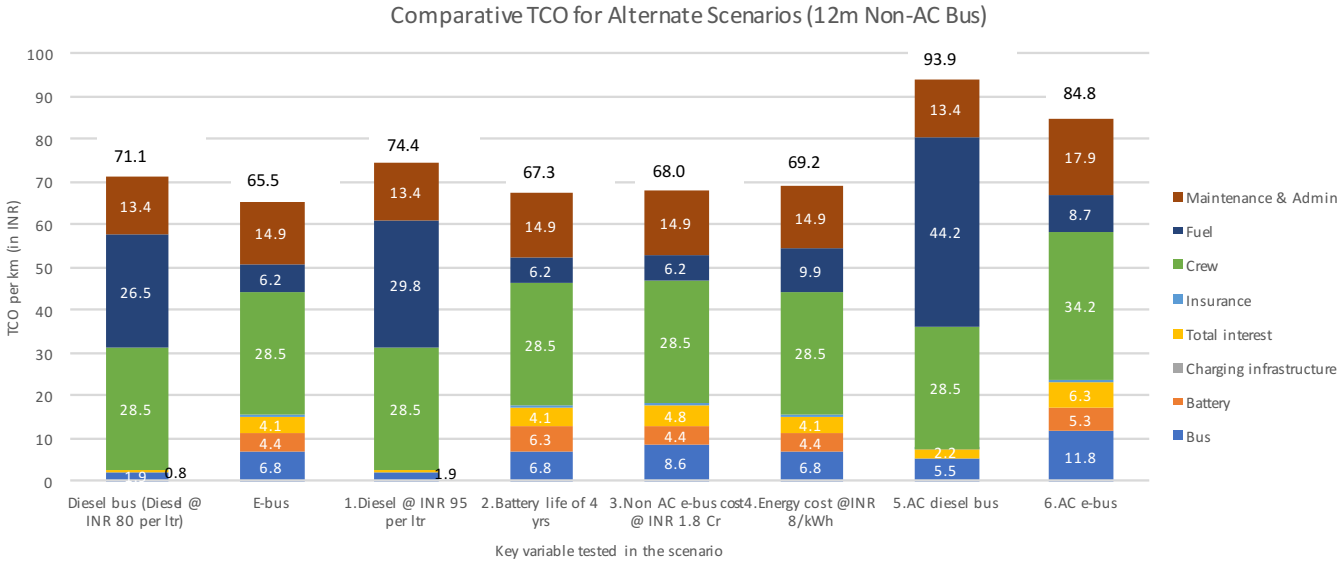

Table 6: Sensitivity analysis for per-km TCO

RESULTS OF FLEET-LEVEL FINANCIAL MODELLING FOR KARNATAKA RTCS

The fleet-level financial model for TCO was applied to the case of the three regional STUs in Karnakata to estimate the cost implications of meeting the 3% annual ridership growth rate scenario explained above.

Table 7 (Annexure 4) summarises the analysis results for four business model scenarios. Scenario 3, where only the GCC model is adopted for both electric and BS VI buses, has the lowest cost among the four models based on the current GCC costs for cities. However, STUs have a large in-house staff on their payrolls, meaning they would have to operate some buses in-house. Hence, Scenario 4, where diesel buses are purchased outright and operated in-house while e-buses are procured on a GCC basis is identified as the most likely scenario to be adopted by the STUs. Findings from the fleet-level TCO model show that even the most feasible solution of operating BS VI buses in-house and e-buses on a GCC basis would require an investment of up to INR 4,939 Cr (USD 617.4 million) across the three regional STUs in Karnataka up to 2030. Similar cost assessments can be made for other states to quantify their investment requirements.

RESULTS OF SENSITIVITY ANALYSIS FOR CAPITAL FINANCING COSTS

Sensitivity analysis was carried out on the key capital financing variables to assess their relative impact on the results for the base case fleetwide TCO assessments. The following variables and their ranges were identified as the most likely ranges in the Indian market and were used for the sensitivity analysis:

i) Interest rate on the loan, i.e. the percentage rate charged by the financing entity per annum. Interest rates of 8%, 9%, and 10% per annum were tested in the analysis.

ii) Tenure of the loan. i.e. the number of years/months by which the loan has to be repaid by the borrower. Loan tenures of 5, 6, and 7 years have been tested.

iii) Equity share of loan, i.e. the percentage of the project cost that is borne by the operator, after excluding the cost financed as a loan. Equity shares of 10%, 20%, and 30% are modelled in the sensitivity analysis.

In order to understand the impact of financing costs on e-buses, the fleetwide TCO results have been derived assuming that all new buses would be electric and procured on an outright purchase basis. This would entail purchasing a total of 25,323 e-buses between FY 2022 and FY 2030. Given that the financing variables remain

the same irrespective of the operator, it is assumed that the findings are relevant even for GCC models where the capital investments are made by the private operator, even though the absolute cost share values may vary based on their operational expenditure. Table 8 (Annexure 5) presents the main results of the sensitivity analysis based on which the following key observations have been made:

- The cost of capital and its financing constitutes about 44%-52% of the e-bus TCO. The absolute values for these to meet the fleet requirements of STUs in Karnataka up to 2030 add up to INR 58,000 Cr (~USD 7.3 billion) to INR 81,000 Cr (~USD 10.1 billion), indicating the large-scale investments needed for e-buses.
- Financing costs can make up 23%-34% of the fleetwide TCO of the new fleet, depending on the lending conditions, in the case of outright purchase and in-house operations by STUs. The share of capital costs is likely to further increase in the case of private operators, given the lower operational costs incurred due to lower staff costs.
- The debt-to-equity ratio has the greatest impact on TCO among the three variables tested, owing to the 15% interest on equity expected by investors.
- Increasing the debt share of investment from 70% to 90% can reduce the cost of financing within the overall TCO by 36-42%, depending on the loan tenure and interest rates.
- Increasing the loan tenure from 5 to 7 years can impact the financing cost within the TCO by 2-9% based on the debt share of investment and interest rates.

- Reducing the loan interest rates will reduce the financing cost of TCO by the same proportion. Therefore, reducing the loan interest rates from 10% to 9% will reduce the financing costs by an equivalent amount.

In summary, the sensitivity analysis highlighted the key role of financing costs in reducing the TCO of a fleetwide transition to e-buses. The debt share of capital is the variable with the greatest cost reduction potential, followed by loan tenure and interest rates. This is because private sector investors build in the returns expected on their investments as a proportion of the equity share of the project, resulting in a higher equity share and a commensurate increase in the overall project costs.

ATTRACTING FINANCING TO MEET LONG-TERM FLEET NEEDS

The fleetwide TCO analysis for the case of Karnataka demonstrated the significant capital investments needed to achieve the ambitious e-bus targets adopted by Indian states. However, India is currently facing several challenges in attracting this capital, thereby hampering the pace of electrification. We have identified the following key barriers to attracting capital investment in e-buses and potential solutions to address them based on consultations with STUs, e-bus original equipment manufacturers (OEMs), operators, & financial institutions, as well as findings from a desk review of available secondary literature on the topic.

CONSTRAINTS TO CAPITAL INVESTMENTS ACROSS BUSINESS MODELS

- **Outright purchase of fleets:** The poor financial situation of STUs across India has led to limited internal resources for capital investment and limited lending opportunities, even from institutional investors like banks and non-banking financial corporations (NBFCs). This has resulted in reliance on budgetary allocations, which have dwindled post-COVID-19.
- **GCC model:** STUs' poor finances and their past track record of deviation from payment timelines. This make GCC projects high risk and less bankable for the financiers because their returns on loans are not assured. This has led to the GCC operators winning bus contracts finding it difficult to access financing from the market.
- **Financial lease:** Cities like Shenzhen, Bogota, and Santiago are unbundling GCC contracts to procure buses on a financial lease model, while O&M is contracted separately (commonly called dry-lease in India). Additionally, the financial institution needs to own the assets being leased to STUs, with necessary warranty agreements with the suppliers. However, such a financial lease model is not common in India, since ICE vehicle leasing attracts 18% GST, which significantly adds to the TCO. In the case of EVs, the GST on lease is 5%, which is likely to provide significant impetus to the market. However, according to our stakeholder consultations, banks are not allowed to own assets on their books as per recent Reserve Bank of India (RBI) guidelines[7], leaving only NBFCs able to do it. NBFCs in India typically focus on two-wheeler and three-wheeler markets rather than buses, and, hence, the model has limited potential for uptake under the current regulations. Even though new financial institutions are being set up with an exclusive focus on EV leasing in India, the market is still nascent and will take a few years to mature.

In summary, all the business models have significant constraints, thereby impeding the large-scale deployment of e-buses in India.

RECOMMENDATIONS

Addressing the capital constraints faced by STUs would require reforms to bring in operational financial sustainability through cost reduction based on higher performance efficiency, increasing ridership through service attractiveness, and consistent VGF mechanisms from the government. While these institutional reforms are

longer-term in nature, the following measures may be taken up to meet the financial needs of STUs in the short to medium-term.

- **National financial support for capital investments:** GoI's investments in bus fleet upgradation have been limited to a few city-level projects under the Smart Cities mission and the recent FAME subsidies. However, the scale of these investments needs to be significantly increased, as demonstrated in the case of Karnataka, to provide the necessary impetus for STUs to recover from the COVID-19 pandemic's impacts. The MV Act (2019) and Road Transport Corporations (RTC) Act (1960) provide adequate scope for the Ministry of Road Transport and Highways (MoRTH), GoI to facilitate the necessary investments in STUs. MoRTH may adapt the mandate of its existing institutions and financing instruments like the National Highway and Infrastructure Development Corporation Ltd. (NHIDCL), Association of State Road Transport Undertakings (ASRTU), and Central Road and Infrastructure Fund (CRIF) to meet e-bus financing needs.

- **Payment guarantee mechanisms:** Even though GCC payments are delayed in some cases, the farebox revenues of most STUs can cover their GCC payments, although government support is still needed to cover overhead staff and management costs. The current GCC contracts have a two-month escrow amount as a buffer to cover for delayed payments. However, given the escrow accounts are also maintained by the STUs, the financial constraints leading to their non-adherence to payment timelines are likely to be reflected in their inability to maintain a sufficient balance even in the escrow accounts. Therefore, a payment guarantee mechanism, in addition to the STU-maintained escrow account, can significantly improve the bankability of GCC contracts and thereby attract additional investment. A central pool of funds supported by state and national governments that can top up the 2-month STU escrow with an additional 3-4 months would significantly improve project bankability. Furthermore, providing first right to ticketing revenue to the GCC operators would also significantly improve the payment guarantee.

- **Enabling financial lease of buses:** Given that many STUs have large volumes of overaged buses and staff that will continue to be on their payrolls in the coming years, enabling the financial lease model can leverage significant e-bus investment from financial institutions with existing staff. Therefore, establishing the above mentioned payment guarantee mechanisms in GCC projects and extending them to e-bus financial leases will significantly improve project bankability and increase investment in the sector.

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- **Establishing financial intermediaries to delink capital investments from operational viability gaps:** GoI and state governments have established several developmental finance corporations with the objective of attracting investment for specific purposes such as power generation, urban development, etc. These corporations act as financial intermediaries with adequate government backing to attract institutional investors. Such mechanisms enable the delinking of capital investments and their sustainability from the larger financial sustainability issues in the sector. However, no financial intermediaries exist at the national level to support investments in bus-based public transport. Even at the state level, Tamil Nadu is the only state with an exclusive financial intermediary—Tamil Nadu Development Finance Corporation (TDFC)—, while other states like Karnataka use urban infrastructure corporations such as the Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC) to finance buses in the state. We recommend special emphasis on creation of bus sector-specific financing corporations at the national and state levels with adequate government investment and payment guarantee mechanisms to attract the necessary capital investments to improve bus services across India.

CONCLUSIONS AND THE WAY FORWARD

India's e-bus deployments have thus far been concentrated in urban areas, while rural and intercity buses, which constitute 70% of the public bus fleets, have seen limited e-bus deployment. STUs have led the e-bus transition in urban India, and ensuring financial support to electrify their rural and intercity services will accelerate the overall adoption of e-buses in India and result in significant economic and environmental benefits.

This knowledge brief presented an approach to long-term financial planning for bus service improvements and the e-bus transition. The three STUs in Karnataka providing regional bus services are used as case studies to demonstrate an approach to long-term fleet needs assessment, TCO comparison for diesel and electric buses, and fleet-level financial assessments for the e-bus transition under alternative business models. The estimates for Karnataka provide an indicative assessment of financial needs under alternative business models.

The brief recommend that STUs adopt such a long-term outlook on the fleet wide e-bus transition and identify solutions to meet their financial needs. The tools used in this analysis, as well as the proposed approach, are applicable to other urban and regional bus agencies, both public and private.

The barriers to accessing financing to meet the STUs' service improvement needs have also been discussed in the paper. The brief have also presented a few potential solutions to address these barriers such as establishing National and State level financing intermediaries and funding mechanisms for consistent support to e-buses, developing payment guarantee mechanisms and unlocking the lease model for e-buses. Adoption of these solutions after adequate deliberation with the relevant stakeholders will be a key step towards unlocking the large-scale e-bus market in India and realising the corresponding energy savings and environmental benefits.

[1]In a GCC model, the operator is responsible for the investment in the bus and charger, as well as their operations and maintenance, while the contracting authority assumes revenue risk, is responsible for the depot and upstream power connectivity, and makes periodic payments to the operator based on the per-km fees arrived at through bidding.
[2]https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1820225
[3] Data received for March 2022 from the Association of State Road Transport Undertakings (ASRTU).
[4]Planning for electrification of rural and intercity buses, UITP Knowledge Brief (2022)
[5]Karnataka Economic Survey (2022), Government of Karnataka
[6]https://www.uitp.org/publications/electric-bus-procurement-under-fame-ii-lessons-learnt-and-recommendations/
[7]Article 6.2: "Master Circular- Lending to Non-Banking Financial Companies (NBFCs)" https://rbidocs.rbi.org.in/rdocs/notification/PDFs/55271.pdf

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This Knowledge Brief was prepared by UITP India.
For any other information, please contact rupa.nandy@uitp.org.

DECEMBER | 2022

UITP ADVANCING PUBLIC TRANSPORT
Rue Sainte-Marie 6, B-1080 Brussels, Belgium | Tel +32 (0)2 673 61 00 | Fax +32 (0)2 660 10 72 | info@uitp.org | www.uitp.org