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'The Grand Challenge' for Electric Bus Deployment:

Outcomes and Lessons for the Future

CEO's Message

In India, Road Transport has emerged as one of the dominant segment in transportation sector with a prominent share in India's GDP. With increasing focus of GoI on E-Mobility, by 2030, we will be requiring more than one lakh electric buses, or 100 times the number currently in operation. This provides a valuable opportunity to understand the challenges and possibilities of switching to a completely new technology for public transportation. This case study, which is based on a thorough market research conducted by CESL, WRI India, the World Bank, and others, highlights the key features of The Grand Challenge, which is globally the largest and most extensive tender to procure electric buses till date. The prices discovered were the lowest ever which were 31% less than the diesel and 18% less than the CNG without subsidy for per kilometer cost.

The current policy environment in India is appropriately addressing the difficulties associated with electric buses and creating a model that would hasten acceptance and implementation. We shall continue advancing CESL's electric mobility initiative to the forefront of India's energy transition landscape making a large impact towards NDC and Net Zero goals of India. CESL is acting as a key enabler by identifying and assessing efficient and scalable solutions for quick adoption and deployment of e-buses in Indian cities.

The National Electric Bus Program aims to deploy 50,000 e-buses and consolidate demand for these vehicles throughout the country. It will assist state transportation entities in incorporating e-buses into their operations and collaborate with both states and DISCOMs to establish charging infrastructure at their depots.

The Hon'ble Prime Minister has pledged to combat climate change and attain sustainability goals, and CESL remains fully committed in meeting these objectives and providing clean mobility solutions within next few years. Our focus will be on promoting the use of electric vehicles at all levels in both private and public sectors to further provide environment friendly public transportation.`

- Vishal Kapoor
MD & CEO, CESL

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Success of the Grand Challenge was anchored by the core team driven by former MD & CEO, CESL - Ms. Mahua Acharya with detailed deliberations with all stakeholders in this ecosystem. The stakeholders composed of several Government of India bodies like the Ministry of Heavy Industries (MHI), the Ministry of Road Transport and Highways (MoRTH), the Ministry of Power (MoP), the NITI Aayog, besides private and institutional organisations.

Core Team of CESL

Ms. Mahua Acharya (Former MD & CEO)
Mr. Rahul Sharma (Lead - Strategy)
Mr. Jagjeet Singh Dadiala (CFO - CESL)
Mr. Polash Das (Lead - Electric Mobility - New Initiatives)
Mr. Kalyan Reddy (Consultant - Electric Mobility - New Initiatives)
Mr Ashim Bhattarcharya (Head - Contracts and Procurement)
Mr. Deepak Mittal (Lead - Contracts and Procurement - Electric Buses)
Mr. Mahendra Singh (Co-Lead - Contracts and Procurement - Electric Buses)

Key Support from Partner Organisations

The World Bank

Mr. Gerald Oliver (Lead Transport Specialist, India)
Mr. Ravi Gadepalli (Consultant)

WRI

Mr. OP Aggarwal (ex-CEO)
Mr. Pawan Mulukutla (Program Director - Electric Mobility)

Background

In India, most formal public transport services are owned and operated either by the State Road Transport Undertakings (SRTUs) or Special Purpose Vehicles (SPVs). However, a Ministry of Road Transport and Highways (MoRTH) 1 report highlights that 90% of the SRTUs in India operate under losses due to the increased gap between the cost of operations and revenue earned. This is due to rising prices of fuel and bus spare parts, and staff cost which have not kept pace with fare revisions. India has 18 lakh buses, of which 1.4 lakh buses are owned and operated by SRTUs, and there is an additional requirement of 2.03 lakh buses2. Over 2,200 e-buses have been deployed as of March 2022. The recent acceptance of electric buses (e-buses) by these SRTUs has helped in reducing operating costs by at least 50%, as compared to their diesel or CNG counterparts. However, the capital cost of e-buses is about 2-4 times higher than conventional alternatives and is one of the major hurdles in their outright purchase. New business models, like the 'Mobility-as-a-Service' model of purchasing e-bus services for a 12-year fixed contract, reduce the financial and operational risks of bus agencies considerably.

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1. Introduction

Increased share of public transport an d electrification of public transport are two key policy priorities of Government of India (GoI) towards meeting mobility needs and reducing oil demand, thereby mitigating the sector's air-pollution, Green House Gas (GHG) emissions and import dependence (NITI Aayog, 2017). Instead of growing with passenger demand, bus service levels in India have stayed relatively stagnant over the years due to the poor financial situation of State Transport Undertakings (STUs). Most STUs operate in financial losses caused by the growing gap between increasing cost of service delivery, due to rising fuel and staff costs, combined with slowly rising revenues on account of fare affordability.

In this context, electric buses offer a lower operating cost alternative with energy cost at least 50% lower than that of a diesel or Compressed Natural Gas (CNG) buses and benefit from relatively stable electricity prices. However, the lifecycle costs of electric buses were more expensive compared to diesel and CNG buses until 2021, in particular for in-house services. This prompted GoI to adopt a new approach in June 2021 with a shift towards e-bus service contracting at scale, focused on service delivery rather than bus purchase.

The recently (April 2022) concluded bidding process for services of 5,450 electric buses in 5 cities has significantly changed the electric bus landscape in India. NITI Aayog and Convergence Energy Services Limited (CESL), a public sector undertaking, have concluded the largest global tender for electric bus procurement through a Grand Challenge (GC) process. The GC aggregated demand across cities, homogenised their procurement specifications and carried out the tendering process to procure buses on a Gross Cost Contract (GCC) basis. The per-km prices discovered are 23-27% lower than the current cost of diesel/CNG buses in the cities without any subsidy. Including the subsidy offered by GoI, these prices are 31 to 35% lower.

Given the significantly lower costs of electric buses discovered by the GC when compared to the current cost of diesel and CNG buses, electric buses have now become the de-facto first choice for Indian cities. Their lower lifecycle cost enables cities to expand shared mobility options more rapidly and open access to mobility solutions for a larger population, generating twin environmental benefits due to a shift to public transport and cleaner bus technologies. In this paper, we explain the approach adopted to achieve these results and the lessons offered for rapid advancement of electric buses in India.

2. Evolution of the Electric Bus Market in India

GoI has taken up several fiscal and regulatory measures to accelerate electric vehicle manufacturing and adoption across vehicle segments, with special emphasis on electric buses. Faster Adoption and Manufacturing of Electric (and hybrid) vehicles in India (FAME) scheme, launched in 2015, is GoI's flagship scheme. It provided end-user incentives for electric vehicle purchase and kickstarted electric bus deployment in India. The first phase of the scheme (FAME-I) sanctioned subsidy for 390 buses between 2017 and 2019. While FAME-I was instrumental in piloting electric buses across 9 cities, the scheme also faced challenges such as cities being unable to achieve project closure due to gaps in procurement process, lack of standardised Gross Cost Contracts (GCC) leading to widely varying bid prices, or performance of buses purchased outright not meeting operational requirements.

Building on the learnings from FAME-I, FAME-II was announced in 2019 with a total budget outlay of USD 1.3 bn, about 35% of which was earmarked for incentives to buses. FAME II was announced with a target to deploy 7,000 electric buses. The scheme has brought in several advancements compared to FAME-I such as mandating Gross Cost Contract (GCC) based procurements using a standardised Model Concession Agreement (MCA) issued by GoI. The minimum share of local manufacturing has also been increased from 15% in FAME-I to 40%. The initial screening for cities eligible for subsidy under the scheme identified 64 cities intending to deploy 5,595 buses. The first phase of FAME-II scheme for buses witnessed procurement of close to 3,500 buses across 36 tenders floated between April 2019 and March 2021. The remaining cities did not procure buses despite being eligible for subsidy due to a variety of reasons including lack of technical capacity to manage the procurement process, reluctance to move towards GCC based procurement and lack of adequate power infrastructure to charge buses in smaller cities. Even among the cities which successfully concluded the tendering process, many of the tenders were not converted to contracts due to several global and local issues including the impact of Covid-19 pandemic on the financial situation of the contracting authority, discovered prices not matching cities' expectations and others.

Notwithstanding the limited uptake, the procurement process offered valuable learnings on electric bus procurement and deployment . The number of bids attracted and prices discovered varied widely between cities despite following the MCA issued by GoI and similar types of buses being procured. The variables driving those differences included variations in operational parameters, volume of buses procured per city varying between 25 buses in some cities to 300 buses in others, varying technical specifications of buses and financial commitments from the bidders and finally, significant variance in creditworthiness of cities- posing varying levels of credit risks to the bidders. Notwithstanding the learnings, the phase-1 of FAME II scheme didn't achieve the anticipated uptake of electric buses, driving the Government to evaluate alternative approaches to advance the mandate.

3. Aggregated Procurement Concentrated in Nine Cities

Based on the lessons from phase-1 of FAME II, NITI Aayog-Government of India's policy think-tank, identified the need to restructure the program to reduce the prices further and improve the level of uptake. Takeaways included a refocus on larger Indian cities with a well-functioning bus system and better technical and financial expertise to procure and operate electric buses, and larger scale tenders with homogenised procurement specifications across cities to improved clarity for bidders and enhance negotiating power of cities. Based on consultations with several Chief Secretaries of States, NITI Aayog identified concentrated deployment in metropolitan cities as the way forward to address many of the gaps in phase-I. Energy Efficiency Services Limited (EESL), with its extensive experience in such aggregated procurements in the energy sector was identified as the agency best positioned to undertake this activity at the National level. With this objective, a corrigendum published in the Gazette of India in June, 2021 nominated EESL to aggregate demand for e-Buses under FAME -II, in 9 major cities having population of over 4 million (Mumbai, Delhi, Bangalore, Hyderabad, Ahmedabad, Chennai, Kolkata, Surat, and Pune). Separately, in 2022, GoI announced USD 5.8 bn of Performance Linked Incentives (PLIs) to incentivize electric vehicle manufacturers, component manufacturers and advanced chemistry cells which include electric bus manufacturing. The PLI scheme's incentives reduced the input costs of manufacturers thereby reducing the cost of bus procurement for cities.

EESL is an Energy Service Company (ESCO), promoted by Ministry of Power, Government of India as a Joint Venture of four reputed public- sector undertakings: NTPC Limited, Power Finance Corporation Limited, REC Limited and POWERGRID Corporation of India Limited. EESL works through its wholly owned subsidiary CESL on electric mobility. CESL offers interventions that solve multiple gap areas in the energy ecosystem by amalgamating seemingly independent yet complementary sectors such as electricity, transport, home appliances and introducing models for adoption at scale through government partnerships and innovative financing such as carbon markets.

CESL launched a 'Grand Challenge (GC)' on 30th September 2021 to aggregate demand from the 9 cities selected for phase-II of the FAME II scheme on an Operational Expenditure (OPEX) basis, i.e., using Gross Cost Contracts (GCC). Under this model, the private service provider invests in the purchase of bus and charging infrastructure along with its operations and maintenance throughout the contract tenure and get paid a fee per kilometre. The revenue collection would continue to remain with the city. The model has the advantage of enabling the contracting authority to focus on overseeing service delivery, limiting the upfront capital investment by cities and the need to manage staff, and at the same time transferring the technology risk of electric buses to the service providers who are best suited to manage them.

[1] Improving bankability of e-bus procurement in India (World Bank 2022).

4. Governance Framework for the Grand Challenge

- **Establishing multi-city platforms for collaboration**

  Homogenising the procurement specifications across cities with varying operating conditions and contractual preferences requires collaborative efforts to build consensus among the key stakeholders. Towards this objective, NITI Aayog constituted a sub-committee within the Grand Challenge comprising of various stakeholders in e-bus implementation and a separate procurement advisory group. The procurement advisory group comprises of all STUs participating in the GC, i.e., Delhi Transport Corporation (DTC), Bengaluru Metropolitan Transport Corporation (BMTC), West Bengal Transport Corporation (WBTC), Telangana State Road Transport Corporation (TSRTC) and Surat Municipal Corporation (SMC).

  CESL convened the procurement advisory group meetings periodically to seek inputs from cities on their specifications such as type of buses needed (9m Vs 12m, AC Vs Non-AC, low-floor Vs standard floor, single vs double decker etc.) and their operational requirements (assured-km of operation, range of bus, operating and charging time needs, availability of depots and their power infrastructure requirements etc.). The participatory approach adopted for consultations with the procurement advisory group allowed for effective communication amongst cities and with Government of India on charting a common way forward for all the participating cities.

  Establishing such multi-city platforms for bus procurement are a key innovation of the GC and has allowed knowledge exchange among peer cities, whose collective intelligence eventually led to a mutually agreeable procurement specifications which addressed several gaps identified in the previous rounds of city-level procurements.

- **CESL procurement policy and past experience**

  EESL and CESL's procurements are guided by the 'Guidelines, policy and procedure for procurement of goods, works and non-consulting services for EESL' which was previously used to deliver several high value assignments in the clean energy space such as 272,000 solar lamps, 9.3 million solar home lighting systems.

- **Financial management and Transparency**

  CESL's procurement norms are compliant with the General Financial Rules (GFR) 2017 issued by Government of India. The GFR ensures transparency and efficiency in management of public finances. The same principles were applied for the e-bus procurement under the GC. Being a National-level public sector undertaking, CESL is also compliant with the norms of the Central Vigilance Commission (CVC) bringing in an additional layer of transparency to the bidding process.

In summary, the Governance framework adopted by CESL allowed participatory processes to homogenise demand across cities while adopting robust financial management and transparency practices, which improve the credibility of the procurement thereby improving the bidder interest and competition.

5. Role of CESL in Electric Bus (E-Bus) Procurement

CESL invited cities to participate in the GC by subscribing to the number and type of electric buses they needed against homogenised procurement specifications to be adopted across all cities. CESL allocated the available FAME II subsidy among the cities participating in the GC and then floated a Request for Proposal (RfP) to discover the prices, in INR per km, on behalf of the cities. The Request for Proposal (RfP) for the procurement of e-buses included the specifications for the vehicle and charging technology, bus operational requirements and contractual terms covering the 12 years of the contracts.

The quoted cost by the service providers includes capital cost for buses, charging infrastructure and any power infrastructure within the depot such as step-down transformers etc., operations and maintenance expenditure including drivers, mechanics and other administrative staff, spare parts needed, electricity cost up to a pre-defined efficiency level along with the financing costs associated with these items. Cities will incur capital cost on bringing power infrastructure like high-tension lines to the depots and operational expenditure on revenue collection (using conductors), Intelligent Transport systems for vehicle tracking and ticketing and contract management expenditure.

The eligible bidders with the least cost quote (L1) would usually be the selected service provider for each lot. To enable diversity in service providers, demand in some lots is distributed amongst two bidders. In such cases, the bidder with the second least cost quote (L2) would be selected as the service provider for part of the demand, subject to their agreement to match L1 rates, thereby ensuring diversity in service providers. The number of buses for L1 and L2 bidders matching L1 rates in each lot and the city to which these bidders would be allotted was decided by CESL in consultation with the cities. Based on the L1 quotes discovered, cities have the option to finalise their demand and enter into an agreement with the selected service provider and manage the contract. CESL will assist cities in ensuring timely delivery of the buses to the city and disburse the FAME II subsidy to the service provider.
While CESL aimed to deploy about 3,472 e-buses using the subsidy available under the FAME II scheme, it has received an aggregated demand of 5,450 e-buses from five cities, i.e., Delhi, Kolkata, Bangalore, Hyderabad and Surat through the GC process. The number of buses eligible for subsidy in each city were allocated in proportion to their share of the aggregated demand across all cities.

However, the type of demand indicated by cities is varied, covering 12m and 9m long buses, Air-Conditioned (AC) and Non-AC buses, low-floor and standard floor buses, single and double decker buses. Similarly, the procurement specifications suggested by cities such as assured-km, obligations on authority and operator, vehicle range requirements etc. are also varied to match local needs.

6. CESL's Approach for Homogenising Procurement Specifications

CESL has adopted the following approach towards homogenising the operational and technological specifications for the procurement under GC.

I. Review of past e-bus tenders:

Procurement results and specifications of previous electric bus tenders across India were reviewed. This built on a detailed consultative process described below. On that basis, the best-in-class specifications across cities were shortlisted as the initial set of specifications published in the CESL's Grand Challenge document.

II. Model Concession Agreement (MCA):

The MCA for electric buses issued by NITI Aayog formed the basis for procurement specifications under the GC. The MCA has previously been adopted by all the cities under the Phase-I of the FAME II scheme and continues to be the base document for the GC RfP. Through consultation as well as a detailed review of contracting conducted by the World Bank Group for NITI Aayog as part of the Transformative Mobility and Energy Storage program, CESL received market inputs and recommendations that were discussed, reviewed and incorporated when deemed relevant in the GC RfP.

III. Ministry of Heavy Industries (MHI) and Make in India requirements:

MHI is in-charge of the disbursement of the FAME II subsidy as well as of the technology specification and certification agencies like the Automotive Research Association of India ARAI. CESL has involved MHI periodically on various key decision-making points. MHI has already mandated Original Equipment Manufacturers (OEMs) to comply with the Phased Manufacturing Program (PMP) that specifies the Make in India requirements for various components of electric buses to be eligible for FAME subsidy. The PMP requirements not only improve local content for the current lot of buses but would even benefit the availability of local components for future procurements and maintenance requirements, thereby driving down the overall cost of e-bus adoption in India. Simultaneously, PLI program of Government of India, also anchored at MHI, is providing incentives for OEMs, component manufacturing and advanced chemistry batteries for manufacturing in India, which is complementing the incentives provided by FAME II.

IV. Bus Technology specifications:

The specifications covering the vehicle and charging technology specific items were covered in significant detail in the GC RfP and they are the most comprehensive specifications for any Indian e-bus RfP. These specifications have been defined through an iterative process which involved collating specifications from several sources. ARAI had previously submitted comprehensive e-bus specification recommendations to MHI. These were mapped against the recent e-bus contracts across cities, the relevant All India Standards (AIS) specific to various components as well as global best practices to identify the specifications for the current RfP. The final specifications have been vetted and approved by ARAI.

[2] https://www.niti.gov.in/sites/default/files/2020-02/ModelAgreement-Operation-and-Maintenance-of-E-Buses.pdf

V. External Technical Advisory support

a. **Knowledge support by the World Resources Institute (WRI):** WRI, a non-profit think-tank supported CESL as a knowledge partner. WRI supported with the e-Sawari coalition under the NITI Aayog which acted as a common platform for all participating cities to convene and build consensus towards the procurement specifications. They have also supported CESL by organising workshops with cities advancing the participatory approach towards homogenising procurement specifications.

b. **Technical support by the World Bank:** CESL received technical inputs from the World Bank Group (WBG) including the World Bank and IFC. The World Bank Group provided recommendations to improve procurement specifications and reduce the bankability risks for the cities and financing entities investing in the project based on past tenders.

c. **The International Association of Public Transport (UITP)** provided continued supported with research and analytical support in assessing the impact and finalising various procurement specifications in consultation with the cities. The feedback from these agencies has been collated and evaluated by CESL to identify the final specifications which are part of the final RfP and MCA.

d. **Support from other agencies:** CESL contracted KPMG for a brief research and was in regular touch with ARAI the technical expert on bus technology specifications.

VI. CESL's in-house team and other advisory support:

CESL has a strong in-house team comprising of technical, financial and legal experts who have anchored the process explained above.

In summary, CESL adopted a collaborative and technically sound approach towards homogenising the procurement specifications across cities and ensuring their robustness. Homogenising led to reducing the number of lots and maximising lot sizes wherever technically, commercially and practically feasible thereby enabling economies of scale. The following table summarises the timeline of the key activities undertaken by the GC.

Timeline of key activities undertaken by the CESL Grand Challenge

Timeline	Activities (Completed)
June 11, 2021	Gazette notification nominating EESL to aggregate bus demand under FAME II
September 30, 2021	CESL, subsidiary of EESL, launches the 'Grand Challenge (GC)'
December 07, 2021	NITI Aayog constituted committee to homogenise specifications across cities
December 23, 2021	Meeting of sub-committee of GC shortlisted cities
January 20, 2022	RfP for procurement of 5,450 e-buses launched by CESL
February 04, 2022	Pre-bid meeting conducted with potential bidders for the RfP
February 11, 2022	Meeting with GC cities on pre-bid queries
February 23, 2022	Meeting with GC cities to finalise homogenising specifications in response to pre-bid queries

7. Improvements in Key Procurement Specifications

The following are some of the key procurement specifications which were improved as a part of the GC RfP through the aggregation and standardisation process explained above.

- **Homogenised specifications across cities:**

  The most significant improvement in the procurement specifications is the homogenisation of procurement specifications across cities through a participatory approach. Homogenisation improves clarity on project requirements to the bidders thereby reducing the uncertainty risks which were built into the prices discovered in the previous rounds of electric buses procured under FAME-II.

- **Volume of buses in each bid lots:**

  The different configurations of buses required by cities (12m Vs 9m, AC Vs Non-AC, low-floor Vs Standard floor) have been grouped in different lots and bids were specific to the operational requirements of the specific type of bus being procured. CESL has adopted a collaborative approach to homogenise demand across cities and reduce the number of lots such that the volume of buses procured in each lot is maximised, thereby leading to economies of scale.

- **Contract tenure of 12 years (10 years fixed, extendable to 12 years):**

  The previous FAME II contracts had a tenure of 10 years. The scheduled age for scrapping of diesel buses in Indian cities typically varies from 10 years to 15 years or 8.5 to 11 lakh km. Given the annual assured-km of 70,000 under the GC, the minimum scrappage value of 8.5 lakh-km would be reached in 12 years. The key degrading part of electric buses are their batteries which are expected to last around 6-8 years. A conservative estimate of 6 years will imply that a 12-year contract tenure would ensure two full life-cycle of a battery. A shorter contract tenure would still require a second battery, but its value would not have completely depreciated by the end of the contract. Hence the GC used a contract tenure of up to 12 years.

  At the same time, cities expressed concerns about the long-life of buses leading poor user experience and reduced on-road performance. To safeguard against that, the contract tenure is defined as 10 years of fixed duration with the option of extending it by 2 years up to 12 years with the same terms of contract. A clause mandating bus-body refurbishment by the end of the 6th year of the contract was added to ensure good bus quality until the end of contract. Additionally, the key parts of the bus such as battery, power controller and traction motor are covered under life-time warranty as a part of the technical specifications. Therefore, a 10 year fixed contract tenure extendable until 12 years was deemed optimal to extract the complete value for investments on the electric buses and consequently, contribute to a lower GCC rates.

- **Eligibility criteria:**

  The previous electric bus tenders in India mandated OEMs to be a mandatory part of the consortium bidding for the project. However, this could limit the number of participants to the five or six eligible OEMs in India. The GC allowed financial aggregators to bid for the tenders as sole bidder, showing an indicative letter of support from a certified OEM. The OEM would later be part of the consortium to which the project would be awarded. This approach allows in principle new investors into the electric bus market and the opportunity to bring in cost efficiencies in financing, as well as increase potential bidder participation driving costs down through competition.

- **Benchmarking quoted cost across cities:**

  Fixed costs involved in electric bus and charger purchase and financing are similar across Indian cities. However, variable costs such as staff salaries and electricity tariff vary significantly. To benchmark price-bids across cities, CESL adopted the following approach

  - Bidders were asked to assume Delhi as the benchmark city for price discovery. The rate was then adjusted for different cities based on the following rationale
  - Staff cost was assumed to be 30% of the total cost of operations, and 30% of the per-km quote was adjusted to different cities in proportion to the Minimum Wage rates of skilled labour in that city.
  - Delhi also has the cheapest electricity tariff of INR 5.5 per-km including service charges. Across cities, the operators would be paying for electricity up to this tariff. In case the actual tariff is higher than this, the contracting agency would be responsible to pay for the additional tariff subject to an energy efficiency target linked to the type of bus. This further incentivises cities to reduce electricity tariff to match Delhi rates.

- **Payment for unutilised and excess-km:**

  Some of the previous electric bus contracts did not allow for any payment in case the actual km operated was less than the assured-km of operation contracted (called as unutilised-km). Since the operator continues to incur fixed costs irrespective of actual km operated, a payment of 75% of assured-km payment per-km is now allowed even for unutilised km, after excluding electricity and other variable costs which may not have been incurred. In case the actual-km is in excess of assured-km the operator will be paid at 50% of per-km cost as the fixed costs are already recovered. The incorporation of these recommendations reduces the payment risks for operators.

- **Payment escalation mechanism:**

  The annual escalation formula as per the previous MCA was linked to CPI-IW and WPI. As per the formula and the CPI-IW and WPI values observed over the past few years, the escalation can be as low as 0% in some years. Therefore, a fixed annual escalation of 2% is now proposed, which is anticipated to cover the operator interests better than a variable escalation clause-which varies between states.

- **Penalties-Capping and definitions:**

  The penalties to be imposed for non-adherence to Service Level Agreements (SLAs) did not have limits in some of the previous contracts thereby significantly adding to the risk of non-payment by operators due to SLA non-adherence. Additionally, many cities linked these penalties to the performance security amount furnished by the bidders, which can be exhausted in a few months, putting the city at risk post that. Therefore, the following items which are now incorporated:

  - A cap on penalties which is now included as 10% (5% cap for operational penalties like punctuality, availability etc. and another 5% for technical failures like safety, bus quality etc.)
  - These penalties are now linked to monthly payments and not the performance security amount
  - The GC MCA also includes improvements to the definitions of various SLAs and SLA-wise penalty capping which did not exist in previous MCAs

- **Range specifications:**

  Many cities in the previous rounds of procurement had a range per single charge requirement of 150 km. While this ensured greater participation from OEMs, given the daily requirement of 200 km, buses needed to be charged mid-day thereby losing revenue earning trips that would have been made during this time. Therefore, the GC mandated requirements that match closely with operating conditions in cities as explained below:

  - Buses to be able to run for 225 km per day for both 9m and 12m buses
  - Single charge range for 12m buses to be 200km at 80% SOC (State of Charge)
  - Single charge range for 9m buses to be 180 km at 80% SOC
  - Opportunity charging allowed for a maximum 45 minutes
  - Overnight charging allowed for a maximum of 4 hours

- **Efficiency:**

  The GC also mandated the following energy efficiency performance for buses

  - 12 m AC: 1.3 kWh/km
  - 12 m non-AC: 1 kWh/km
  - 9 m AC: 1.0 kWh/km
  - 9 m non-AC: 0.85 kWh/km

- **Depot and electrical infrastructure readiness:**

  Some of the previous e-bus contracts handed over depots in 'as-is' condition which meant that the depots sometimes did not have adequate civil and electrical infrastructure like power supply, concreting within depots, maintenance pits, rooms for spares etc.-which the operators had to invest in. The GC RfP sets out clear responsibilities for the authorities to ensure preparedness.

- **FAME II Subsidy:**

  The FAME II program will provide a subsidy of INR 55 lakhs or 40% of the cost of bus, whichever if lesser, for a 12m bus. In case of a 9m bus the subsidy would be the lesser of INR 45 lakhs or 40% of the cost of the bus-calculated based on a formula linked to the quoted per-km cost. This would mean a subsidy eligibility of up to INR 6.55 per km for a 12m bus and INR 6.25 per km for a 9m bus. However, due to the competitive quotes realised through the GC, the 40% of bus cost reduced the subsidy required to INR 35.6-41.1 lakhs per 12m bus depending on the city-wise quotes and INR 26.6-26.7 lakhs per bus in case of 9m buses. This translates to a subsidy of INR 4.2-4.9 for 12m buses and INR 3.7 per km for 9m buses over the contract life.

- **Integration of state subsidy into price-bids and estimating price-bids for unsubsidised buses:**

  In case of cities which have subscribed for more buses than their eligibility for FAME II subsidy, the priced -bids received with FAME II subsidy would still be applicable if they match the subsidy by GoI through State/ City level resources. In case the cities are unable to match the FAME II subsidy, a fixed formula was defined under the GC to generate the per-km cost for the 'over-subscribed buses' which

are beyond the number of buses eligible for subsidy, with a fixed value of INR 0.25 per km for every lakh (INR 100,000) of subsidy not provided by the city. For example, if the 'with subsidy' quote for a 12m bus was INR 50 per km, since the subsidy eligibility per bus is INR 55 lakhs, the quote without subsidy would be INR 63.75 (50 + 0.25 x 55). In case the city provides a subsidy of INR 25 lakhs per bus, the quote would be INR 57.5 (50 + 0.25 X (55-25)).

- **Other revisions made to RfP and MCA** to address technological and financial risks of electric bus contracts:

- Warranties for batteries, electric motor and power train-to safeguard against the technological risk with the three key components of buses
- Depot land availability and electricity connection responsibility allocated to the city
- Addition of a clause on the maximum additional buses to be awarded under contract to be capped at 50% to safeguard bidder interests

- Best in class technological specifications for safety standards, bus body performance and localisation requirements for any Indian electric bus tender. The local manufacturing requirements for some of the components went even beyond the minimum specified under the Phased Manufacturing Program (PMP) requirements.
- Mandates that 10% of the workforce to be women
- Improved language in the Model Concession Agreement (MCA) on the following items

  - Inclusion of pandemic as an indirect political event, thereby ensuring at least 50% payment to operators even during lockdown- to cover for debt servicing and other fixed costs
  - Request for maintenance manual included in the MCA to allow cities to be trained on electric bus maintenance
  - Clarity on allowed changes to routes during the course of the contract: Operators need to be consulted in case depots of operation are being changed. Within a given depot, cities are allowed the flexibility to update routes periodically
  - Clarity on definitions specific to appropriation of performance security in case of operator default
  - Definition of fees and penalties for under-performance
  - Changes in language on termination payment
  - Language edits to clarify post termination clauses
  - Best in class Arbitration clauses for e-bus contracts in India

8. Outcome of the Grand Challenge

The bids were invited for five lots of buses covering 12m and 9m, AC and Non-AC buses. Bidders were asked to submit their price bids per-km assuming demand for subsidised buses. The following table summarises the lot-wise number of buses subscribed by each of the five cities prices discovered for various Lots under the GC. Tata Motors was selected as the Lease Cost (L1) bidder for all the lots.

Summary of total buses subscribed by Cities participating in the Grand Challenge

City	Lot 1: 12m Low Floor AC	Lot 2: 12m Low Floor Non-AC	Lot 3: 12m Std Floor AC	Lot 4: 9m Std Floor AC	Lot 5: 9m Std Floor Non-AC	Total
Delhi	1500	-	-	-	1500	**1500**
Kolkata	250	-	475	575	700	**2,000**
Bangalore	-	1500	-	-	-	**1500**
Hyderabad	-	300	-	-	-	**300**
Surat	-	-	-	150	-	**150**
Total	**1750**	**1800**	**475**	**725**	**700**	**5,450**
L1 quote received* (INR per km)	**47.49**	**43.49**	**44.99**	**41.45**	**39.21**	

* The L1 quote received assumes Delhi labour rates and is subsequently adjusted to other cities' in proportion to their skilled worker minimum daily wage rates, assuming 30% of the quoted cost is labour cost

Convergence Energy Service Limited (CESL) has successfully concluded the bidding process for the largest global tender for electric bus procurement covering 5,450 electric buses through a Grand Challenge (GC) process that discovered prices under the Gross Cost Contracting (GCC) model. Through a combination of economies of scale and contractual improvement, the prices discovered without subsidy are 23-27% lower than the current cost of diesel/CNG buses in these cities. If the central Government's subsidy were to be included, prices achieved are 31 to 35% lesser. Even though recent factors like hike in fuel prices are leading to higher than usual costs per km for diesel and CNG buses electric buses would continue to remain cheaper even after the oil prices stabilise. Furthermore, the prices discovered were lower by 28% (Surat) to 52% (Kolkata) compared to contracted prices under phase-1 of the FAME II program-18 months prior. This is equivalent to a saving of more than INR 10,800 Cr over the 12 years of the corresponding contracts. The following tables summarise the comparison of prices discovered under the GC with diesel and CNG buses and the price comparison with the previous round of tenders in each city.

Therefore, the results of the GC indicate a critical inflection point in India's electric bus journey and pave the way for rapid scale up of electric buses in the future.

Comparison of prices discovered through the Grand Challenge with current Diesel/ CNG costs

Type of Bus	GCC Cost/ km (INR per km)				Cost savings through Grand Challenge (GC) (in %)			
	e-Bus with subsidy	e-Bus without subsidy	Diesel Bus*	CNG Bus**	GC vs Diesel (with subsidy)	GC vs Diesel (without subsidy)	GC vs CNG (with subsidy)	GC vs CNG (without subsidy)
12m Low Floor AC	47.99	53.35	*95.14*	86.14	50%	44%	44%	38%
12m Low Floor Non-AC	43.49	48.85	*65.45*	71.41	34%	25%	39%	32%
9m Std Floor AC	44.99	49.75	71.07	58.00	37%	30%	22%	14%
9m Std Floor Non-AC	39.21	43.61	48.00	48.00	18%	9%	18%	9%
Average % savings					35%	27%	31%	9%

* GCC rates of diesel buses in Surat, Bhubaneswar and Mumbai

**GCC rates of CNG buses in Delhi, Surat, etc.

Figures in italics are per-km in-house operations costs of diesel buses excluding the cost of conductor (Source: BMTC)

Comparison of prices discovered through the Grand Challenge with previous e-bus tenders

City	FAME II Phase 1 (INR/km)	GC Quote (INR/km)	GC Quote Labour-Adjusted (INR/km)	No. of Buses	Savings per km (GC vs FAME II Phase 1) (INR)	Savings (in %)	FAME II Phase 1 (INR/km)	Savings over 12 years (in INR Cr)
Delhi	68.58	47.49	47.49	1,500	21.09	-31%	70,000	2,657
Kolkata - 9m	67	41.45	35.9	1,275	31.1	-46%	60,000	2,855
Kolkata - 12m	86.00	47.49	41.13	725	44.87	-52%	70,000	2,733
Bangalore	48.95 (57.2)*	43.49	40.99	1,500	16.21	-28%	70,000	2,042
Hyderabad		43.49	40.46	300	16.21		70,000	408
Surat	48.87	41.45	35.08	175	13.79	-28%	60,000	174
Aggegrate Savings						-37%		10,870

Data Source: CESL based on inputs received from cities

9. Key Lessons from the Grand Challenge

- **Electric buses as a service are now the most cost-effective approach with or without subsidy**

  The unsubsidised per-km prices discovered by the GC are 23-27% lower than the current cost of diesel/CNG bus services and 31 to 35% lesser if the central Government's FAME II subsidy were to be included. Therefore, the GC marks the inflection point wherein the purchase of electric bus services at scale with enhanced contract terms become de-facto most the cost-effective approach for cities.

- **Homogenising procurement specifications**

  The GC standardized technical and contractual terms and parameters across cities includes critical clauses for the bankability of a contract like payment default, delays, termination, bus safety standards, manufacturing localisation requirements, which can serve as a benchmark for electric bus contracts in India.

- **Benefits of demand aggregation and collaboration amongst cities**

  The GC demonstrated the benefits of demand aggregation across cities and states along with the benefits of the combined experience of the cities participating in the Grand Challenge. Together, these factors encourage future aggregation of demand with or without subsidy to drive-down the cost of adoption of electric buses. In addition to demand aggregation, the collaborative platforms set up under the GC such as the subcommittee on electric buses and the procurement advisory committee provides a scalable and replicable template for future demand aggregation of electric buses.

- **Benefits of National level Governance framework**

  CESL's experience of high-value procurements, efficiency gains through GoI-compliant financial management and transparency practices have added up to the benefits accrued from standardisation and aggregation. Therefore, future demand aggregation efforts would benefit from a National-level intermediary like CESL, building on a diverse ecosystem of partners.

- **Complexity of e-bus services**

  While cost effectiveness was established through the recent tender, the planning and delivering of e-bus services remains a complex endeavour. It requires a solid institutional framework and STUs able to plan and monitor service delivery considering the specificity of e-buses (evolving range, charge), manage large contracts effectively, carry out timely payments and prepare depots and their connection to the power grid in line with contractual requirements. Scaling up such aspects from five large size cities to a broader range of STUs will require substantial capacity building, financing and upfront preparation, to ensure that beyond price discovery, effective service delivery over the contract life can be achieved.

- **Need to de-risk financing**

  The upfront capital cost of e-buses remains a major cost in delivering e-bus services for concessionaires, requiring large-scale access to commercial financing. Certainty in payment timeliness plays a major role in unlocking such financing. Large institutional investors also growingly require environmental, social and governance standards to be carefully followed. In addition to demand aggregation and

price discovery through credible processes, the National level platform could offer additional measures to improve the bankability of contracts across cities. For example, a National level Payment Security Mechanism (PSM) for electric buses, in line with similar measures adopted for solar energy could be established. Such PSM would provide national level guarantees to ensure timely payments to operators despite any short-term cashflow issues that cities may face, thereby significantly improving the bankability of the contract. Such measures would attract more investors into the sector, in particular for cities with a weaker financial standing.

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