



India Innovation Lab  
for Green Finance

# BATTERY SUBSCRIPTION FACILITY

INSTRUMENT ANALYSIS  
SEPTEMBER 2018



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# Battery Subscription Facility

*LAB INSTRUMENT ANALYSIS*

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## GOAL & DESCRIPTION

A facility to accelerate deployment of electric buses in India by providing batteries to electric buses on a subscription basis to reduce upfront costs for the bus operators

## SECTOR —

Sustainable transport, urbanization

## PRIVATE FINANCE TARGET —

Banks, NBFCs, pension funds, developmental financial institutions, multilateral agencies and donors

## GEOGRAPHY —

For pilot phase: Delhi, Bangalore, and Hyderabad

In the future: Across India

The Lab identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy. It is comprised of three programs: the Global Innovation Lab for Climate Finance, the Brazil Innovation Lab for Climate Finance, and the India Innovation Lab for Green Finance.

## AUTHORS AND ACKNOWLEDGEMENTS

The authors of this brief are Saurabh Trivedi and Chavi Meattle.

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## 1. CONTEXT

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*Large scale deployment of electric buses is key to India's transition to meet its decarbonization target of 33-35% by 2030 under its Nationally Determined Contribution (NDC) to the Paris Agreement. But high upfront costs, lack of long term financing, perceived technology risk, and lack of supporting infrastructure are barriers to their mass adoption.*

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Electrification of road transportation is instrumental **to meeting India's climate goals**. The transport sector alone in India accounts for 13% of energy related carbon emissions (INCCA, 2010). Large-scale deployment of electric vehicles (EV) is a necessary starting point for India's transition to a low-carbon economy, and especially for sustainable urban mobility.

In fact, the Government of India recognizes the urgency to accelerate sustainable mobility solutions to reduce dependency on imported energy sources, reduce GHG emissions, and mitigate adverse impacts from transportation. Under the National Electric Mobility Mission Plan, the Government envisages a 30% market share for electric vehicles (or 6-7 million) by 2030 through its various policy initiatives like the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme (PIB, 2016) to subsidies EV purchases.

The electric bus sector has high potential as a starting point for accelerating EV deployment. Electric buses in public transport have high GHG mitigation potential on account of substitution of diesel with clean electricity and high vehicle utilization per dollar of investment (NITI Aayog, 2017). Additionally, since buses generally operate on planned routes, the scaling up of charging infrastructure could be done efficiently. In certain configurations and geographies, electric buses already have a lower total cost of ownership than comparable diesel buses over their lifetime (BNEF-C40, 2018).

However, the high upfront costs of electric buses and lack of access to suitable financing solutions are key barriers to the large-scale deployment of electric buses. The cost of electric buses is almost 1.5 to 2 times the cost of diesel buses, mainly due to the high cost of electric batteries (UITP, 2018). While battery prices are continuously decreasing, the upfront costs of electric buses **won't reach parity with diesel buses until 2025-30** (BNEF, 2018). This is compounded further with lack of awareness and experience with electric bus technology amongst various stakeholders especially financiers, perceived technology risks, and the need for concurrent development of charging infrastructure. Consequently, traditional sources of financing such banks are not yet equipped to provide suitable long-term financing options for electric buses.

One solution to lower the upfront costs of purchasing electric buses is to provide the bus batteries on a subscription basis to bus owners/operators – renting them on daily or per kilometer rates. The Battery Subscription Facility ('the Facility') allows buyers to buy electric buses without the upfront cost of batteries and use the batteries on a subscription basis. This could lower the upfront capital cost of electric buses for bus owners/operators by 40-50% and accelerate the adoption of electric buses in cities in India.

# CONCEPT

## 2. INSTRUMENT MECHANICS

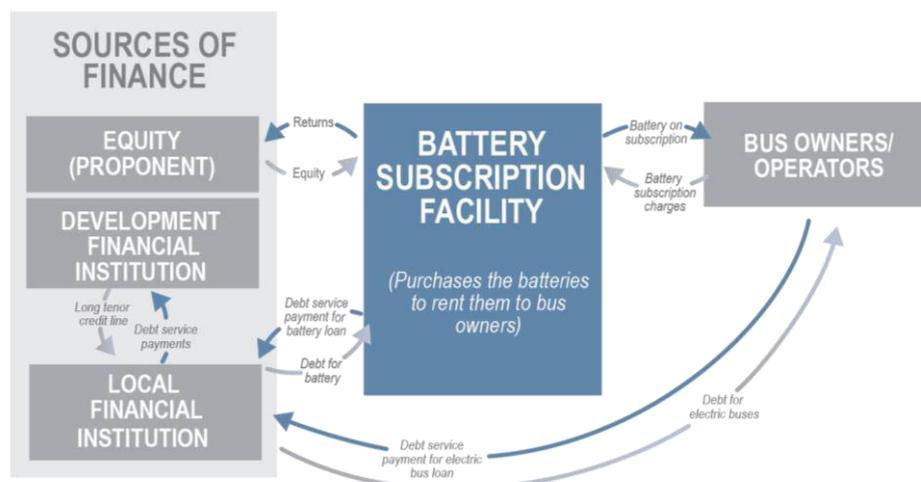
*The Battery Subscription Facility aims to lower the upfront cost of the electric buses in India by investing in batteries and providing them to bus operators on a subscription basis, charging for use on daily or per kilometer rates.*

The Battery Subscription Facility addresses the barriers of high upfront costs of electric buses and high costs of financing to ensure widespread adoption of electric buses. The Facility, set up as a special purpose vehicle (SPV), invests in batteries for electric buses, and provides the batteries to bus operators for use on either a daily or per kilometer basis.

The key stakeholders involved in the Facility are:

- Battery Subscription Facility – a third party battery service provider which pays for the capital cost of the battery and provides the batteries on a daily or per kilometer basis to the bus owner. In this case, it is managed by the proponent, Myrtah Mobility.
- Bus owner/operator – purchases the electric bus (without the battery) and operates it, either for its own private operations or for public transportation.
- Capital providers
  - Development finance institutions (DFIs) – which will provide the credit line as a sub-debtor to a local financial institution (LFI) for a longer tenor, i.e. 8-10 years to fund both electric buses and batteries at commercial rates and to ensure commercial viability for bus operators and the Facility.
  - Local financial institutions (LFIs) – will on-lend plus co-finance both the Facility for the batteries, and the bus owner for the buses. The lending rates for the bus operators is expected to be on par with that of diesel buses which is between 9-12% depending upon the risk profile of the operator. The Facility is targeting a lending rate of about 9.5-10% from the LFI.
  - Equity provider – the proponent will provide the equity to the special purpose vehicle (SPV) which will host the Facility.

Figure 1: The Battery Subscription Facility - instrument mechanics



## 2.1 FUNCTIONING OF THE FACILITY

- a. The bus operator and the Facility will jointly approach a local finance institution (LFI) to raise long term debt capital to purchase electric buses and batteries, respectively. This arrangement will be coordinated by the managers of the Facility. The Facility will purchase and own the battery, and the bus operator will purchase and own the electric bus. This joint financing will allow the bus owner to buy an electric bus, without a battery, at almost cost parity with a diesel bus at current prices.
- b. All three parties – the bus operator, Facility and the LFI – will enter into a tripartite agreement. The electric bus and battery contracts would need to be financed by the same financier because batteries on a standalone basis are not considered or proven to be income generating assets; therefore, debt capital providers cannot finance these assets separately.
- c. The bus owner and the Facility will jointly purchase buses and batteries from the electric bus manufacturer, so that the two assets are compatible with each other and there is no physical separation of the two. This will remain the case until the battery technology is evolved as matured technology with a proven track record.
- d. The Facility provides the bus owner the battery on a subscription basis (daily or per kilometer rates). The subscription fee will be designed to ensure the following criteria to ensure viability for all the stakeholders:
  - o The operating cost including the subscription fee and charging infrastructure of an electric bus operator will always be less than an equivalent diesel bus.
  - o The Facility is able to service its debt taken for the battery and also meet the return expectations of the equity investors within the warranty period of the battery.
  - o The Facility can recover its investment from savings in cash flows from operations.

In addition, it is possible that the Facility will be able to recover more investment by unlocking the value through second, post-traction uses of the batteries. This will also lead to a reduction in the effective cost of the subscription of a battery. Electric bus batteries after traction applications are still expected to hold a charge of 70-80% of their rated charge capacity. The instrument proponent is exploring the potential of repurposing these batteries for second use applications such as energy storage. Table 1 below discusses the key roles of the Facility with its associated stakeholders and their corresponding value propositions.

Table 1: Key benefits to the Battery Subscription Facility stakeholders

Stakeholder	Key Benefits to the Stakeholders
Battery Subscription Facility	<ul style="list-style-type: none"> <li>• Short-medium term: Revenue stream as the equity investors</li> <li>• Long term: First mover advantage in the electric mobility and energy storage space.</li> </ul>
Bus owners	<ul style="list-style-type: none"> <li>• Short-medium term: Savings in operation costs in comparison with conventional buses by hedging against volatile diesel/CNG prices</li> <li>• Short-medium term: No technology risk related to owning, servicing and replacing batteries as covered under warranty</li> <li>• Long term: Reduced capital expenditure for buses to achieve cost parity with diesel buses</li> </ul>
Capital Providers	<ul style="list-style-type: none"> <li>• Short term: Opportunity to enter an emerging sector and leverage the first mover advantage.</li> <li>• Long term: Opportunity to earn high returns for equity investors and less off-taker risk for debtors given the lower default rates in the private commercial vehicle sector in India</li> </ul>

### 3. INNOVATION

*The Facility is an innovative concept that enables third party-led, non-subsidized deployment of electric buses at scale.*

#### 3.1 BARRIERS ADDRESSED: HIGH UPFRONT COSTS, HIGH COST OF FINANCING, TECHNOLOGY RISK

The Facility addresses some of the most persistent barriers to large scale deployment of electric buses in India - high upfront costs, shorter tenor of financing, and perceived technology risk. Table 2 provides details on the how the Facility addresses these barriers.

Table 2: Barriers addressed by the Facility in mass adoption of electric buses in India

Barrier	Description	How the Facility addresses the barrier
High upfront costs of electric buses compared to diesel	In comparison to conventional diesel buses, electric buses are 1.5 to 2 times more expensive mainly because of the high import cost of lithium-ion batteries.	The Facility owns the battery and provides it to the bus owner on subscription basis, thus reducing the upfront cost for the bus operator.
Informational barriers causing high perceived risk	Stakeholders are marred with skepticism related to EV technology and government policies, making them adopt a wait and watch approach.	The Facility engages in providing proof of concept and offers innovative financing options for electric bus deployment to encourage buy-in from stakeholders.

High cost of financing with shorter loan tenor	<ul style="list-style-type: none"> <li>• Electric bus technology is perceived to be riskier by bankers in India, leading to a higher cost of financing.</li> <li>• Shorter loan tenor of 4-5 years creates a mismatch with the cash flow profile of electric buses. (Please see Annex 7.2)</li> </ul>	The Facility targets creating long-term financing for bus operators by facilitating a specific line of credit from DFIs.
Overreliance on subsidies to accelerate EV adoption	In India, and globally as well, the increase in electric vehicles deployment is mainly on back of capital subsidies.	The Facility aims to pilot and scale-up commercially viable projects. Once the financing of the first wave of private sector electric bus deployment in India is concluded with commercial viability, it is expected to attract more private investors in the EV space.

### 3.2 INNOVATION: THE ONLY HYBRID MODEL IN INDIA THAT TARGETS THE PRIVATE SECTOR

Typically, there are three business models deployed by bus operators/owners to finance buses.

The first is a gross cost contract (GCC)/operating expense model. This is mainly undertaken by the public sector wherein the State Transport Undertaking (STU) enters into a contract with a bus manufacturer to provide electric buses and associated services on a lease basis. Out of the 10 contracts issued by the Government of India recently, five have been tendered under the GCC model. This financing option is mainly deployed in the public sector and not much by the private bus operators in India.

The second is an outright purchase/capital expenditure model. Under this option, the bus operator procures, owns, and operates the electric buses. The STUs deploying this financing option enjoy a 60% subsidy on the total cost of the electric bus under the Government of India's FAME scheme. However, no such subsidies are provided to the private sector which accounts for 90% of the total bus market in India.

The third is a hybrid model, which is what the Battery Subscription Facility is. The bus operator/owner purchases the bus without a battery and avails the battery on a lease basis. It is primarily suitable for those bus owners who prefer to own the bus, but the high upfront cost of the electric bus makes it difficult to switch to electric buses.

While there are applications of the hybrid model in other countries (see Annex 7.4), there are no other instances of the hybrid model in India in the public domain, making the Battery Subscription Facility unique in India. In addition, the Facility is aiming to focus at least initially on private bus operators in India. It is unique in this aim, where there is no or limited uptake of electric buses among private operators due to high upfront cost and no capital grants.

### 3.3 CHALLENGES TO INSTRUMENT SUCCESS

Electric vehicle technology is still very nascent in India, with no precedence or proof of concept of financing batteries on a standalone basis. Consequently, the Facility in its initial phases is likely to encounter certain challenges, summarized along with the proponent's strategy to mitigate them in Table 3.

Table 3: Potential challenges to the Facility and proposed mitigation strategies

Challenges to the Facility	Description	Risk mitigation strategies
No separate financing for batteries	No independent financing of the buses and batteries because of concerns around utility of buses without batteries and vice versa	Initially both the bus (without battery) and battery needs to be financed by a common lender wherein the Facility, lender and the operator will enter into a tripartite agreement.
Technology risk related to battery performance	Electric buses and batteries are nascent technologies. Bus operators are concerned about their performance and future replacement costs.	Battery warranties (along with mid – replacements) are provided by the bus manufacturers to cover the expected lifetime of the battery. This limits the technology and performance risk to be borne by operators.
Access to longer tenor debt	Higher upfront costs of electric buses require debt which is 2-3 years more than existing debt available to commercial vehicles in India.	The Facility intends to access and mobilize long term debt capital from DFIs which will act as sub-debtor.
Counterparty risk	High upfront investments and longer tenor lead to increased counterparty risks i.e. delayed or default on payments	<ul style="list-style-type: none"> <li>• Target corporates segment (offices transporting employees/schools transporting children) of the bus market in India for whom operation of private fleet of buses is a key operational requirement</li> <li>• Bus owners are invested with the Facility given their significant capital investment in the bus.</li> </ul>
Second use of battery not recovered	Usage of batteries after traction life at scale is yet to be proven.	The Facility intends to procure old batteries to repurpose them for various storage applications. The Facility is best placed to test out storage application given proponent's parent company is one of India's largest Independent Power Producer.

## 4. IMPLEMENTATION PATHWAY

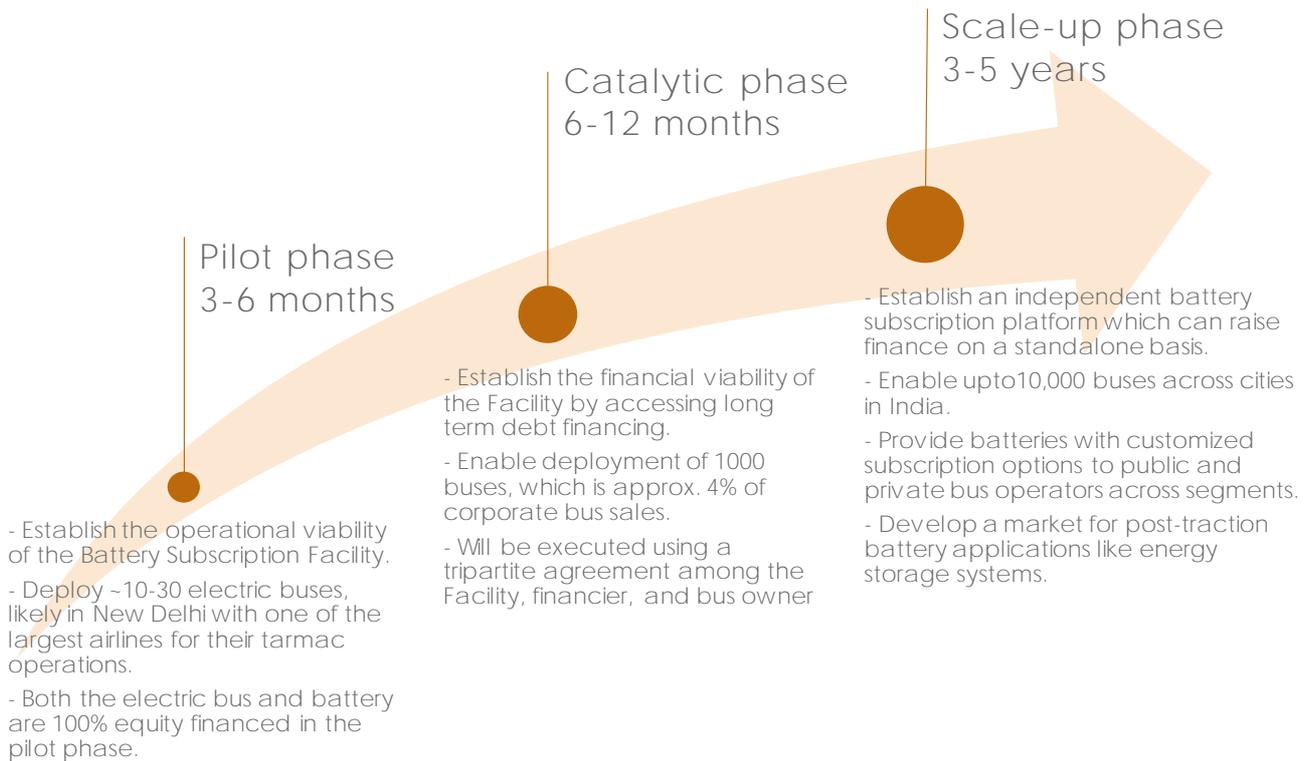
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*The proposed pilot is to deploy 10-30 electric buses with a corporate client, expected to be operational in October 2018. Once the model is proven, it can be scaled up to 10,000 buses in the next 3-5 years.*

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The implementation pathway for the Battery Subscription Facility consists of three phases: pilot, catalytic, and scale-up, represented in Figure 2 below.

Figure 2: Implementation pathway



The nascence of the proposed business model requires proving its operation viability before creating traction for a debt financier. Hence, it is important to note that the proposed instrument mechanics which entails a tripartite agreement between the bus owner, the Facility and the LFI will be executed in the catalytic phase only. Further, the need for a tripartite agreement may not be needed in the scale-up phase once the battery as a standalone income generating asset is proven during the catalytic phase.

#### 4.1 PILOT PHASE: ESTABLISH A BATTERY SUBSCRIPTION FACILITY AND SHOWCASE ITS OPERATIONAL FEASIBILITY

Mytrah Mobility, the proponent, will form a special purpose vehicle (SPV) that will serve as the Battery Subscription Facility and will own the batteries. The proposed pilot is with a reputed corporate client which would purchase 10-30 buses without the batteries and will use the Facility to rent batteries on a daily rate. The pilot discussions are in fairly advanced stages, and it is expected to be operational in November-December 2018.

The corporate client is one of the largest airline companies with tarmac operations at the New Delhi airport and is willing to enter into a contract of 10 years, which means the pilot faces low counterparty risk. The Facility will provide a standard warranty of 500,000 kilometer/5,000 cycles/5 years with 80% residual capacity to the client to cover their

technology risk. The proponent will also market test their electric vehicle technology solutions (Symphony<sup>1</sup> and Saathi<sup>2</sup>) to provide additional supporting infrastructure to its client.

Investment Mobilized for the Pilot:

- Equity – US\$ 4.7 million: The pilot will deploy ~30 buses with total investment of US\$ 1.9 million from the equity provider of the Facility (the proponent), and US\$ 2.8 million from the bus owner, initially funded with all equity.

In the absence of debt financing, both the Facility and the electric bus owner will purchase the buses and batteries through their own equity. Once the operational viability of the Battery Subscription Facility and the technology implemented is proven in 3-6 months, the Facility will reach out to debt capital providers to access long term debt for further projects.

## 4.2 CATALYTIC PHASE: ACCESS LONGER TENOR FINANCING VIA TRIPARTITE AGREEMENTS

In the intermediate catalytic phase, the Facility will raise financing for ~1,000 buses for corporate clients, which is around 4% of the total corporate buses sold annually in India. The proponent is in the process of signing MOUs with several potential clients. The expected timeline for the phase is 6-12 months, starting from February 2019.

Investment Requirement:

- Equity - The proponent will contribute up to 15% (US\$ 8.6 million) as equity towards procurement of batteries by the Facility. The bus owners/operators will contribute ~5% (US\$ 3.2 million) towards the cost of buses without batteries, at today's market price.
- Long-term debt – The debt requirement is estimated at US\$ 110 million. It would require development finance institutions (DFIs), climate fund or an institutional investor to extend a credit line to a local financial institution (LFI) for 8-10 years to ensure viability of the electric bus operations. These debtors will be junior debtors in the overall capital structure. The DFI is expected to provide 30-40% of the total capital and will act as the sub-debt in the capital structure. The LFI will act as the senior lender and will provide the remaining debt required for the project for similar tenor as provided by the junior debtor.

The proponent also proposes to provide charging infrastructure access, real time asset monitoring and maintenance support alongside the Facility. These supporting services are important to make bus owners/operators comfortable with the new EV technology and ensure higher utilization and faster deployment of electric buses. To this end, the proponent estimates a grant requirement of US\$ 300,000. This grant would help in identifying and creating a pipeline for this Facility with corporates for intracity transport for scale-up.

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<sup>1</sup> Symphony is an EV and charging infra planning tool for electric buses which a) assess the feasibility of replacement of diesel buses with electric buses b) analyze the charging requirement and support assessment during the operating schedule. Four Indian cities are already using Symphony for EV and charger assessment planning.

<sup>2</sup> Saathi is a fleet management solution which a) ensures access to charging infrastructure b) supports customers in maximizing utilization of its buses c) provide real time monitoring of vehicle health, battery performance and maintenance requirement

### 4.3 SCALE UP PHASE: EVOLUTION INTO AN INDEPENDENT FACILITY

The final phase would be scaling up the Facility to deploy up to 10,000 electric buses. The expected timeline is 3-5 years, starting in December 2020. The key objectives of the scale-up phase are:

- o Provide batteries on a customized subscription options (various tenor options) to suit varied users including public and private bus operators apart from corporate clients.
- o Raise long term commercial debt on a standalone basis, eventually phasing out development capital from DFIs.

### 4.4 THE TEAM

The Battery Subscription Facility is a mechanism that can be adopted by any commercial entity which understands the battery technology. One such emerging player and pioneer in India's electric mobility segment is the instrument proponent, Mytrah Mobility.

Mytrah Mobility is a subsidiary of Mytrah Energy, one of India's largest independent power producer with a portfolio of over 2 GW of operational & under development renewable energy generation capacity. Mytrah Mobility has pioneered the first commercial deployment of 25 electric buses in India (Manali, Himachal Pradesh). They have also developed several data and technology platforms like Symphony and Saathi to support bus operators around technology, product performance and charging infrastructure.

In addition, the prospective DFIs and local financiers willing to provide longer tenor debt would also be critical to the success of the Facility.

## 5. IMPACT

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*The Facility reduces the upfront capital cost of an electric bus for the bus owner by 40-50%, achieving parity with a CNG/diesel bus. It also results in estimated savings of ~13%-16% in the total cost of ownership over the bus's lifecycle, compared to a CNG/diesel bus.*

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### 5.1 QUANTITATIVE MODELLING

The main driving factor for a bus owner to adopt electric buses is savings on the upfront capital cost and total cost of ownership. This section provides estimates on these savings. The pilot of 30 electric buses will replace CNG buses, so we've compared the savings with CNG buses. For the catalytic phase, we've compared the savings with diesel buses.

#### 5.1.1 PILOT TRANSACTION

Under the Battery Subscription Facility, the total cost of ownership of an electric bus over its lifetime would be cheaper than a natural gas (CNG) bus by ~13% for the proposed pilot transaction.<sup>3</sup> For 30 buses, the cost of electric buses, including batteries, is ~1.4x more expensive than the CNG buses that the corporate client is currently operating. However,

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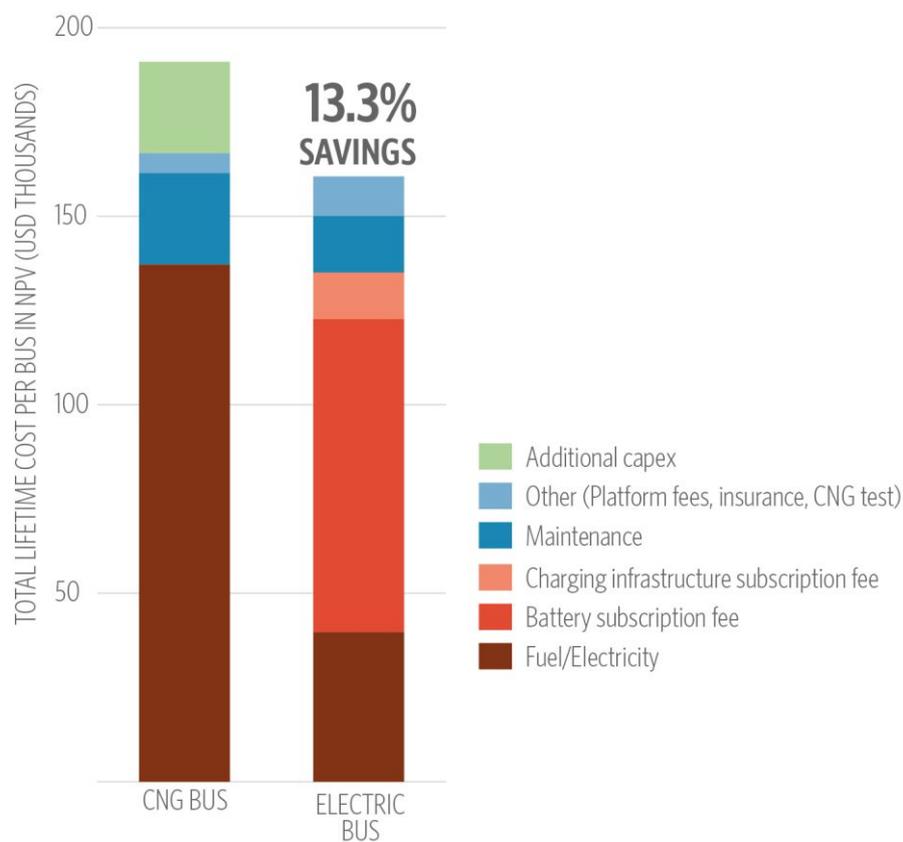
<sup>3</sup> The numbers are based on assumptions used for the pilot transaction and may vary for other transactions. It will also vary based on the savings compared with CNG buses vs diesel buses.

through the contract with the Facility, the client will enjoy the following savings on the electric buses relative to CNG buses:

- ~17% savings in upfront capital cost to buy an electric bus (without a battery) as compared to a CNG bus, as the cost of battery is now borne by the Facility.
- ~4% lower operational costs over the lifetime of the bus (10 years) in net present value terms, as shown in Figure 3 below
- ~13% lower total cost of ownership

This will translate into savings of US\$ 5.2 million in total cost of ownership over the lifetime of 30 buses for the client.

Figure 3: Total cost of ownership of a CNG bus versus an electric bus in the pilot



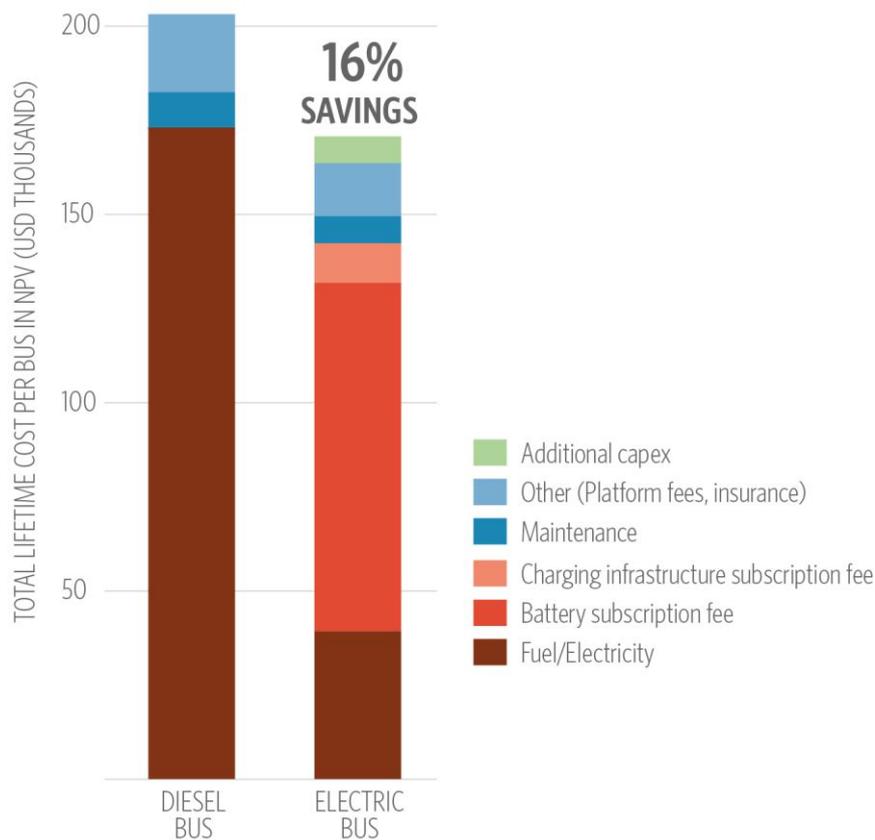
### 5.1.2 CATALYTIC PHASE

Under the Battery Subscription Facility, the total cost of ownership of an electric bus over its lifetime would be cheaper than a diesel bus by ~16%. In the catalytic phase of deploying 1,000 buses, we estimate the savings of an electric bus compared to a diesel bus. An electric bus (with the battery) is ~2.2x more expensive than conventional diesel buses. However, with the help of the Facility, the bus owner will have the following benefits:

- Upfront capital cost of an electric bus (without the battery) almost achieves parity with a diesel bus.

- ~19% lower operational costs over the lifetime of the electric bus (10 years) in net present value terms. This saving is primarily driven by ~18% lower cost of the battery subscription fee, charging infrastructure subscription, and the cost of electricity vs. the diesel fuel cost, as shown in the Figure 4 below
- Consequently, this leads to ~16% lower total cost of ownership

Figure 4: Total cost of ownership of a diesel bus versus an electric bus in the catalytic phase



Please note that these numbers are based on a certain set of assumptions, including the assumption of utilization rate and the battery subscription fee. In addition, these numbers will be different for different configuration of the buses compared, the type of fuel (CNG vs diesel) being compared with the electric bus running cost etc.<sup>4</sup>

The pilot project will be key to proving the operational viability of the Facility, including making a case for longer-term debt financing. An electric bus is commercially viable in the longer run of 6-9 years, once the savings accrued by the electric bus have compensated for the additional upfront capital expenditure (the exact length of time depends upon the utilization rate, or distance run per day) (more details in Annex 7.2). Hence, the additional capital expenditure would require longer tenor debt to spread out the cost of financing and match the cashflow profile of the savings accrued in electric bus operation. If the Facility is financed with shorter tenor debt, then it will have to charge higher battery subscription fees

<sup>4</sup> Table 6 in Annex 7.3 presents the savings in total cost of ownership under different utilization rates of an electric bus vs. a diesel bus.

to the bus owner to ensure its debt service repayments' viability. This will drive away bus owners from the subscription model and could make it commercially unviable for them.

## 5.2 ENVIRONMENTAL IMPACT

Deployment of electric buses under the Battery Subscription Facility will reduce carbon emissions and urban pollution in India. Based on our estimates, an electric bus has a net saving of 0.2475 kgs of carbon emissions per effective bus kilometer (km).<sup>5</sup> The pilot is expected to deploy 30 buses with a lifetime of 10 years, with an estimated daily operation of 18 hours. This would result in incremental savings of 2,700 tonnes of carbon emissions.

The catalytic phase of deployment of 1,000 buses is expected to save over ~250,000 tonnes of carbon emissions over the lifetime of the bus. Further, using the batteries for storage applications after their traction use is expected to save an additional ~300,000 tonnes, considering the batteries will replace conventional power sources with renewable energy.<sup>6</sup>

## 5.3 PRIVATE FINANCE MOBILIZATION

### 5.3.1 PRIVATE FINANCE MOBILIZATION

- The pilot phase is mainly financed from private capital but all through equity from the proponent and the bus owners.
- The catalytic phase will target the development finance capital provider as a sub-debtor for longer tenor line of credit. This credit line will be extended to a local financial institution (LFI) which will then on-lend plus co-finance to the bus owner and the facility. Once the financing of the first wave of private sector electric bus deployment in India is concluded with proven commercial viability based on market demand, it is expected that other new private investors will be able to attract adequate long-term financing from local and international commercial banks. It is estimated that DFI capital would be able to generate a leverage factor of 2.3 with a certain capital structure. The leverage factor can go up to 6.0 once the idea reaches towards scale up stages.
- In the scale-up phase, once proven that batteries can be a standalone income generating asset class, the Facility should be able to mobilize large scale commercial private debt. It is expected that in the scale up stage, DFI capital would be either exited or remain there at a very marginal level of the total capital deployed.

Table 4 below summarizes the estimated capital mobilization expected through the Facility by the proponent and prospective bus owners in each phase under certain capital structure:

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<sup>5</sup> According to our analysis for the Lab's Phase 2, each bus is expected to run on an average 140 KM/ day with 26 operational days in a month. This would mean a total of 436,800 KM over the contract period of 10 years. However, over its lifetime an electric bus is expected to run for over 1 million. A similar diesel bus emits 2.64 Kgs of CO<sub>2</sub> per liter of diesel consumption with additional 20% accounting for Well-to-Tank emissions. Considering a mileage of 3 KMs per liter, the net effective emission comes out to be 1.1 KGs of CO<sub>2</sub> per bus KM. Electric buses on the other hand have an emission footprint based on electricity generation source. The power generation mix in India after accounting for renewable energy generation that is expected to during the course of the project is estimated to be 0.775 Kgs per KWh of electricity generated, after accounting for transmission and distribution losses (20%). The average consumption of electricity assumed for the electric buses is at 1.1KWh/km.

<sup>6</sup> The carbon intensity of conventional power sources in India is estimated at 0.82 kg/KWh.

Table 4: Estimate of capital mobilization of the Facility by the proponent (in US\$ millions)

	Pilot	Catalytic phase	Scale-up phase
Equity	4.7	12	118
Junior debt (DFIs)	–	39	179
Senior debt	–	70	918

### 5.3.2 MARKET POTENTIAL

India is the second largest market for buses after China with average annual sales of over 80,000 buses (ICRA, 2018) and growing at 8-10% every year. The total vehicle stock in India is about 1.7 million buses (MOSPI, 2015). The corporate bus segment comprises ~32% (~26,000 buses) of the existing market with an average daily run of 120 -160 km. This Facility primarily targets the corporate segment which comprises of buses which are used by: companies to transport their employees to the workplace; corporates which require buses for their internal operations; and by schools.

This target segment is targeted to ensure that the counterparty risk is lower for the Facility and also ensure that the additional infrastructure like charging stations can be easily installed on the premises of the bus owners.

During the catalytic phase, the Facility intends to enable 1,000 buses which is approximately 4% of the corporate bus segment (annual sales) by making batteries available on a subscription basis. The success of this Facility would help catalyze the electric vehicle ecosystem by helping further reduce solution costs and helping electric buses compete with a larger market share of diesel buses.

## 6. KEY TAKEAWAYS

**Innovative:** The Facility addresses a persistent barrier to electric bus deployment – high upfront costs – by providing the battery on a subscription basis, thus reducing the upfront cost of electric buses for bus owners by 40-50%. In addition, the operational cost, including the battery subscription fee, will be significantly less than the conventional diesel buses over its lifetime.<sup>7</sup>

**Financially Sustainable:** The Facility is financially sustainable in the long run. However, currently available debt products of 4-5 years tenor do not match the cash flow profile of an electric bus, thus making it commercially unviable at the moment. To this end, the Facility is contingent on obtaining a longer tenor credit line from a DFI or an institutional investor to showcase its electric bus profitability over its lifecycle.

**Catalytic:** The Facility, subject to financing availability from DFIs, will be able to mobilize large scale commercial private debt once proven that batteries can be standalone income generating assets. Electric buses deployed through the Facility are expected to result in significant environmental benefits. For instance, 1,000 buses deployed by the Facility will save over ~250,000 tonnes of CO<sub>2</sub> over the 10-year lifetimes of the buses.

**Actionable:** The Facility benefits from a strong implementer in place which is in advance stages to actualize the pilot with its own equity (100%). The pilot is likely to be implemented in the next two months.

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<sup>7</sup> Please refer to Table 6 in the Annexure 7.3

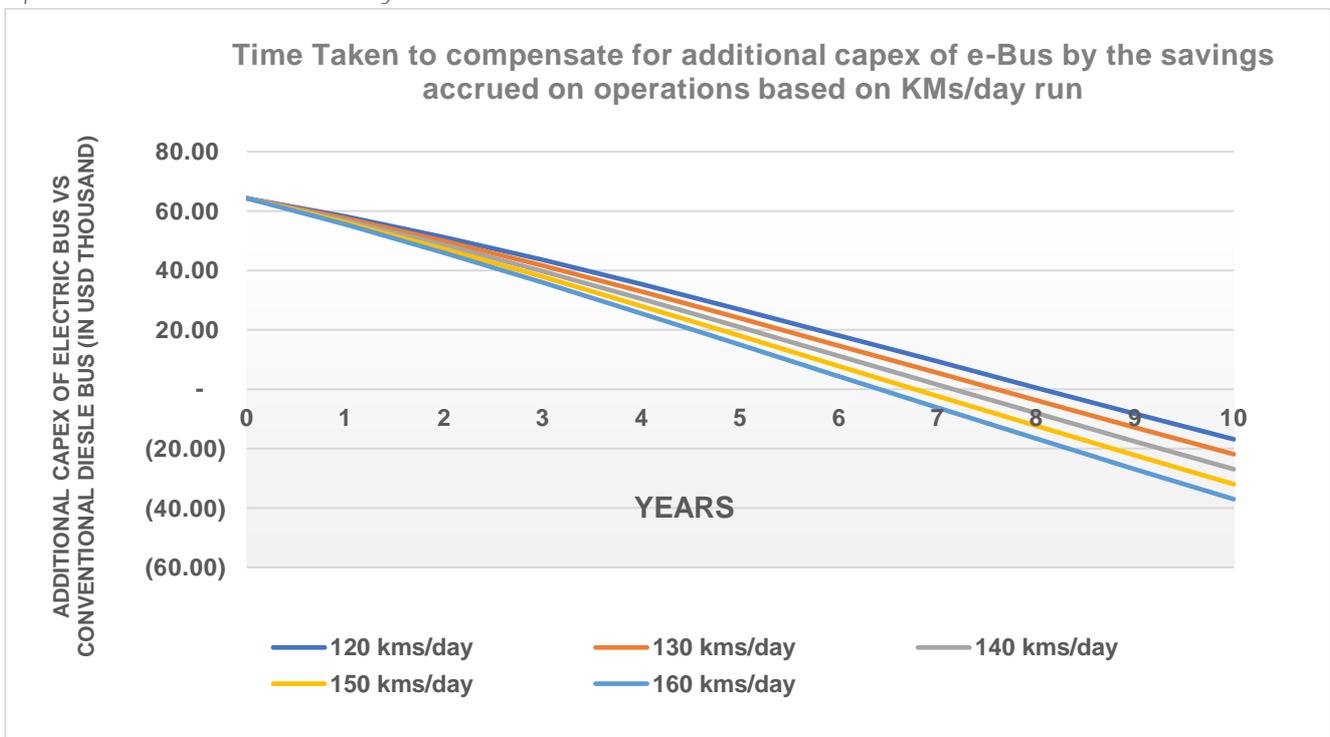
## 7. ANNEX

### 7.1 VIABILITY ANALYSIS FOR AN ELECTRIC BUS AND CASE FOR LONG TERM DEBT

It is important to note that electric buses will require longer-term debt financing to be competitive with conventional buses as there are perceived uncertainties around the performance of electric bus technology, especially battery performance. Moreover, the current financing market in India offers predominantly 4-5 years tenor of loan. The higher capital expenditure for electric buses cannot be serviced with these financial products. So essentially electric vehicles need to be financed over a longer period, 6-15 years depending on the utilization, to make their deployment viable. All the savings in operation accrued until that time will be able to service the additional capital cost of electric buses.

Figure 4 below highlights a case where the additional capital expenditure of INR 4.5 million (~USD 69,000) required to purchase an electric bus compared to a similar diesel bus. Depending upon the utilization of the electric buses, this additional investment of the electric bus can be paid through operational savings accrued over the years. For example, the net present value (NPV) of savings for an electric bus running on an average of 140 kms for 26 days a month would exceed the additional capital expenditure only after 8 years. Similarly, for a bus running on an average of 120km/day the savings would exceed the additional capital expenditure only in the 9<sup>th</sup> year. Hence, a longer tenor loan will be required to pay for additional capex of an electric bus.

Figure 4: Years taken to compensate the additional capex of an e-Bus by the savings accrued on operations based on KMs/day run



## 7.2 ASSUMPTIONS FOR FINANCIAL MODEL

Table 5: Key assumptions of the financial model for the pilot

Parameter	Electric Bus (9-12m)	Ultra-Low Floor AC CNG Bus (12m)	Diesel Bus (9m)
Bus Cost* (INR mn)	4.5 – 6.7	7.8	4.0
Battery Cost (INR mn)	4	NA	NA
Average Maintenance Cost (INR mn/annum)	0.15	0.25	0.20
Diesel or CNG Cost (INR/litre or INR/kg)	NA	43	70
Electricity Cost (INR/kwh)	5.5 – 8.0	NA	NA
Battery Subscription Rate (INR mn/year)	0.50 – 0.72	NA	NA
Escalation in Battery Subscription Rate / Fuel Cost	5.0 –12.0%	4.0 %	4.0%
Lifetime Assumed (in Yrs)	10	10	10
Tax (GST) on Battery Purchase	18%	NA	NA
Fuel Consumption (kg/day)	NA	90	NA
Electricity Consumption (kWh/day)	225 (kWh/day) 1.1 (kWh/km)	NA	NA
Weighted Average Cost of Capital for Pilot	12%	12%	12%
Weighted Average Cost of Capital for Catalytic Phase (expected)	10.5%	10.5%	10.5%

Note: \*The cost of the different buses is specific to the analysis undertaken and subject to vary for different variants.

## 7.3 TOTAL COST OF OWNERSHIP COMPARISON

The cost effectiveness of an electric bus in terms of total cost of ownership over its lifetime say 10 years improves with improvement in utilization rate. At higher utilization rates i.e. more kms covered per day, the savings in the operational cost of an electric bus over a diesel bus are also high. This is primarily driven by the fact that higher utilization rate leads to higher consumption of diesel fuel which is more expensive than the battery subscription fee plus the charging infrastructure fee plus the charging cost combined. The table 6 below shows savings in terms of TCO under different utilization rates of electric and diesel buses:

Table 6: Total cost of ownership comparison under different utilization rates

Battery Subscription Fee	Utilization Rate (Km/Day)	% Savings in total cost of ownership (10 years) of electric buses vs diesel buses <sup>8</sup>
INR 5.9/km @ escalation of ~11% YoY for 10 years	160	16%
INR 5.9/km @ escalation of ~11% YoY for 10 years	150	14%
INR 5.9/km @ escalation of ~11% YoY for 10 years	140	12%
INR 5.9/km @ escalation of ~11% YoY for 10 years	130	9%

## 7.4 SUMMARY OF COMPARABLE INSTRUMENTS REVIEWED

<sup>8</sup> These numbers will be different when the comparison is done with a CNG fueled bus.

Table 7 below provides a brief summary of similar hybrid models. For instance, Proterra, first introduced a separate battery leasing mechanism in 2017 for its electric buses which enables a bus operator to own a bus for roughly the same price as a diesel bus, putting the operating savings toward the battery lease. Similar options are also offered by electric car manufactures like Renault and Nissan wherein one owns the car and rents the battery pack. However, no such Facility is functioning in India for electric buses.

Table 7: Similar instrument across geographies and key differentiating factor of the Facility

Similar instruments/ business models	Description	Differentiation/competitive advantage
Proterra Bus Service Agreement	Offers batteries owned by Proterra or a financing partner, at a monthly operating lease payment.	<ul style="list-style-type: none"> <li>Proterra manufactures both buses and batteries while the facility is setup by a third party.</li> <li>The Facility is relatively more scalable with ability to diversify technology risk owing to OEM agnostic structure.</li> </ul>
Renault / Nissan Battery Leasing	Offers batteries on lease separate from its EV cars. 93% of its EV customers lease their battery	<ul style="list-style-type: none"> <li>Renault/Nissan manufactures both buses &amp; batteries while facility is owned by a third party which will be primarily a service provider with value-addition features.</li> <li>Third party like setup will have more flexibility to realize the use and ensure the benefits of the batteries in their second life.</li> </ul>

## 8. REFERENCES

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