DELIVER ELECTRIC DELHI

PILOT ON ELECTRIFICATION OF FINAL-MILE DELIVERY VEHICLES IN DELHI

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The Dialogue and Development Commission (DDC-D) is a premier think tank of the Government of the National Capital Territory (NCT) of Delhi and advises the government on finding sustainable, people-centric solutions to the critical development challenges faced by Delhi.

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RMI India is an independent organization. RMI India takes inspiration from and collaborates with Rocky Mountain Institute, a 40-year-old non-governmental organization. RMI India's mission is to accelerate India's transition to a clean, prosperous and inclusive energy future.

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Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has been supporting India's mobility and energy transformation since 2016.

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EXECUTIVE SUMMARY

Delhi is one of the fastest-growing cities in the world. Between 2011 and 2019, the population of Delhi increased from 18 million to 20 million[1] and GDP grew by 12% per year[2]. This growth has given rise to a higher demand for goods from urban residents and businesses to meet their daily needs. Higher demand for goods, in turn, has led to higher vehicular movement as goods are delivered to stores and customers. This process system is known as final-mile delivery.

While final-mile delivery is a fundamental part of an urban transportation system and a necessary enabler of increasing quality of life, it has negative impacts on urban life as it is a source of air pollution, carbon emissions, and high costs to customers. The air quality problems are particularly acute – urban freight transportation, both light-duty vehicles (LDVs) and heavy-duty vehicles (HDVs), accounts for 45% of the vehicular NO_x pollution in Delhi[3] and is the leading cause of respiratory ailments. Electric vehicles (EVs) present an opportunity to simultaneously address those three challenges. EVs have no tailpipe emissions, emit 35% less CO_2 as compared to internal combustion engine (ICE) vehicles[4] and present a strong opportunity to reduce operational costs in the medium term.

While the benefits from reduced pollution and carbon emissions are immediate, the cost reductions that EVs can bring are likely to arrive in the next five years. Currently, the total cost of ownership (TCO) of EVs is higher than ICE vehicles due to higher purchase costs and higher interest rates on vehicle loans. To enhance the value proposition of EVs, the Delhi government has announced its EV policy which outlines incentives for the sale and use of EVs, with a special focus on urban freight vehicles. The incentives provided in that policy, along with those available from the central government, known as FAME II, bring the TCO of most types of urban-delivery EVs below that of ICE vehicles. For example, the TCO of a CNG three-wheeler, a typical final-mile delivery vehicle in Delhi, is ₹2.5/km compared to ₹3/km for an unsubsidized electric three-wheeler[5]. With the Delhi EV policy support, the TCO of that EV falls to ₹2.3/km. While these incentives are justified by the public health and environmental benefits they create, they need not be permanent. With falling battery prices and competitive financing, electric goods three-wheelers are expected to reach cost parity with ICE vehicles by 2022[6], even without incentives.

While the benefits of EVs are substantial and growing every year, the use of EV for final-mile delivery in Delhi is still very limited. To accelerate the deployment of delivery EVs in Delhi, RMI and Delhi Government are collaborating to launch an initiative called "Deliver Electric Delhi". This initiative is a collaborative effort among RMI, DDC and 36 private sector organizations to deploy 1,000 delivery vehicles, and associated charging infrastructure, in Delhi in 2020, and rigorously document their performance and value proposition with the aim of creating a replicable and scalable roadmap for the full electrification of urban deliveries in Indian cities. The purpose of that roadmap will be to improve policymaking to support EV adoption as well as support the private sector with reliable information as it makes the decision to purchase delivery EVs and install the charging infrastructure needed to power them.

The "Deliver Electric Delhi" pilot is divided into three phases – design, execution, and documentation. The design phase involved finalizing stakeholders, aligning pilot specifications and road map implementation. The pilot has recently entered its second phase, the execution phase, which will be a collaborative effort between the public and private sectors for vehicle and charger deployment and troubleshooting. The private sector players will deploy EVs and charging stations in the city. RMI will work with private sector players to document the barriers to deployment and work with them to resolve those issues. In the documentation phase, RMI will aggregate and analyze data and insights from pilot participants and assemble that information into a final report. RMI will share the critical findings and learnings from the pilot to inform further private and public sectors' decision-making around EV deployment in Delhi and beyond.

BACKGROUND

Delhi is the second largest urban agglomeration in India with a population of about 20 million[7] and a population density of 13,400 per sq. km[8]. The population in Delhi is expected to increase by 1.4 times in the next decade[9]. With the increase in population, the city's demand for goods consumption is also expected to increase from 68,000 tons/day in 2015 to 100,000 tons/day in 2025, and to 130,000 tons/day in 2035[10].

While goods movement is a vital component of the urban ecosystem providing residents with the necessities of daily life, the vehicular movement generated through final-mile deliveries is one of the key causes of pollution in Delhi. Freight movement (both LDVs and HDVs) accounts for 45% of the vehicular NO_x pollution in the city[11] and has an adverse impact on human health. Because EVs have no tailpipe emissions, replacing existing ICE delivery vehicles with EVs can eliminate a major cause of vehicular air pollution and also lower CO_2 emissions by 35%[12]. This creates an imperative for electric urban final-mile delivery vehicles to rapidly enter the market.

Delhi has released its EV policy[13] with a goal to cut vehicular pollution and improve air quality. Delhi's EV policy promotes electrification of goods vehicles used for urban deliveries through financial incentives, preferential access policies and the provision of charging infrastructure.

DELHI ELECTRIC VEHICLE POLICY, 2019

The goals of Delhi EV policy are two-fold – 1) to improve air quality in Delhi by incentivizing EVs with 25% of new registrations to be battery-electric by 2024, 2) to create jobs in the EV industry. The policy highlights are as below:

Incentives for Goods Carriers (three- and four-wheelers)

> The policy offers a purchase incentive that is equal to ₹30,000, on top of FAME II incentives. These incentives will be applicable to the first 10,000 electric goods vehicles registered.

> In case of swappable battery, when the vehicle is sold without the battery, 50% of the incentive amount will be given to original equipment manufacturers (OEMs), and up to 50% will be reimbursed to consumers, for any deposit they pay to energy operators (EOs) for the battery.

> E-carriers will be exempted from road tax, registration and Municipal Corporation of Delhi (MCD) parking fees.

> The policy also recognizes the high interest rates currently offered on e-carriers, and it provides an interest subvention of 5%.

> Policy exempts e-carriers from the prohibition on plying and idle parking of lights goods vehicles on identified roads of NCT of Delhi during specified timings.

> A scrapping incentive up to ₹7,500 will be matched to the OEM contribution, and will be available to consumers for scrapping and deregistering their old ICE goods vehicle.

Incentives for Two-wheelers

> Purchase incentive of ₹5,000/kWh of battery capacity per vehicle.

> Additional top-up incentive of ₹7,500/kWh of battery capacity for the first 1 lakh vehicles to be registered in Delhi.

> In case of swappable battery, when the vehicle is sold without the battery, 50% of the purchase and top-up incentive amount will be given to OEMs, and up to 50% will be reimbursed to consumers, for any deposit they pay EOs for the battery.

> A scrapping incentive up to ₹5,000 will be matched to the OEM contribution and will be available to consumers for scrapping and deregistering their old ICE goods vehicle.

Incentives for EV Charging Infrastructure

Private Charging –

> A subsidy of 100% for the purchase of EV charging equipment up to ₹6,000 for home/workplace charging. The subsidy will be available for the first 30,000 charging points for BEVC-AC001 charger specification.

> Customers with captive charging will be charged the special EV tariff and not the commercial one. The EV tariff set by Delhi Electricity Regulatory Commission (DERC) for 2019-20 is ₹4/kWh for High Tension and ₹4.5/kWh for Low Tension.

Public Charging –

> Capital subsidy to be provided for charger installation expenses to EOs.

> EOs will be incentivized to set up charging and battery swapping stations in multiple phases by pooling and providing concessional locations for charging stations at minimum lease rentals.

> EOs will be fully reimbursed for state GST for the purchase of advanced batteries to be used at swapping stations.

To ensure the policy meets its long-term goal of full transition to the use of EVs in final-mile deliveries in Delhi, DDC and RMI are working with 36 private sector companies in the city to pilot EVs. The vision of the pilot is threefold:

1. Create a replicable and scalable roadmap for 100% electrification of urban deliveries in Indian cities.
2. Enable improved policymaking in the public sector to accelerate deployment of EVs.
3. Enable improved decision-making in the private sector to enable least-cost deployment of EVs.

This report aims to provide an overview of the pilot and will cover the following topics:

> **Opportunity and need** for electrifying final-mile delivery vehicles in Delhi.

> “Deliver Electric Delhi” **pilot specifications.**

> The process for pilot implementation through **a phased approach.**

> **Conclusions** and path forward.

OPPORTUNITY AND NEED

India is urbanizing at a rapid rate. Forty percent of India's population is expected to reside in urban areas by 2030 up from 30% in 2008. At that time, urban GDP will account for 70% of the total GDP[14]. This growth in urban population and GDP has increased the demand for goods transport in Indian cities, including Delhi, leading to strong growth in the ownership and use of delivery vehicles. As of 2016, there were around 146 thousand light-duty goods vehicles registered in Delhi, of which 63 thousand were three-wheeler goods vehicles[15], and that number is projected to increase by 32% by 2025[16]. While accelerating urbanization and GDP growth have created a greater demand for goods in Indian cities, another force, e-commerce, has changed the way those goods are purchased and transported. Between 2012 and 2017, India's e-commerce market expanded at a compound annual growth rate (CAGR) of 27% and is expected to be worth ₹10.6 lakh crore by 2022[17]. While e-commerce has made goods procurement convenient for consumers and has stimulated economic activity in Delhi, it has also increased the need for final-mile deliveries. Growth from final-mile deliveries due to e-commerce and other urban logistics applications is adding to:

> **Air pollution in the city** – Freight delivery vehicles (both LDVs and HDVs) contribute around 45% of NO_x, 41% of PM_{10} and a large portion of $PM_{2.5}$ vehicular pollution in Delhi[18]. Other pollutants from vehicles, like SO_x, NO_x, CO, have negative impacts on human health.

> **High carbon emissions** – Registered delivery vehicles (three- and four-wheelers) emitted 0.7 million tons of CO_2 in 2019 in Delhi[19].

> **High cost** – Final-mile delivery commonly accounts for more than 50% of the total logistics costs[20].

Given this context of worsening air pollution, greater carbon emissions and growing costs, Delhi has identified use of EVs as a key measure due to their following attributes:

a. Lower emissions – EVs do not have tailpipe emissions and have lower well-to-wheel CO_2 emissions as compared to ICE vehicles.

b. Suitable driving patterns – The short, low-speed, stop-and-go travel patterns typical of urban delivery routes play to the strengths of EVs.

c. Lower energy consumption – EVs consume less energy per km as compared to internal combustion vehicles.

d. Lower cost – With central and state incentives, EVs have lower cost of ownership than ICE vehicles. Without incentives, EV cost superiority will likely arrive in the next five years.

a. Lower emissions

In Delhi, by the end of 2015, urban light-duty freight vehicles comprised just 2.5% of vehicles in use, but were responsible for 33% of NO_x vehicular emissions, 29% of PM_{10} vehicular emissions and a significant portion of vehicular $PM_{2.5}$ emissions[21]. These emissions have a serious impact on human health, especially higher incidences of ailments such as asthma, heart attack and stroke. Electrifying these delivery vehicles in Delhi will eliminate all of their tailpipe emissions, including NO_X and $PM_{2.5}$.

EVs also reduce emissions of another important pollutant: CO_2. On a well-to-wheel basis, EVs emit ~35% less CO_2 emissions compared to their ICE counterparts. For example, with the carbon intensity of today's grid in India, an electric three-wheeler emits 47 gm CO_2/km[22] on a well-to-wheel basis, whereas a CNG three-wheeler, which is the most common type of final-mile delivery vehicle in Delhi, emits 72 gm CO_2/km. With a push towards renewables in India, CO_2 emissions from EVs can be reduced to 40 gm CO_2/km by 2030[23].

b. Suitable driving patterns

Driving patterns of delivery vehicles are apt for electrification for three reasons. Firstly, the average daily utilization of delivery vehicles in Indian cities is around 110 – 120 km[24]. This allows for relatively small battery packs without compromising vehicles' ability to complete their daily delivery tasks. Secondly, urban delivery vehicles often have predictable travel patterns and return to warehouses at night. This provides an opportunity for overnight charging at or near the warehouses when electricity prices are low, and vehicles are idle. Finally, EVs have regenerative braking, which recovers energy that would otherwise be lost, and uses it to recharge the vehicles batteries. Given the stop-and-go driving for making deliveries in a highly congested megacity such as Delhi, the savings from regenerative braking can be substantial.

c. Lower energy consumption

EVs also offer high-efficiency advantages over ICE vehicles. A light ICE delivery vehicle (3-wheeler CNG) consumes 95,000 Btu of energy a day, whereas an equivalent light electric delivery vehicle, plying the same route, will consume just 20,000 Btu a day, which amounts to ~80% less energy consumed[25].

d. Lower cost

While the emissions reductions benefits of EVs in urban delivery are immediate, the cost benefits will arrive in the medium term. However, in order to reach maturity, the system needs public investment in the short term. Currently, EVs have higher TCO compared to ICE vehicles. While EVs have 70% lower fuel costs and 50% lower maintenance costs than ICE vehicles[26], they only partially offset the capital costs.

Two major drivers of the higher cost of EVs are higher upfront costs because of battery packs and higher interest rates for financing EVs. Battery pack costs have declined sharply over the last decade and may continue to fall in the near to medium term as technology and production processes mature. Our analysis includes decreasing prices of lithium ion batteries, which are projected to decrease at a CAGR of 8% by 2030, but we don't include new disruptive battery chemistry technologies in the analysis. The other major element is EV financing cost, which is also projected to fall in the near future as the market matures. The reasons for high financing costs are discussed below, but their convergence with ICE financing terms will be critical for large-scale commercial EV deployment.

Across all delivery vehicle segments, without any incentives, the TCO of EVs is currently higher than that of ICE vehicles. However, with purchase incentives and interest subvention, the TCO of EVs would be lower than or approximately equal to ICE vehicles.

The below charts show the competitive dynamics of delivery EV versus ICE vehicle, how those dynamics are likely to evolve over time and the effect of Delhi's policy and FAME II on TCO of EVs.

FIGURE 1

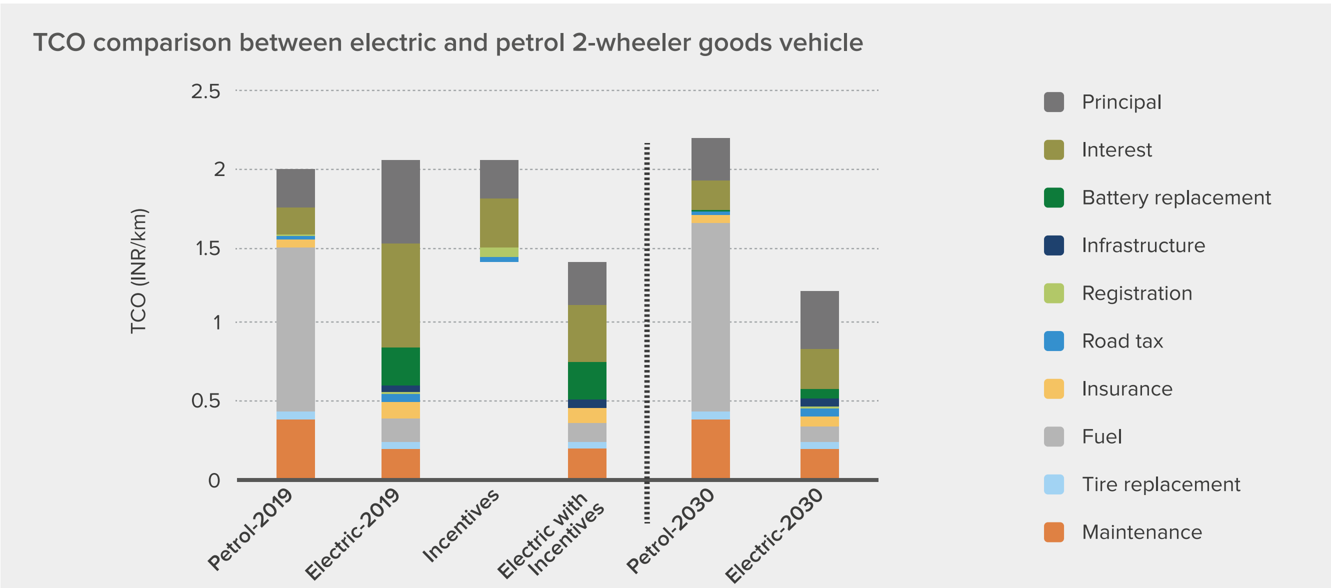
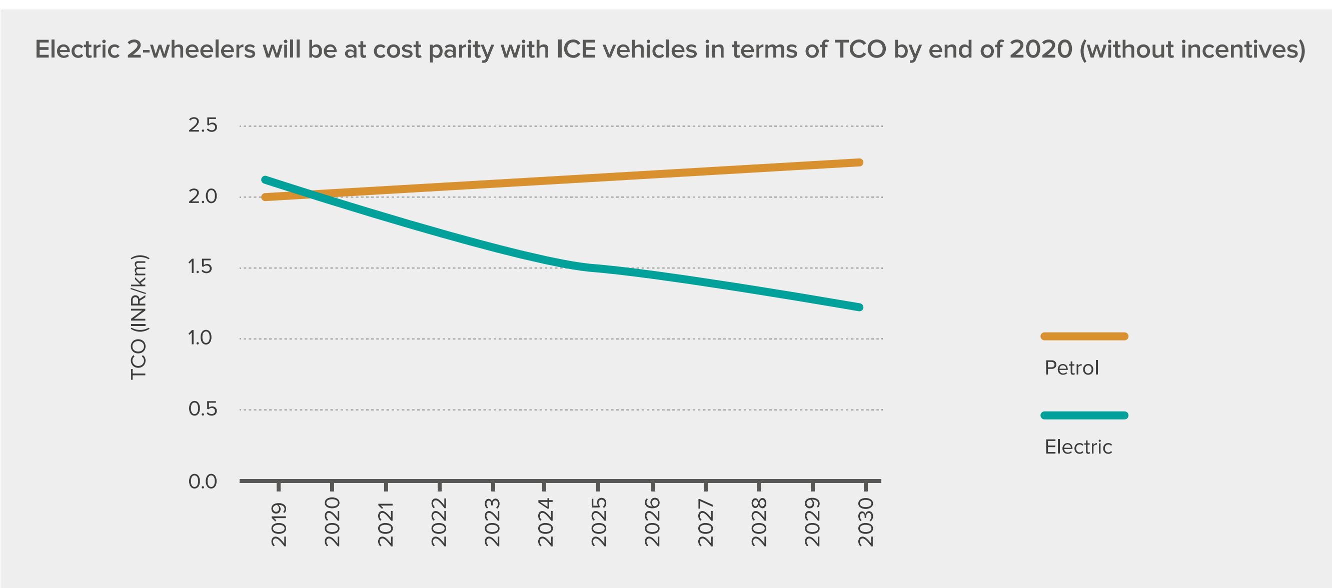


FIGURE 2



FIGURES 1 & 2 - TCO of electric and petrol 2-wheelers in Delhi. TCO of subsidized EVs was 30% lower than ICEs in 2019. Unsubsidized EVs will have 45% lower TCO than ICEs in 2030.

Two-wheeled vehicles, scooters and motorcycles are the most viable near-term applications for EVs in final-mile delivery. For a petrol vehicle, fuel costs are by far the largest element of the cost stack. This enables operational cost reductions from lower fuel consumption and less maintenance to offset the increased costs associated with purchasing and financing of an EV. Even without any incentives, with normalized interest rates, an electric two-wheeler is projected to reach TCO parity with an equivalent petrol model by end of 2020.

FIGURE 3

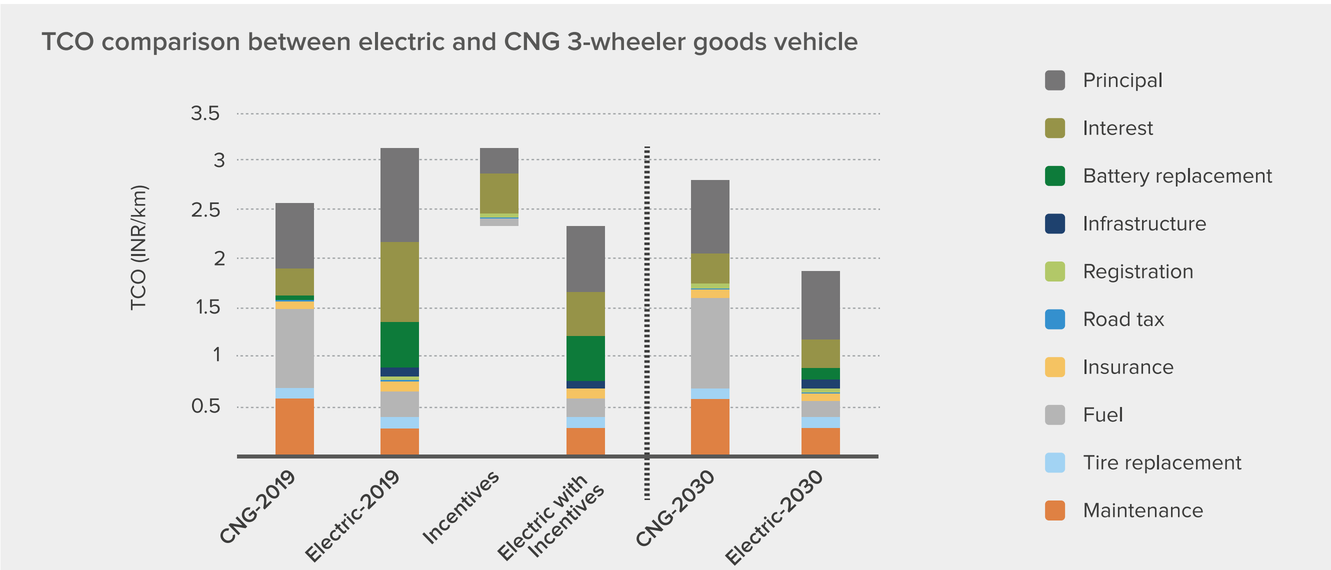
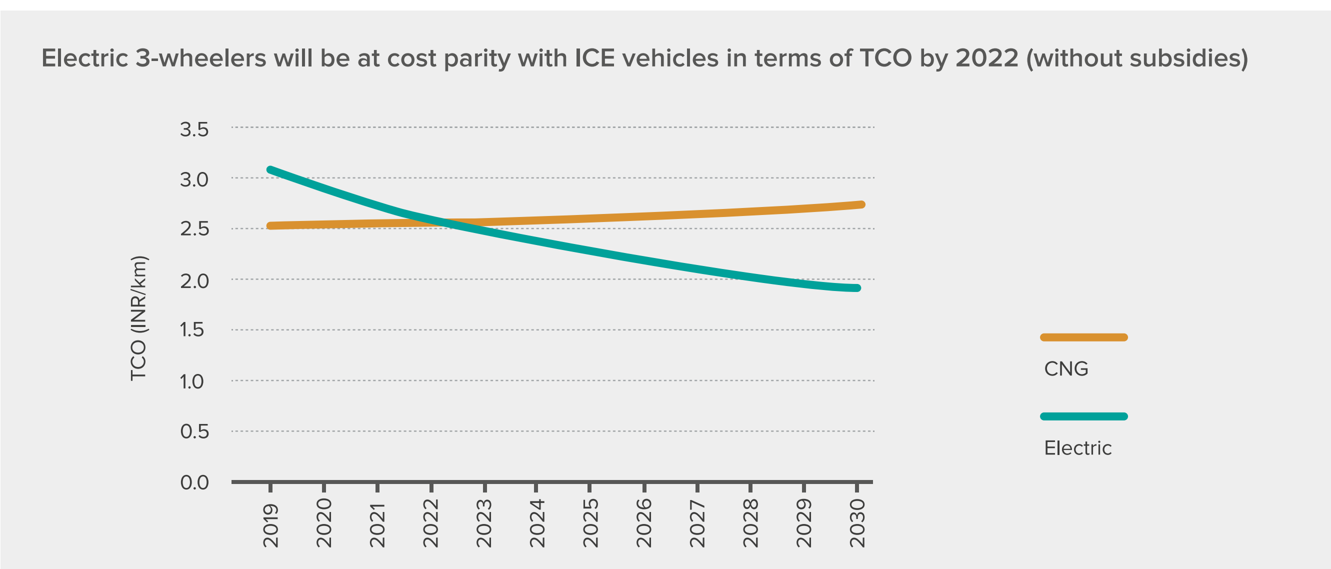


FIGURE 4



FIGURES 3 & 4 - TCO of electric and CNG 3-wheelers in Delhi. TCO of subsidized EVs was 9% lower than ICE vehicles in 2019. Unsubsidized EVs will have 33% lower TCO than ICEs in 2030.

For a larger, more expensive three-wheeled vehicle, the impact of higher interest rates is greater. While three-wheelers travel greater daily distances than two-wheelers, and therefore realize greater savings from lower fuel costs, the cost of a heavier vehicle with a larger battery pack is higher and has higher financing charges. However, with the incentives and a 5% interest subvention offered in the Delhi EV policy, three-wheeler EVs will become cheaper than their CNG counterparts on TCO basis. Without incentives and with normalized financing rates, three-wheeled EVs are expected to reach cost parity in typical urban delivery applications by 2022.

FIGURE 5

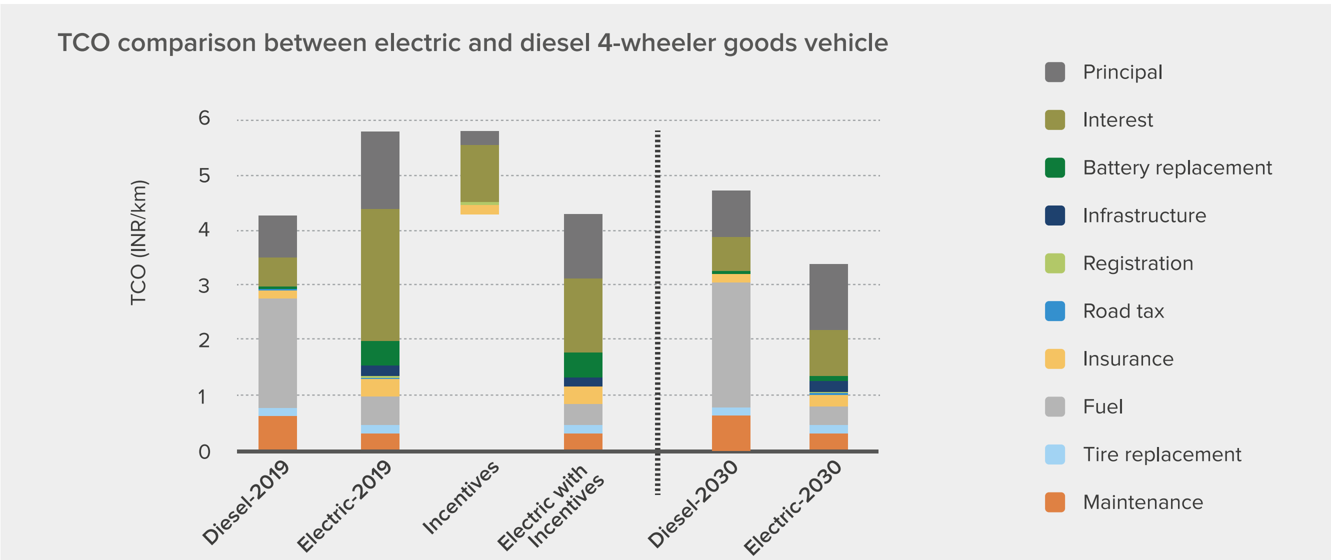
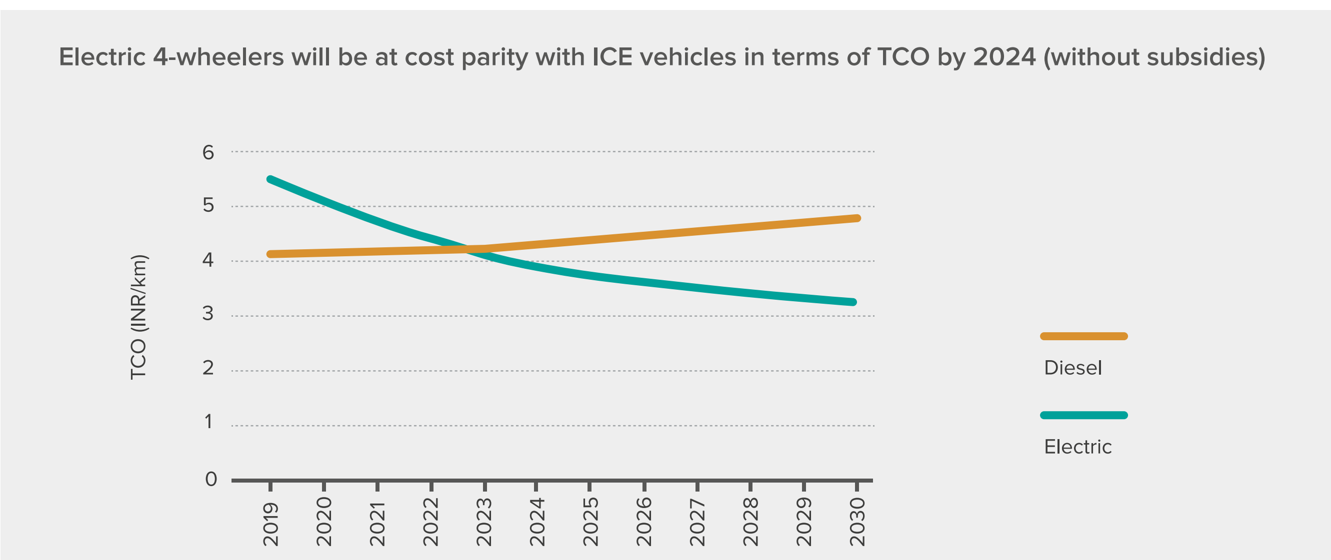


FIGURE 6



FIGURES 5 & 6 - TCO of electric and diesel 4-wheelers in Delhi. TCO of subsidized EVs was approximately equal to ICE vehicles in 2019. Unsubsidized EVs will have 29% lower TCO than ICE vehicles in 2030.

Four-wheeled vehicles, light-duty trucks and vans are similar to three-wheelers in terms of larger purchase cost premiums and higher interest payments, which make TCO for EVs higher than that of ICE vehicles. However, purchase incentives and interest subvention, on top of FAME incentives, bring down the TCO of EVs to levels that are approximately equivalent to that of ICE vehicles. With normalized interest rates and no incentives, four-wheeler EVs are expected to reach cost parity by 2024.

Inputs and assumptions for the TCO model

Total cost of ownership includes maintenance, tire replacement, fuel, insurance, road tax, registration, charging infrastructure, battery replacement, interest and principal costs. Driver costs are excluded.

	2-WHEELER (EV vs Petrol)	3-WHEELER (EV vs CNG)	4-WHEELER (EV vs Diesel)
Vehicle life (years)	10	6	8
Distance traveled per day (km/day)	50	121	116
Battery size (kWh) - for EV	2.4	4.8	14.4

Base year for the model: 2019

PILOT SPECIFICATIONS

While EVs have a potentially compelling social and commercial value proposition, as a new disruptive technology, they lack both the reliable track record of success and the well-established supporting infrastructure which their ICE competitors have. Without an established history of strong performance, purchasers are reluctant to invest large sums in EVs, banks are reluctant to finance them, and entrepreneurs are reluctant to invest in the infrastructure to charge them. This lack of critical mass is a barrier to the rapid rollout of EVs and the societal benefits that they would bring. DDC and RMI, with the support of other government departments, are working with 36 private sector partners from all parts of the EV value chain to create a pilot on last-mile electric delivery vehicles through an initiative called "Deliver Electric Delhi." This pilot will address the barriers to EV adoption in this segment and provide learnings to policymakers and businesses for an increased uptake.

OEMs	> Altigreen Propulsion Lab > E-trio > Euler Motors > Evy Mobility > Hero Electric > Jitendra EV > Kinetic Green > Li-ions Electrik Pvt. Ltd. > Mahindra Electric > Shigan Evoltz > Tata Motors > Tork Motors > Va-yu
CHARGING & SWAPPING PROVIDERS	> Bharat EV > British Petroleum > Charge-Zone > Esmito Solutions > Flowtrick Technology > Livguard > Magenta Power > Tech-prespect Software > Sun Mobility
E-COMMERCE AND LOGISTICS FIRMS	> Amplus Solar > Areon > Bigbasket > Blue Dart Express > DOT > eBikeGo > Flipkart > GATI > Grofers > Linfox > ONN bikes > Swiggy
DISCOMs	> BSES Rajdhani Power > BSES Yamuna Power > Tata Power Limited

Through the "Deliver Electric Delhi" pilot, RMI is aggregating data from deployed EVs and charging infrastructure to analyze EV performance, the economic and environmental benefits of EVs, and their charging behaviour. Additionally, the pilot aims to collect qualitative data on the barriers to implementation of EVs which will be combined with quantitative data to inform findings. This research and data collection will lead to the creation of five key outputs:

> **Rigorously documented TCO for various segments of EVs:** This can create private sector confidence in the value proposition of EVs and also help create targeted support policies for EVs.

> **Unbiased documentation of EV productivity and reliability:** The operational capabilities of EVs will be a key to how fast they will be able to replace ICE delivery vehicles. This data can, again, inform purchase decisions of private sector and incentive structure of policymakers.

> **Aggregation and visualization of travel patterns of EVs:** The times and places of EVs plying in the city can inform both policy and charging infrastructure design specific to the needs of delivery EVs.

> **Analysis of charge patterns of EVs:** Documenting when and where EVs charge, and the current which they draw while charging can inform grid decisions about where chargers can be added with the least needed capacity upgrades and where they fit well with other existing loads and vehicle travel patterns. It can also inform electricity rate design decisions that seek to use price signals to shape loads over time and space in a way that is friendly to the grid.

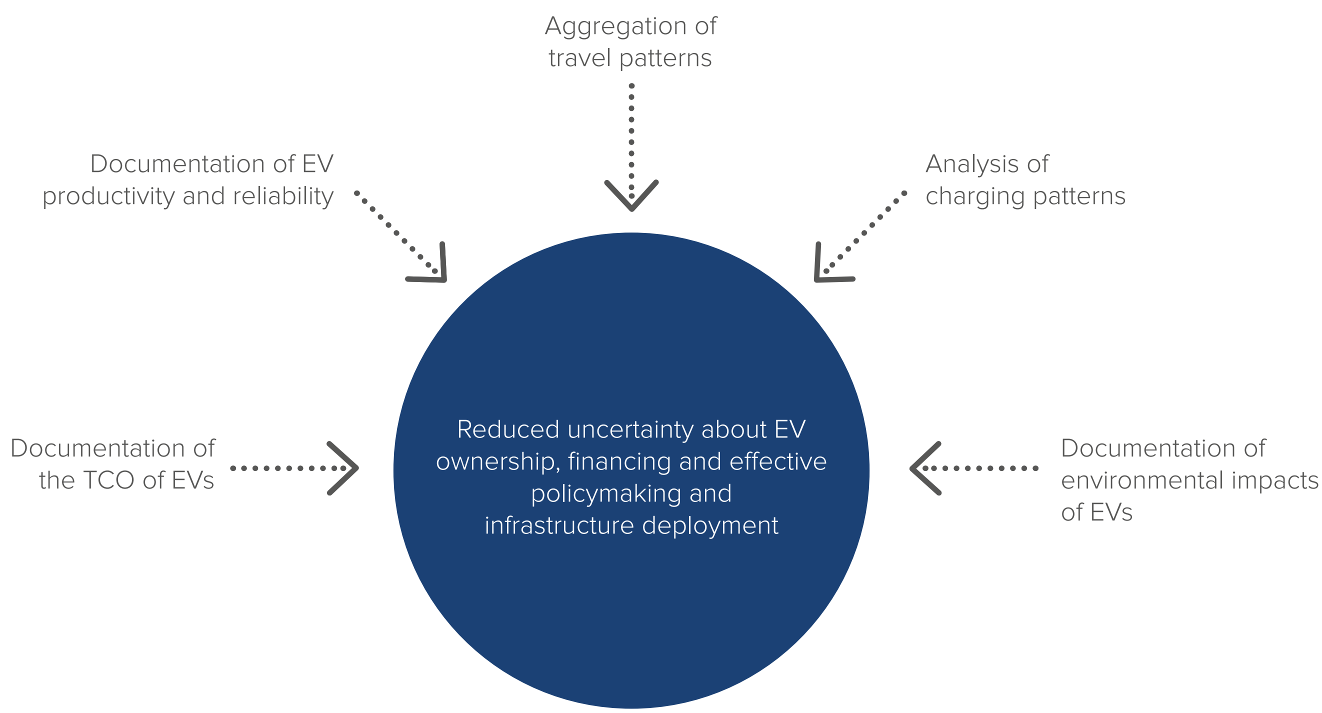
> **Quantification of the environmental impact created by freight EV deployment:** Given that significant public funds are being directed towards the deployment of EVs in Delhi, an estimated return on investment, in terms of particulate and CO_2 emissions avoided, must be calculated in order to ensure that public investment is generating acceptable social returns.

With those outputs, the pilot hopes to address three specific risks to accelerated EV deployment in final-mile delivery:

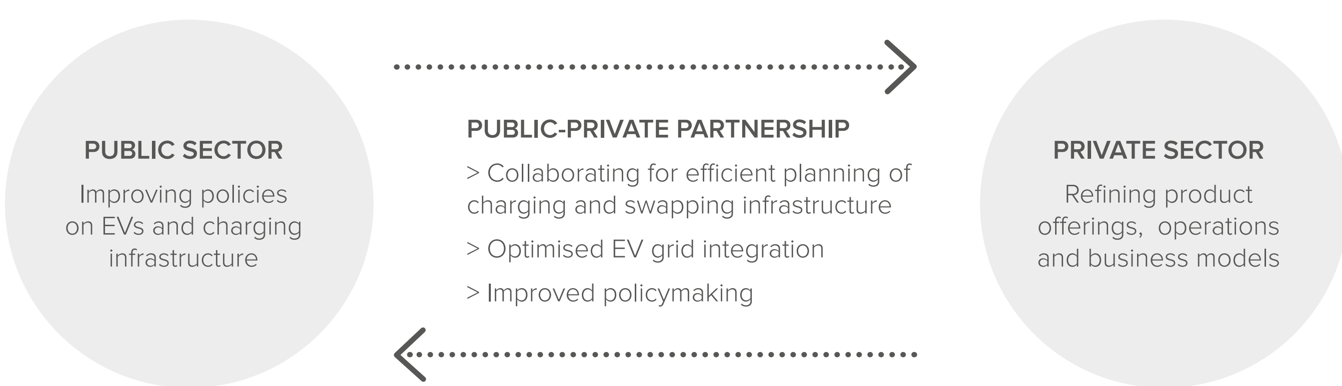
> **Reducing risk and uncertainty associated with EV ownership:** Uncertainty impacts freight EV purchase decision in two key ways. The first is total cost uncertainty. Given that EVs come with an upfront cost premium relative to ICE vehicles, operators must recoup that cost with lower operational costs. While electricity is a cheaper fuel source than its alternatives (petrol, diesel, CNG), many uncertainties, especially maintenance costs and battery degradation, complicate the picture. The second way in which uncertainty impacts the purchase decision is the vehicle's ability to generate revenue on a par with an ICE vehicle. Downtime for charging has effects on how much an EV can drive a day and, therefore how much revenue it can generate. Documenting how EVs are used, what battery pack sizes are required for effective service, and how different charging models (fast versus slow versus swapping) affect both operating cost and utilization can bring confidence to EV owners when making the purchase decision.

> **Reducing risk and uncertainty associated with EV financing:** Currently, a major barrier to the deployment of EVs in final-mile delivery is the ability to finance the purchase of the vehicle. As discussed above, it is common that EVs can only obtain financing at double to triple the rates of ICE vehicles and half the tenors. This is largely because lenders do not have confidence in their ability to sell an EV in the event of a default and repossession. Creating confidence in the operational capabilities of EVs and creating urban charging networks that make them universally usable can spur the growth of a secondary market for EVs and reduce the risk to financial institutions, who finance them, which will, in turn, reduce interest rates for first-time purchasers of the vehicle.

> **Reducing uncertainty in the effectiveness of policymaking and infrastructure deployment:** Due to the upfront cost gap between EVs and ICE vehicles and the required infrastructure for charging, initial rounds of EV deployment require both substantial fiscal incentives as well as large public investment in charging and grid infrastructures. To ensure that the public funds are used rationally, policymakers must understand how much amount of incentives is needed and ensure that sufficient suitable land and distribution grid capacity are available for EV charging. In-depth understanding of vehicle value propositions, both in terms of expense and revenue, as well as vehicle use and charging patterns can help ensure that infrastructure build-out is rational and that incentives are sufficient but not excessive.



By bringing real-world data and analytical rigor to reduce uncertainties, which constrain both public and private sectors' action to quickly roll out EVs in urban delivery, this pilot seeks to create a replicable and scalable roadmap for 100% electrification of final-mile deliveries in Indian cities. Ultimately the objective is that the roadmap created through "Deliver Electric Delhi" should lead to the emergence of a robust public-private partnership that enables policymakers and private sector players across India to move more quickly and confidently to electrify urban delivery.



A PHASED APPROACH FOR PILOT IMPLEMENTATION:

In order to deliver the desired outcomes, we have adopted a three-phased approach to pilot implementation. These phases are:

> A **design phase** where stakeholders align around the vision, objectives and roadmap to pilot implementation.

> An **execution phase** where the roadmap is implemented, data is gathered, and outcomes are recorded.

> A **documentation phase** where data from the pilot is analyzed and a final report is created to share insights and recommend next steps.

PHASE 1: DESIGN

> Stakeholder mapping

> Finalizing roles and responsibilities

> Pilot roadmap creation

PHASE 2: EXECUTION

> Pilot roadmap implementation

> Data collection

> Troubleshooting and progress tracking

PHASE 3: DOCUMENTATION

> Analysis of pilot data

> Final report to share insights and next steps

> Recommendations for other cities

PHASE 1: PILOT DESIGN

The design phase was focused on ensuring that the pilot could both be carried out effectively and upon completion, it would be capable of delivering its learning objectives. To do so, Phase 1 sought to achieve six objectives:

> Set the vision for the pilot
> Identify the right location for the pilot
> Finalize stakeholders, roles and responsibilities
> Determine pilot specifications and outcomes
> Identify barriers and associated solutions regarding pilot execution
> Finalize methodology for data collection and analysis

RMI met those objectives by hosting multiple stakeholder convenings and workshops.

PUNE URBAN MOBILITY LAB	DDC-D & RMI DRAFT EV POLICY CONSULTATION	STAKEHOLDER REACH OUT BY RMI	EV PILOT DESIGN ROUNDTABLE	DELHI URBAN MOBILITY LAB
Objective: > Create vision and action plan for the use of EVs in final-mile delivery in Indian cities.	**Objective:** > Ensure that the draft EV policy meets needs/ considers use of EVs for good movement.	**Objective:** > Reach out to potential partners to discuss the pilot concept > Identity barriers to pilot execution and associated solutions.	**Objective:** > Propose pilot and receive feedback on pilot oblectives, design and execution.	**Objective:** > Gather pilot participants in preparation for pilot execution.
(October 2018)	(December 2018)	(January 2019 – April 2019)	(May 2019)	(June 2019)

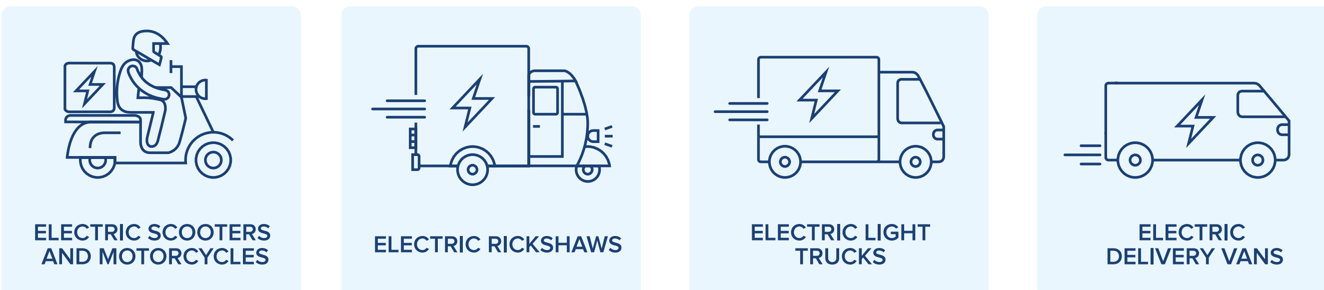
In October 2018, as part of the Urban Mobility Lab (UML) in Pune, RMI convened a working group representing the entire freight EV value chain to outline a roadmap for electrification of final-mile deliveries in Indian cities. As part of the roadmap design process, the working group suggested hosting a pilot on electrification of final-mile delivery vehicles in order to improve policymaking in the public sector and decision making for the private sector.

As a follow-up to the convening, RMI analyzed various EV deployment initiatives in different cities in India to find the right home for hosting the pilot. Delhi government's focus on urban freight electrification in its draft EV policy and enthusiasm to collaborate with the private sector made Delhi an appropriate location for the pilot. Starting November 2018, RMI started working with the Delhi government to support EV policy formulation. As its first step in supporting Delhi's EV policy formulation, RMI led a nearly three-hundred-person stakeholder consultation in December 2018. This consultation generated feedback from the private sector about its needs from the EV policy and how the draft policy could be modified to meet those needs better. Following the consultation, RMI had one-on-one discussions with potential operators of freight EVs about the idea of a pilot in Delhi and began to build the coalition of companies who would ultimately become the participants.

The next step was to convene that working group to design an effective pilot by focusing on what types of vehicles and use cases could be electrified and how the operation of those vehicles could be documented and analyzed. To that end, DDC-D and RMI hosted a stakeholder roundtable in May 2019, composed of both private sector players and government bodies representing the existing freight ecosystem in Delhi.

During the roundtable, RMI hosted a discussion on vehicle categories and delivery use-cases to define the scope of the pilot. Participants identified the below vehicles and use cases as high potential early movers in electrification:

VEHICLES UNDER CONSIDERATION



USE CASES FOR DEPLOYMENT UNDER CONSIDERATION

Once the scope of the pilot had been agreed upon, the group focused on identifying near-term barriers to the deployment of EVs for the pilot. Some of the barriers that were highlighted by the private sector were:

> Slow and unclear vehicle registration and clearance process
> Operational barriers associated with vehicle plying and parking
> Lack of financing on acceptable terms
> Lack of charging infrastructure

The table below summarizes the details about the barriers, proposed solutions and relevant stakeholders for proposed action items. Many of these barriers have now been addressed in the final version of Delhi's EV policy.

TOPIC	ISSUE DETAILS	PROPOSED SOLUTION
Vehicle registration and clearance	• Slow and unclear registration process • Lack of clarity around policy inclusions and coordination between government bodies	• Batch inspection process for registrations • Memo clarifying registration and licensing process
Operational barriers	• Lack of overnight parking and charging space • City entry restrictions • Lack of loading and unloading areas	• Dedicated parking for EVs • Green plate for EVs
EV financing	• Higher loan interest rates for EVs • Lack of financing from banks for EVs and charging infrastructure	• Upfront financial incentives or financing schemes for EVs • Indirect measures such as mandates
Charging infrastructure deployment	• Land unavailability • Electricity rates • Power reliability/grid capacity • Lack of standardization	• Coordination among DISCOMS, Transco, delivery companies about the delivery patterns and grid capacity

Following the roundtable, RMI provided inputs to DDC to refine the policy based on pilot participants' feedback. In June 2019, RMI and DDC hosted the Delhi UML to prepare participants for the pilot execution. Delhi UML also provided a platform for the private sector to network within itself and have a one-on-one discussion with local government bodies. The event also included vehicle showcase and demonstration to officially launch the pilot.

RMI and DDC collected feedback and suggestions from the stakeholder convenings to provide inputs to draft Delhi EV policy. The Delhi government released the EV policy in December 2019.

PHASE 2: PILOT EXECUTION

Through the pilot design process, RMI and DDC finalized the participants for it and their respective roles in the execution. The efforts of the different groups for the pilot are complementary and collectively will add up to a successful pilot. The roles for each group are as follows:

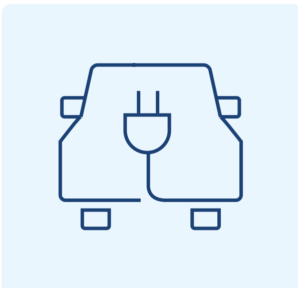
> **Commercial players:** Asset purchase and deployment with support from Delhi's EV policy, data collection and sharing, documentation, and communication of non-financial barriers encountered in the deployment of EVs.

> **DDC:** Finalization and publication of EV policy, coordination with other departments of the Delhi government, responsive troubleshooting of non-financial EV barriers as encountered in daily operations.

> **RMI:** Hosting ongoing convenings of public and private sectors to resolve non-financial issues encountered during EV operation, data aggregation, anonymization, and analysis, preparation of reports on data analysis and EV operation to inform ongoing policymaking, infrastructure, and land-use planning.

The pilot aims at deploying 1,000 vehicles and associated charging infrastructure in Delhi in 2020. Through the span of the pilot execution, RMI will host one-on-one discussions as well as group convenings with the participants to track progress. The group convenings will serve as a forum to discuss learnings from vehicle deployment, identify shared opportunities and challenges as well as brainstorm resolutions and course corrections.

As the pilot progresses, Key Performance Indicators (KPIs) will be monitored to evaluate its effectiveness of and ability to support the build-out of an EV ecosystem in Delhi. Interim report will be created over the course of the pilot to share key findings and track pilot performance versus KPIs. Those KPIs will include:



NUMBER OF EVS INCLUDED IN THE PILOT

NUMBER OF CHARGERS INCLUDED IN THE PILOT

SUBSIDY VALUE COLLECTED BY VEHICLES AND CHARGERS IN THE PILOT

VALIDITY AND REPRESENTATION OF DATA COLLECTED

ISSUES IDENTIFIED AND RESOLVED THROUGH CONSULTATION

PARTICIPANT SATISFACTION WITH PILOT OUTPUTS

PHASE 3: PILOT DOCUMENTATION

As the pilot is executed and both commercial and public sector partners carry out their roles, RMI will document the process, learnings and findings from it. The first step in that documentation process will be data collection. The data to be collected will be both quantitative and qualitative. Quantitative data will be collected both from devices on vehicles and chargers, as well as through surveys from pilot participants on a bi-monthly basis. Qualitative data will be gathered through participant interviews. The data points include:

> **Telemetric data:** Data detailing vehicle movement and charging, including GPS location, speed, timestamp, battery state of charge (SoC) as well as data from chargers, including timestamp and power discharge.

> **Cost data:** Data associated with capital, operational and maintenance costs of vehicles and charging infrastructure.

> **Geospatial data for grid and land:** Digitized maps of city land-use plan and grid capacity.

> **Non-financial barriers:** Qualitative data regarding barriers to pilot execution.

FOR EACH DATA TYPE, A DIFFERENT COLLECTION METHODOLOGY WILL BE USED

TELEMETRIC DATA:

Encrypted data uploaded to secure RMI server by each pilot participant

COST DATA:

Surveys sent out to all pilot participants; RMI staff will assist participants in completing the survey as necessary

GEOSPATIAL DATA FOR GRID AND LAND:

Aggregated from existing government and utility datasets, digitizing as necessary. Map data collected in person by RMI staff from government and utility partners

NON-FINANCIAL BARRIERS:

Qualitative data collected from phone calls and surveys by RMI staff with vehicle operators. Surveys supplemented by recurring participant workshops

Aggregated data will be processed and analyzed to advance the learning outcomes as follows:

Document EV Routes and Activities:

> **Data:** GPS coordinates of EVs as they operate in Delhi

> **Processing:** Individual data points grouped into routes that represent a day of driving, including when the vehicle is moving, stopping and charging. Routes, stops, and charges overlaid onto a map and density of overlaid routes on the map to be calculated.

> **Output:** Fully aggregated and anonymized maps showing the density of occurrences of driving, stopping and charging across Delhi.

> **Outcome:** Improved policymaking on road access for EVs, guidance on land use and grid investment to support EV charging, evaluation of policy effectiveness by quantifying travel distances of pilot vehicles.

Document EV Value Proposition:

> **Data:** Daily vehicle routes from GPS logs, daily energy consumptions from telematics data, vehicle maintenance costs from user logs, financing, insurance and licensing costs from owner records, residual value estimates from market experts.

> **Processing:** Build a financial model using averages of aggregated data.

> **Output:** Model to compare TCO and revenue generation ability for all classes of EVs included in the pilot relative to comparable ICE vehicle models.

> **Outcome:** Vehicle purchasers positioned to make value-maximizing decisions when purchasing, OEMs understand and enhance product offering to maximize user value proposition, policymakers understand the required support for different use cases and vehicle types to further close the gap between EVs and ICE vehicles with financial and non-financial incentives.

Document Charging Loads Created by EVs:

> **Data:** Power discharge data from charge stations, battery SOC change from vehicles.

> **Processing:** Power output from chargers aggregated and averaged over a 24-hour period, power output from chargers linked to individual vehicles charging sessions and averaged over 24-hour period.

> **Output:** Average load curves for existing chargers and tools to project load curves created by new fleet additions.

> **Outcome:** Utilities are able to minimize grid costs by effectively integrating new charging loads with the existing distribution network; EV tariffs can be designed.

Document Available Land and Grid Capacity:

> **Data:** Coordinates of government-owned land and map of grid capacity/connectivity in different areas of the city.

> **Processing:** Convert location coordinates and grid capacity into geospatial data types, overlay into mapping software.

> **Output:** Open-source digital map with potential sites for charging.

> **Outcome:** EV users are able to quickly plan and sign contract for sites to charge vehicles based on transparent, open data that enables effective site selection.

Non-Financial Barriers to EV Operations:

> **Data:** Qualitative experience of EV users regarding barriers encountered during the operation in Delhi (e.g. registration bottlenecks, unresolved issues of operational legality, etc.), collected via surveys and regular check-ins by RMI with pilot participants

> **Processing:** Issues aggregated and communicated to DDC and relevant local government departments

> **Output:** Periodic memos to Delhi government with issues and proposed solutions, continuously updated checklist with issues outstanding

> **Outcome:** Pain points regarding EV operation quickly resolved as they are encountered

The table below summarizes the data type and related outcomes:

LEARNING OBJECTIVE	DATA TYPE	ANALYSIS OUTPUT	OUTCOME
Document EV routes and activities	Vehicle GPS coordinates	Aggregated maps showing vehicle driving patterns	Improved policymaking on road access for EVs, land use for charging and grid investment
Document EV value proposition	Vehicle GPS and telematics data, capital and O&M costs	TCO and revenue generation ability	More educated decision-making for customers to purchase EVs, for OEMs to enhance product offerings and for policymakers to craft financial incentives
Document charging loads created by EVs	Power discharge data and battery SOC	Load curves	Effective integration of new charging loads with the existing distribution network
Document available on land and grid capacity	Coordinates of government-owned land and map of grid capacity	Open-source digital map	Effective site selection
Non-financial barriers to EV operations	Qualitative experience of EV users	Periodic memos to Delhi government	Faster resolution of barriers to deployment

PATH FORWARD

The transport sector in India is transforming at a rapid rate, with vehicle electrification being the key disruptor in the last few years. The government is developing supportive policy frameworks to electrify the transport sector. Automakers, vehicle operators and end consumers are all starting to embrace this new paradigm. Electric vehicles for final- mile deliveries present an opportunity to reduce both the operational costs and the vehicular emissions associated with increasing logistics activities, the benefits of which can be passed on to consumers and society. “Deliver Electric Delhi” is an initiative by RMI and DDC in partnership with the private sector to push the EV deployment for delivery vehicles in the city by hosting a thoughtfully designed and documented pilot.

A well-documented pilot can spread awareness about the benefits of EVs for final-mile deliveries and can support public and private sector players in India with their deployment and scaling plans. The analysis from collected data will be helpful in understanding the economics and productivity of EVs, their environmental impact, and optimizing EV charging infrastructure and grid integration. The public sector can refer to the pilot to improve policies related to incentives, access, and infrastructure for EVs. The private sector can refine its financing, purchasing, and business models. It can also enable public-private partnership and collaboration to plan charging and swapping infrastructure more efficiently and optimize EV-grid integration. With successful completion of the pilot, Delhi can be at the forefront of the EV revolution and can serve as an example for other Indian cities to follow.

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