# Roadmap for 100% Delivery Electrification in Delhi:

## Unlocking Insights from the Deliver Electric Delhi Pilot

Report / April 2022

# About Us

## Deliver Electric Delhi Pilot Participants

The Deliver Electric Delhi network is composed of a diverse group of industry stakeholders engaged in e-mobility activities in Delhi. The network includes vehicle manufacturers, e-commerce companies, charging infrastructure manufacturers and providers, electricity distribution companies, and fleet aggregators. The following organisations participated in the Deliver Electric Delhi pilot:

Altigreen, Amplus Solar, Areon, Bharat EV, BigBasket, Blue Dart Express, BSES Rajdhani Power Limited, BSES Yamuna Power Limited, Delta Electronics India Pvt Ltd, DOT, eBikeGo, Elektromobilitat, Energy Efficiency Services Limited, Esmito Solutions, Etrio, Euler Motors, EVY Mobility, Hero Electric, Kinetic Green Energy & Power Solutions, Linfox, Livguard Energy Technologies, LoadExx, Magenta, Mahindra Electric, Micelio, MoEVing, Shigan Evoltz, Spoke, Sun Mobility, Tata Motors, TechProspect, TecSo Charge Zone, Tork Motors, VA-YU, Vecmocon Technologies.

## About the Dialogue and Development Commission of Delhi

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

## About RMI

RMI—an independent non-profit 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.

## About RMI India

RMI India is an independent organisation. RMI India takes inspiration from and collaborates with RMI, a 40-year-old nongovernmental organisation. RMI India's mission is to accelerate India's transition to a clean, prosperous, and inclusive energy future.

# Foreword

On behalf of the Dialogue and Development Commission of Delhi (DDC), RMI, and RMI India we are pleased to introduce the final synthesis report on the Deliver Electric Delhi pilot. This report builds on the Deliver Electric Delhi pilot design report published in July 2020 and assembles findings from the pilot. It highlights the benefits of delivery vehicle electrification and assesses how private and public action helped drive EV adoption in Delhi.

Transforming the final-mile delivery sector is urgent. Final-mile delivery vehicles contribute disproportionately to air pollution, and significant environmental, economic, and performance benefits can be gained from their electrification. Electric vehicles are well suited to final-mile deliveries. With rapidly evolving technologies, policies, and supportive business models, electrification is highly achievable. This pilot has paved a path for Delhi to achieve 100% electrification of delivery fleets over the next decade.

By diligently documenting participants' experiences in the Deliver Electric Delhi pilot, DDC, RMI, and RMI India identified ways to improve policymaking and scale least-cost EV deployment opportunities. The summary findings and advancements from the Deliver Electric Delhi pilot outline steps cities across India can take to scale electric vehicle adoption and fully electrify final-mile delivery vehicles.

Finally, we express our gratitude to the Deliver Electric Delhi pilot participants. We are encouraged by public- and private-sector leadership and the efforts made to further fleet electrification. The progress made in Delhi shows how coordinated actions and public-private collaboration can boost electrification across India.

Sincerely,
Jasmine Shah,
Vice Chairperson, Dialogue and Development Commission of Delhi

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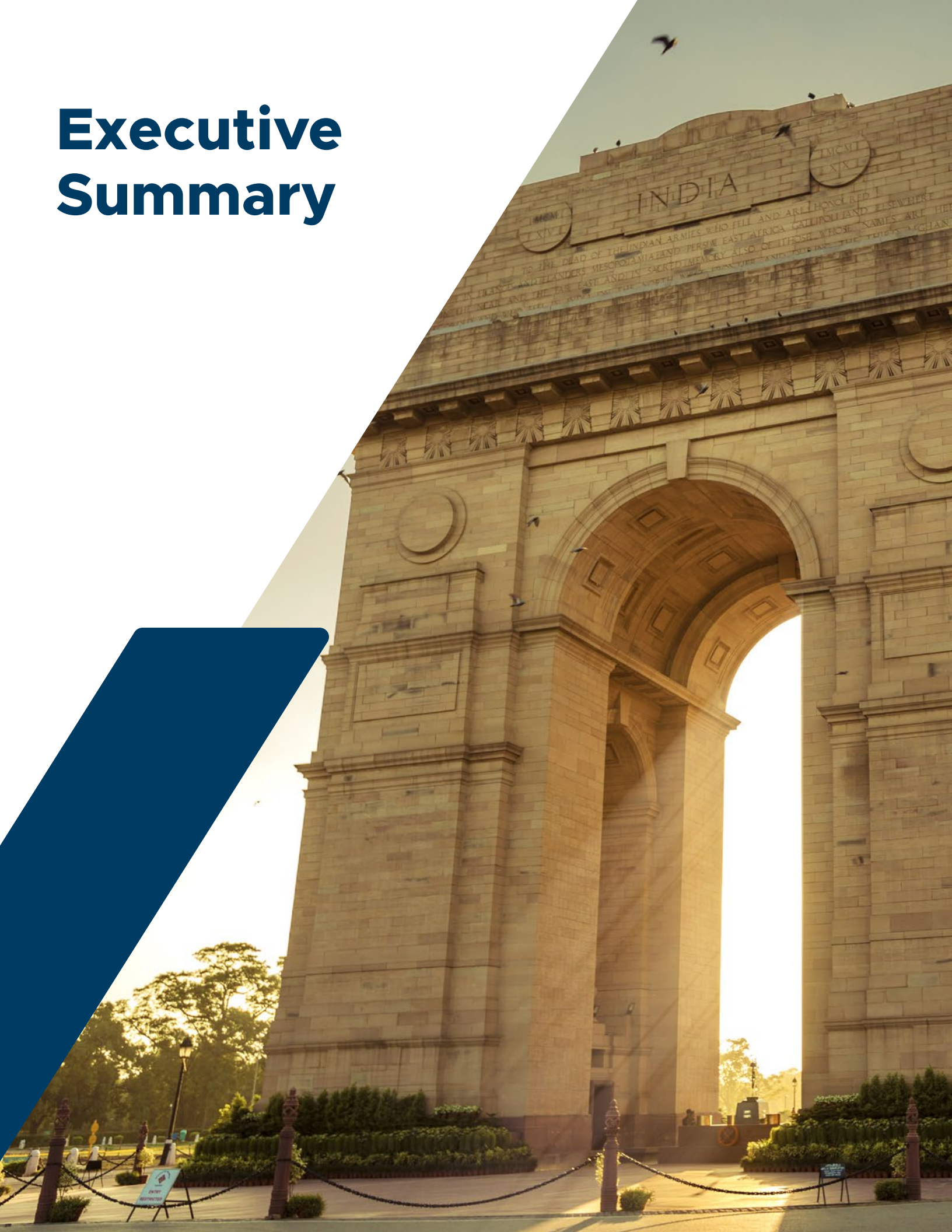
# Executive Summary



# Executive Summary


Delhi is the second-largest city in India, with a population of about 20 million. Within this decade, Delhi is expected to become the largest megalopolis in the world.[1] As the city has grown, the gross state domestic product and its per capita income have also increased. Delhi's per capita income is nearly three times higher than the national average.[2] Increasing population, growth of e-commerce, and digitisation coupled with rising incomes have increased the city's demand for goods. New and sustained demand for goods has resulted in more vehicle movement for final-mile deliveries, and freight travel within Delhi has increased 88% in the past decade alone.[3] On average, delivery vehicles cumulatively travel over 30,000 km a day, plying more kilometres than any other vehicle segment, in the city, outside of commercial passenger vehicles.[4]

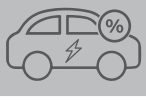
Deliveries are an integral part of the urban transport system; however, deliveries completed by internal combustion engine (ICE) vehicles disproportionately contribute to ambient air pollution. Today, the majority of final-mile delivery vehicles — two-wheelers used for deliveries, e-carts, L5N three-wheeler goods carriers, and N1 goods carriers — run on fossil fuels. Two-wheelers primarily run on petrol while three and four-wheelers in Delhi predominately utilise compressed natural gas (CNG). These ICE vehicles emit carbon dioxide ($CO_2$) and dangerous local air pollutants such as particulate matter (PM) and nitrogen oxide ($NO_x$). Relative to equivalent petrol and CNG vehicles, an electric vehicle (EV) emits zero PM and $NO_x$ pollution and nearly 25% less $CO_2$.[5] Adopting EVs, which have zero tailpipe emissions, can significantly improve air quality.

Recognising that fleet electrification represented a tremendous opportunity to reduce air pollution, the Delhi government notified a dynamic EV policy in August 2020. The policy adopted a holistic approach to vehicle electrification and set an ambitious target: to have 25% of new vehicles registered in 2024 be electric. To achieve this target, Delhi enacted a series of fiscal incentives and regulatory measures to boost EV demand and create a robust EV ecosystem.

To help Delhi accelerate the electrification of final-mile delivery vehicles, the Dialogue and Development Commission of Delhi (DDC), RMI, and RMI India designed the Deliver Electric Delhi pilot. Over the span of three years, DDC, RMI, and RMI India collaborated with 35 industry partners to design the roadmap to deploy EVs and associated infrastructure in Delhi. The pilot also served as a forum for industry stakeholders to share feedback on the policy and connect with other relevant stakeholders. Throughout the pilot, user experiences were documented to provide insights on the benefits of fleet implementation and scale EV adoption. DDC, RMI, and RMI India also collected vehicle performance data from pilot participants to compare the total cost of operations and performance capabilities of electric vehicles with equivalent ICE vehicles. This report synthesises the findings from the pilot, compiling these into a roadmap for scaling final-mile delivery vehicle adoption.

While the findings outlined in the table below were drawn from urban freight electrification efforts, the highlighted solution pathways can be readily adopted to support broader EV acceptance in Delhi.

Exhibit 1 **Solution pathways for scaling urban freight electrification**

| Key enabler for EV adoption in Delhi | Solution pathways in Delhi |
|---|---|
| **Reduce the up-front and total cost of ownership of EVs**  | The Delhi government offers a purchase and scrappage incentive in addition to Faster Adoption and Manufacturing of Electric Vehicles II (FAME II) subsidies that brought the capital cost of EVs down by 25%.[6] The government also enacted a registration fee and road tax waiver to further lower the cost of EV ownership. |
| **Ensure effective policy implementation**  | Technical working groups and institutional bodies provided a framework for policy implementation. The State EV Cell and Working Group for the Accelerated Roll-out of Charging Infrastructure helped the government establish processes for EV registration, subsidy disbursement, and charging infrastructure deployment. |
| **Mobilise EV finance and lower the cost of borrowing**  | Interest rates regularly hover around 20% for electric two-wheelers and can be above 25% for electric three-wheelers. In contrast, the average interest rate for an equivalent ICE vehicle is 12%.[7] To address the high borrowing cost for EVs, the Delhi government is devising an interest subvention programme to lower EV interest rates.[8] |
| **Deploy charging infrastructure**  | To reduce charging infrastructure installment costs in Delhi, the government floated a tender to deploy over 500 charging points across 100 locations in Delhi. The tender provides land at concessional rates and defrays the cost associated with upstream electrical infrastructure. |
| **Promote awareness about EVs**  | The Delhi government launched the "Switch Delhi" campaign to highlight the positive impact EVs have on the environment and showcase the incentives offered for EV purchase. These workshops also aimed to foster EV adoption among logistics providers and fleet aggregators. |
| **Foster public- and private-sector collaboration**  | The Delhi government adopted a consultative approach to designing and implementing the Delhi EV policy. Throughout the Deliver Electric Delhi pilot, the government sought feedback from companies and government agencies. The government also encouraged participants to raise concerns about operational barriers they faced. |

Within just over a year of enacting the Delhi EV policy and implementing the Deliver Electric Delhi pilot, EV sales in Delhi increased from 3.3% to 10% of new vehicles registered.[9] In the past year, Delhi's EV sales have tripled. Given the growth in EV sales, Delhi is on track to become one of the global front-runners when it comes to EV sales. For comparison, battery electric vehicles (BEV) represented 8.3% of the new vehicle market share in California in 2021, and in Europe, BEVs made up 19% of new vehicle sales on average.[10]

Delhi aims to continue that explosive growth with an ambitious yet achievable target: the goal is for EVs to make up 25% of new vehicle registrations by 2024. Achieving this goal in the final-mile delivery sector would result in 58,000 EVs registered by the end of 2024. By 2030, if electric final-mile delivery vehicles reach a 100% sales penetration, there could be over 7.5 lakh EVs on the road, and roughly 70% of final-mile delivery vehicles plying in 2030 would be electric.[11] Given this level of electric vehicle adoption by 2030, $CO_2$, $NO_x$, and PM emissions can be reduced by 31%, 29%, and 28%, respectively. This reduction in $CO_2$ emissions is equivalent to the amount of carbon sequestered by 235 million tree seedlings grown for 10 years.[12]

# Background and Opportunity

# Background and Opportunity

Transportation is the leading cause of air pollution in Delhi, and final-mile delivery vehicles disproportionally contribute to high PM and $NO_x$ pollution levels. Additionally, final-mile delivery vehicles in the city emitted 1.6 million tonnes of carbon dioxide in 2020, 23% of total road transport $CO_2$ emissions.[13] Switching to EVs can make the city's final-mile delivery sector cleaner, more sustainable, and more cost-efficient. EVs have the following advantages over ICE vehicles, making them the front-runner in Delhi's clean transport transition:

- ***Reduced air pollution:*** EVs use batteries and electric motors to power wheels, emitting zero tailpipe pollutants. Achieving Delhi's 25% EV registration target by 2024 and reaching a 100% EV sales penetration by 2030 would mean that roughly 70% of final-mile delivery vehicles in 2030 would be electric, reducing emissions by 140 tonnes of PM and 12,370 tonnes of $NO_x$ through 2030.[14] Deployed electric final-mile delivery vehicles emit 25% less $CO_2$ than ICE final-mile delivery vehicles today.[15]

- ***Cost savings:*** The shift to all-electric fleets represents a significant opportunity for sustained fuel and maintenance cost savings. In Delhi, electric two-, three-, and four-wheelers can save 96%, 69%, and 74%, respectively, on fuel costs compared with equivalent ICE vehicles.[16] EVs also have fewer moving parts than ICE vehicles, e.g., a combustion engine, gearbox, clutch, transmission, catalytic converter, etc. This translates to lower maintenance costs for EVs.[17]

Final-mile delivery vehicles are particularly critical to electrify given the distance they travel each day and the vehicle segment's forecasted growth. Today there are roughly 4,00,000 final-mile delivery vehicles. These vehicles collectively travel 13.9 billion km/year, and by 2030 annual final-mile delivery vehicle travel is projected to increase by 149% to nearly 35 billion kilometres.[18]

Moreover, EVs are well suited for final-mile delivery applications. Firstly, urban duty cycles are typically between 70 km and 120 km, within the range of EVs on the market today.[19] Additionally, final-mile delivery vehicles have high utilisation rates, which presents an opportunity to capitalise on significant fuel savings. Electric two-wheelers used for deliveries had an average reported utilisation of 100 km/day. Had a petrol two-wheeler been used in lieu of an electric two-wheeler, daily fuel costs would have been roughly INR 170 compared with the INR 9 spent on electricity to charge an electric two-wheeler.[20] Lastly, given the nature of stop-and-go city traffic and frequent stops, electric final-mile delivery vehicles have an advantage over ICE vehicles in their ability to conserve energy from regenerative braking.

Recognising that EV adoption was economical and represented a tremendous opportunity to reduce air pollution, the Delhi government notified a comprehensive EV policy. The policy establishes an ambitious yet achievable target: to have 25% of new vehicle registrants by 2024 be electric. This target helped form the basis of the policy and Delhi also adopted a series of measures to help drive EV demand and supply.

Several supportive regulatory schemes and incentives were implemented to spur EV adoption under the Delhi EV policy. A purchase and scrapping incentive in addition to the FAME II scheme is offered to lower the cost of EV ownership and drive EV demand. The policy also takes a technology-agnostic approach to increase the availability of plug-in charging and battery swapping within the city. The government offers land concessions and electrical infrastructure subsidies to reduce charging infrastructure deployment costs and establish a streamlined and subsidised charger installation process to simplify public and private charging development.

The Delhi government adopted a consultative approach throughout the policy implementation process, regularly engaging with industry partners to address the operational barriers they faced in electrifying fleets. This feedback enabled the government to develop effective policy implementation strategies, streamline the EV registration process and scale final-mile delivery electrification.

## Box 1 **The Delhi EV policy and how it applies to final-mile delivery vehicles**

The Delhi EV policy focuses on electrifying priority vehicle segments, including two-wheelers, three-wheelers, and final-mile delivery vehicles. In addition to financial incentives, the Delhi EV policy adopted a series of regulatory interventions to promote the adoption of electric vehicles for final-mile delivery vehicles. Below is a list of policies that specifically addressed final-mile delivery electrification.

| Vehicle Segments | Fiscal Incentive | Regulatory Measures |
|---|---|---|
| **Electric L5N category three-wheeler goods carrier and N1 category four-wheeler goods carrier** | - Purchase incentive: **INR 30,000 per vehicle**<br>- An interest subvention which reduces the total interest rate for loans availed to EVs by 5%<br>- Scrapping incentive: **up to INR 7,500 per vehicle** for scrapping three-wheelers (shared with original equipment manufacturers)<br>- Road tax and registration fee waiver | - E-carriers are exempt from plying and idle parking restrictions during specified time periods |
| **Electric two-wheeler** | - Purchase incentive: **INR 5,000 per kWh** of battery capacity per vehicle (not exceeding INR 30,000)<br>- Scrapping incentive: **up to INR 5,000 per vehicle** for scrapping two-wheelers (shared with original equipment manufacturers)<br>- Road tax and registration fee waiver – same as above | - Recommends delivery service providers (e.g., food delivery, e-commerce logistics providers, couriers) switch to electric two-wheelers in a time-bound manner |

## The Deliver Electric Delhi pilot

To support the policy's goal of electrifying the city's delivery fleet, DDC, RMI, and RMI India launched the Deliver Electric Delhi pilot with 35 leading industry players. The pilot was formed to realise the electrification targets outlined in the policy and chart a path toward fully electrifying final-mile delivery vehicles. The pilot also served as an engagement platform between the public and private sectors. By documenting the experience of pilot participants, the Deliver Electric Delhi pilot quantified the benefits of fleet electrification, identified opportunities to improve policy implementation and crafted a pathway to scale EV adoption. DDC, RMI, and RMI India partnered with a diverse cohort of industry partners from all parts of the EV value chain to create a pilot on final-mile delivery vehicle electrification and deployment. The partners and details regarding the development and execution of the Deliver Electric Delhi pilot are outlined in Exhibits 2 and 3.

Exhibit 2 **The Deliver Electric Delhi pilot participants**

| Category/Segment | List of Organisations | | |
|---|---|---|---|
| Vehicle manufactures | Altigreen | Etrio | Euler Motors |
| | EVY Mobility | Hero Electric | Kinetic Green Energy & Power Solutions |
| | Mahindra Electric | Shigan evoltz | Spoke |
| | Tata Motors | Tork Motors | Vecmocon Technologies |
| Distribution companies | BSES Rajdhani Power Limited | BSES Yamuna Power Limited | |
| Charging infrastructure providers | Bharat EV | Esmito Solutions | Energy Efficiency Services Limited |
| | TechProspect | Magenta | Sun Mobility |
| | | TecSo Charge zone | |
| Logistic providers/ e-commerce companies | Amplus Solar | Areon | BigBasket |
| | Blue Dart Express | DOT | eBikeGo |
| | Elektromobilitat | Linfox | LoadExx |
| | Micelio | MoEVing | VA-YU |

The Deliver Electric Delhi pilot was designed to provide insights on policy implementation and support public- and private-sector decision-making regarding EV deployment. The pilot was divided into three phases: design, execution, and documentation. Each part of the pilot process is detailed in Exhibit 3 below.

Exhibit 3 **The three phases of the Deliver Electric Delhi pilot**

## Design phase

- The Delhi government, with the support of DDC, RMI, and RMI India, convened an initial consultation with nearly 300 stakeholders, including government agencies, industry, civil society, and academia, to receive feedback on the Delhi EV draft policy.
- To design the Deliver Electric Delhi pilot, DDC, RMI, and RMI India consulted with leading businesses to gauge their interest and convened a roundtable in May 2019 to craft a framework for pilot execution.
- During the pilot design, stakeholders shared feedback on the policy and identified use cases most effective for electrification.

## Execution phase

- The pilot was launched during the Delhi Urban Mobility Lab (UML), in June 2019.
- DDC, RMI, and RMI India developed a consensus on the pilot's overarching goals and barriers and established clear communication channels between public- and private-sector participants.
- The Delhi EV policy was announced in August 2020. The execution phase was a collaborative effort: private companies deployed EVs and charging stations in the city, and DDC, RMI, and RMI India helped troubleshoot and worked with the government to ensure implementation of the policy and pilot.

## Documentation phase

- From qualitative interviews, surveys, and detailed data analysis, DDC, RMI, and RMI India collected information on EV value proposition and assessed how coordinated actions support broad EV and infrastructure adoption for final-mile deliveries.
- RMI compiled the discoveries and developments from the Deliver Electric Delhi pilot.

This report summarises the lessons from the Deliver Electric Delhi pilot and provides a detailed assessment of government policymaking and business decision-making relating to EV deployment in Delhi. By thoroughly documenting the pilot processes and convening pilot participants, DDC, RMI, and RMI India gathered insights on the following topics:

- ***Operational barriers:*** Throughout the pilot process, industry players highlighted the logistical and operational challenges they faced. By engaging with both private- and public-sector stakeholders, the pilot helped the Delhi government identify better long-term policymaking strategies and ease the transition to electric mobility.

- ***EV value proposition:*** By aggregating cost and emissions data on vehicle fleets deployed as part of the pilot, DDC, RMI, and RMI India calculated the total operating cost, energy efficiency, and emission reductions from EV adoption.
- ***EV performance:*** To support EV and charging infrastructure design, DDC, RMI, and RMI India assessed vehicle and charging infrastructure specifications such as battery size, battery lifetime, vehicle range (rated and realised), energy efficiency, charger type, power rating, and utilisation rate.
- ***Policy design:*** Through extensive stakeholder consultations, DDC, RMI, and RMI India collected feedback on the draft EV policy. Stakeholder insights helped inform the licensing procedures for EVs and charging stations, incentive structures, and subsidy disbursement processes.

To gather these insights, DDC, RMI, and RMI India used qualitative and quantitative surveys, vehicle data, and stakeholder consultations to assess the fleet electrification efforts of pilot participants. Original equipment manufacturers (OEMs) provided information on vehicle costs and economics. E-commerce companies explained their fleet electrification plans and barriers to expansion. Fleet aggregators discussed EV operations. Local government bodies such as Delhi Finance Corporation, the Transport Department, and electricity distribution companies (DISCOMs) shared insights on policy implementation.

# EV Performance and Economics

# EV Performance and Economics

To scale final-mile delivery, electrification fleet owners and delivery drivers need assurance that EVs can replace ICE vehicles on a one-for-one basis, both in terms of performance and costs. By evaluating the range, payload capacity, speed, and battery longevity of EVs deployed in the field today, DDC, RMI, and RMI India were able to compare the performance of EVs with equivalent ICE vehicles. Freight transport is also a particularly cost-sensitive sector. Providing a clear assessment as to when EVs will reach cost parity will support business decision-making regarding EV fleet transitions and can inform policymaking as well.

## EV performance

When fleet operators switch to EVs, they look for high-quality products that can perform equal to or better than existing ICE vehicles and can credibly replace them. Specifications like vehicle range, speed, payload, and battery size inform the purchase decision. In the past, breakdowns, frequent wear and tear, low range and speed, and older battery technologies stopped operators from using EVs for deliveries. However, vehicle quality has improved dramatically in the past several years, and many barriers have now been addressed. By surveying Deliver Electric Delhi pilot participants, DDC, RMI, and RMI India were able to aggregate vehicle performance data.

### Vehicle range

Vehicle range refers to the maximum distance an EV can cover with a single charge under typical operating conditions. Vehicles with longer ranges are often more expensive due to larger battery sizes, and fleet operators can manage costs by sizing vehicles to meet their daily utilisation needs.

To meet the daily freight demand, delivery two- and three-wheelers typically need to travel between 70km and 120km in a day.[21] Electric two-wheelers sold today have an operational range of 80–120 km, while electric three-wheeler goods carriers have a range of 60–120 km.[22] The variation is due to differing battery capacities and vehicle efficiencies. Thus, electric two-wheelers can replace ICE vehicles in terms of range and would not require subsequent charging in the middle of the day to meet their daily distance demands. Based on the battery size of the vehicle, electric three-wheelers might need a top-off charge or charging during the day to satisfy their average distance demands. However, as battery technology advances, electric three-wheelers will be able to fully replace equivalent ICE vehicles.

Exhibit 4 **Comparison between EV range and the average daily distance travelled by final-mile delivery vehicles within the pilot**

| Vehicle Segment | Average daily distance travelled by a delivery vehicle in Delhi | Operation range of EVs | Number of charges required during daytime operations |
|---|---|---|---|
| Two-wheeler goods carrier | 100 km | 80–120 km | 0 |
| Three-wheeler (L5N) goods carrier | 120 km | 60–120 km | 0-1 |

### Payload

Payload refers to a vehicle's load-carrying capacity. Vehicle payload directly affects a fleet operator's productivity – drivers can deliver more load over fewer kilometres with a higher payload, thereby increasing their operating margin. For EVs, the battery weight can hamper the maximum payload capacity, depending on the vehicle type and battery size. For final-mile delivery vehicles, especially electric two- and three-wheelers, the battery weight is less than 5% of the total vehicle weight. Based on the experience of the Deliver Electric Delhi pilot participants, the maximum payload falls in the same range as equivalent ICE vehicles. From the perspective of payload capacity, electric final-mile delivery vehicles can directly replace ICE vehicles.

## Speed

EVs have a lower top speed than ICE vehicles — especially two-wheelers. However, the average vehicle speed in Delhi is only 27 kmh, and delivery EVs can easily meet this speed.[23] Fleet operators should look at driving patterns to determine whether the top speed is a significant factor when making procurement decisions. The Delhi government only provides incentives for two-wheelers with a minimum top speed of 40kmh. Three-wheeler EVs already have top speeds that almost match that of three-wheeler ICE vehicles.

Exhibit 5 **Comparison of top speed between EVs and ICE vehicles**


# Vehicle economics

Competitive vehicle economics between ICEs and EVs play an important role while making policy and business decisions related to EV transition. DDC, RMI, and RMI India anonymised data from the Deliver Electric Delhi pilot participants to understand costs associated with operating EVs. This data was then used to assess the economic benefits of electrification and determine when EVs will be at cost parity with equivalent ICE vehicles. Data points such as battery life, operating range, and the average distance travelled each day were collected from pilot participants. Additional input data such as EV lending characteristics, the post-GST price of vehicles, FAME II and Delhi subsidies, road tax exemptions, petrol and CNG prices, and insurance costs specific to Delhi were also modelled. The average capital and operating costs of different electric vehicle types were then calculated and the TCO of EVs and ICE vehicles was compared.

Based on the modelled results, EV adoption represents an opportunity for sustained operational cost savings, particularly from reduced fuel expenditures. The low operational costs of EVs relative to equivalent ICE vehicles enable operators to recoup their higher capital outlay for EVs over the vehicle's operational life. The TCO is also projected to drop as battery prices fall, access to financing for EVs increases, lending terms improve, and production processes become more efficient.

Currently, the unsubsidised TCO of electric two-wheelers is less than ICE two-wheelers. Until parity is achieved in the three-, and four-wheeler segments, incentives to reduce capital cost are important. These subsidies need not be perpetual. As battery prices decline, interest rates for EV loans become competitive with ICE vehicles, and charging becomes ubiquitous, electric three- and four-wheelers will become cheaper to own and operate than equivalent ICE vehicles. At that point, subsidies will no longer be required.

**Two-wheelers:** Two-wheelers represent a high potential market for EVs. The TCO of electric two-wheelers is INR 0.52/km, significantly lower than ICE two-wheelers' TCO, which is ~ INR 2/km. The divergence between ICE and EV TCO is primarily due to fuel costs. The fuel costs of petrol two-wheelers are 96% higher than fuel costs for EVs, because petrol vehicles have relatively poor efficiency and high petrol prices.[24] With FAME II and Delhi subsidies, the up-front price of a standard electric delivery two-wheeler is 22% less than a new ICE two-wheeler.[25]

Exhibit 6 **TCO trajectory of two-wheelers**

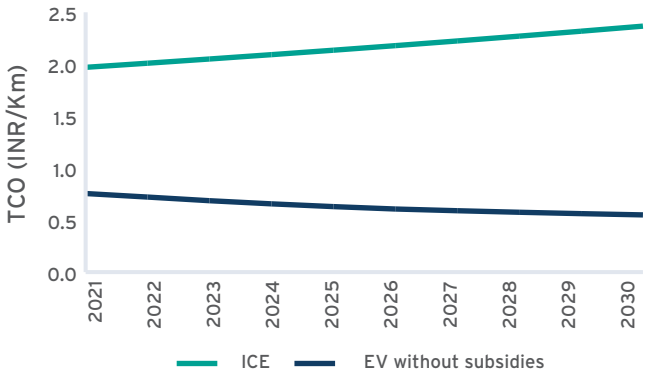
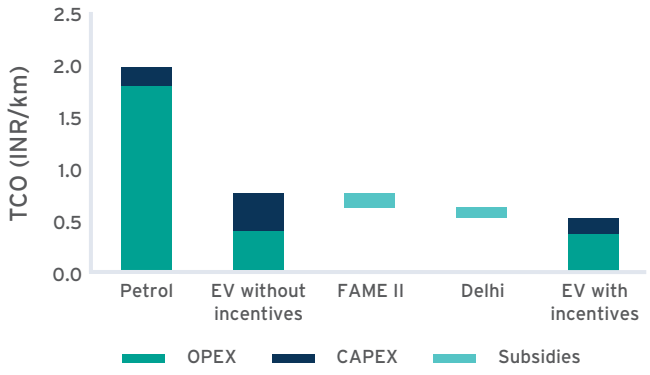



Exhibit 7 **Impact of subsidies on the TCO of two-wheelers**




***Note:*** *The TCO values shown here may vary from those presented in the Deliver Electric Delhi design report (2020). The difference is due to several reasons, including newer, more efficient EVs and EVs travelling longer distances per day.*

**Three-wheelers:** Unsubsidised electric three-wheelers (L5N) have a slightly higher TCO than ICE three-wheelers. FAME II and the Delhi EV policy offer subsidies that reduce the TCO of electric three-wheelers and seed the market faster. The combined incentives bring the TCO of electric vehicles to INR 1.94/km, below the cost of CNG vehicles at INR 2.25/km. Without subsidies or other policy support, electric three-wheeler goods carriers are projected to reach cost parity with their ICE counterparts by 2023.

Exhibit 8 **TCO trajectory of three-wheelers (L5N)**

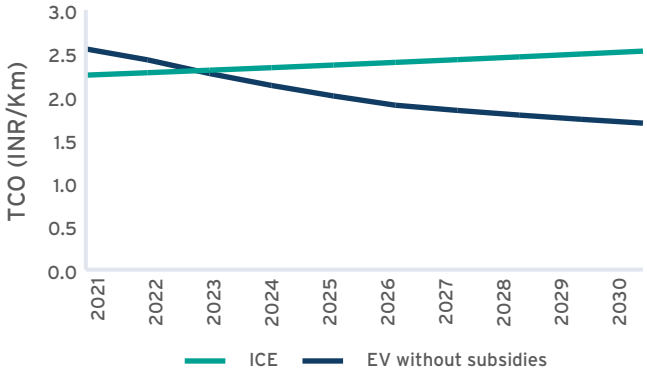
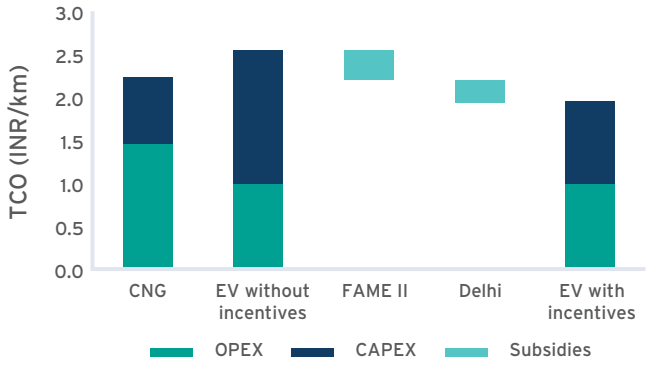



Exhibit 9 **Impact of subsidies on the TCO of three-wheelers (L5N)**



**Four-wheelers:** For electric four-wheelers – primarily light-duty vans – the capital costs are double the cost of equivalent ICE vehicles, and the TCO for electric four-wheelers is 21% higher than their ICE counterparts.[27] However, with FAME II and Delhi EV policy, EVs are at cost parity with ICEs. As the EV ecosystem improves and EV interest rates lower, the unsubsidised TCO of four-wheelers is expected to reach price parity with ICE vehicles by 2024.

Exhibit 10 **TCO trajectory of four-wheelers (N1)**

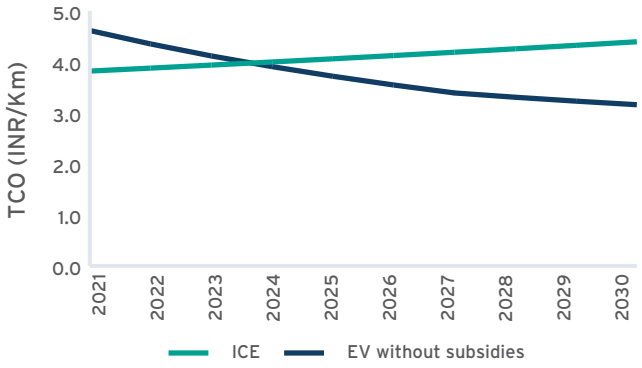
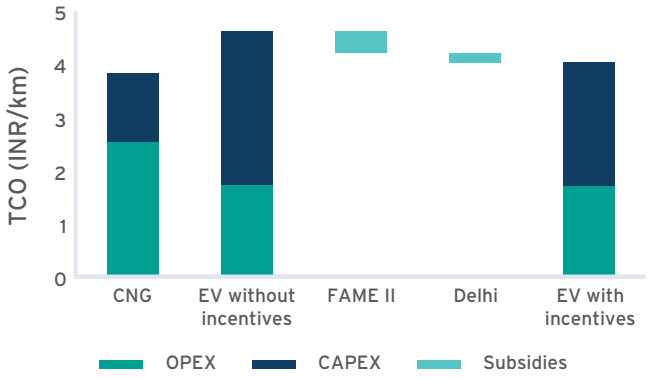



Exhibit 11 **Impact of subsidies on the TCO of four-wheelers (N1)**



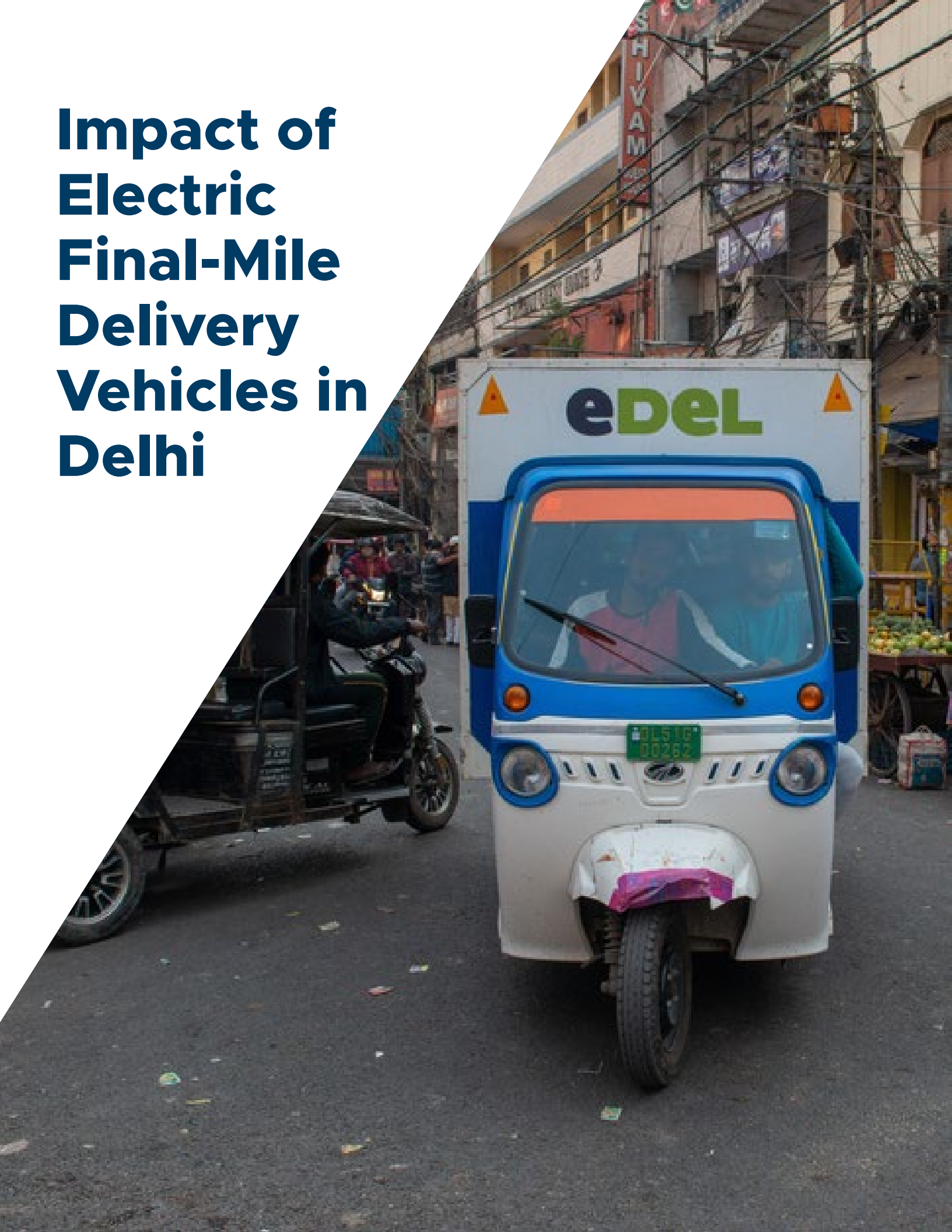

## Box 2 **Battery Technology**

Vehicle performance and costs are directly correlated to battery technology. Batteries are the highest cost component of EVs, responsible for roughly 40% of the total purchasing price. Battery life, i.e., the number of cycles a battery lasts before needing to be replaced, directly affects the costs associated with battery replacement. Most EVs sold in Delhi have a battery life of 2,000 cycles, up from 1,000 cycles two to four years ago. A battery that can last more cycles means fewer batteries are required over a vehicle's lifetime, reducing costs. For example, the total cost of ownership (TCO) for an electric three-wheeler travelling 90 km per day with a battery life of 2,000 cycles is 15% less than a three-wheeler with a battery life of 1,000 cycles, because the higher number of cycles yields an 18-month increase in battery life, on average.

Over the past decade, battery technology has improved greatly, and the price per kWh of battery storage has fallen significantly.[1] Advancements in battery technology coupled with price declines have enabled automakers to install batteries with higher energy density (the energy potential of a battery in relation to its weight). The decline of battery costs has led, and will continue to lead, to reductions in EV purchasing price. Additionally, as battery technology improves, vehicle range will also increase, alleviating some range anxiety.

Overall, electric delivery vehicles are well suited for the demands of urban driving, and there are fuel and operational cost savings from transitioning to EVs. Given the favourable economics and fleet operators' ability to optimise delivery routes, final-mile delivery vehicles are a cost-effective sector to electrify. Based on the data collected and RMI analysis, two-wheelers and three-wheelers are the more cost-effective segment to electrify today, closely followed by four-wheelers after subsidies.

# Impact of Electric Final-Mile Delivery Vehicles in Delhi



# Impact of Electric Final-Mile Delivery Vehicles in Delhi

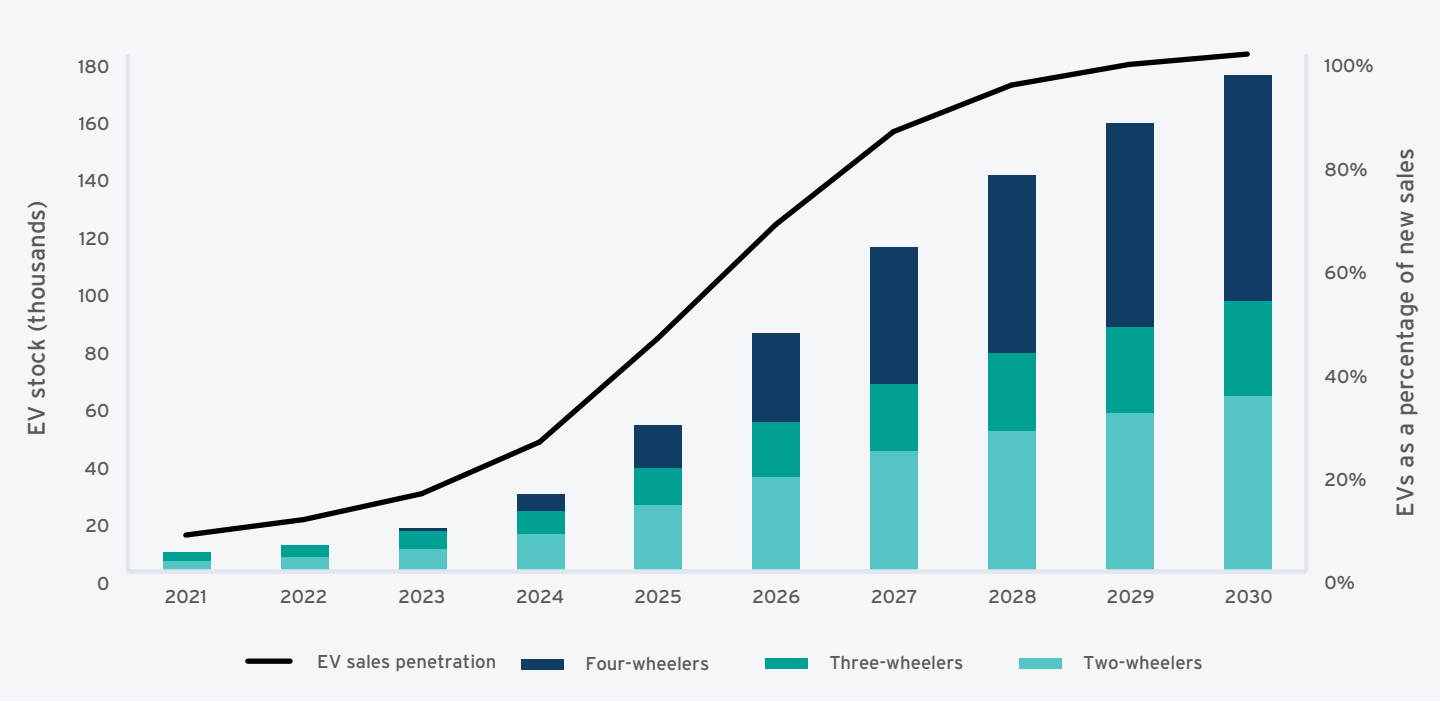
Fully electrifying the final-mile delivery sector can yield substantial economic and environmental benefits. EV adoption is one of the best ways to mitigate tailpipe emissions from final-mile delivery vehicles, reducing air pollution and carbon emissions, and promoting health. Using EVs for final-mile deliveries can also lead to significant fuel cost savings, reducing delivery expenses.

By assessing the current stock of final-mile delivery vehicles in Delhi, RMI built an analytical model to evaluate the impact of final-mile delivery electrification through this decade. Two scenarios are compared: a high electrification scenario, depicting 100% sales penetration for electric final-mile delivery vehicles by 2030; and a second "frozen" scenario, which depicts the status quo projected through 2030.[28] The two scenarios are then compared to assess the air pollution reductions, carbon emission decrease, and fuel cost savings that can be sustained from fully electrifying final-mile delivery vehicles.

## Expected sales penetration

Between December 2021 and February 2022, EV sales in Delhi reached a 10% sales penetration, and the EV market in Delhi is poised to undergo significant growth within the next decade. Based on market momentum in Delhi today, the continuation of supportive state- and national-level policies, and EV cost competitiveness, all final-mile delivery vehicles sold in 2030 could feasibly be all-electric. Exhibit 12 depicts the number of electric final-mile delivery vehicles that could plausibly be on the road by 2030 under a high electrification scenario. By 2024 there could be as many as 58,000 electric final-mile delivery vehicles in Delhi, assuming the city achieves its 25% registration target for final-mile delivery vehicles, and by 2030 this number could feasibly reach 7,71,000 final-mile delivery vehicles.[29]

Exhibit 12 **The projected number of final-mile delivery vehicles in Delhi under a high electrification scenario**



# Expected emission reductions

Electrifying final-mile delivery vehicles can lead to considerable improvements in air quality and benefit public health. Achieving 100% EV sales penetration by 2030 across the final-mile delivery sector can lead to 140 tonnes of PM emission reductions and 12,370 tonnes of $NO_x$ emissions reductions through 2030.[30]

Exhibit 13 **PM emission reductions**

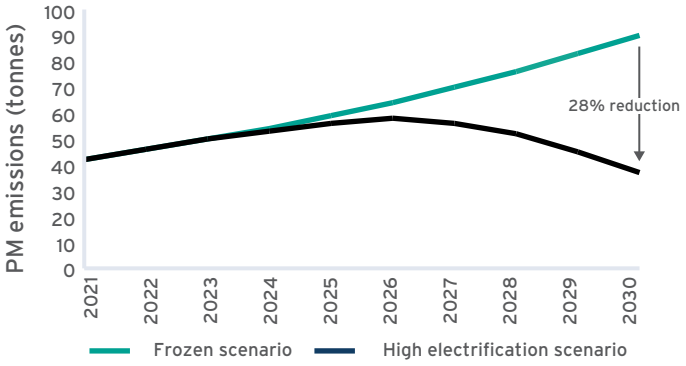
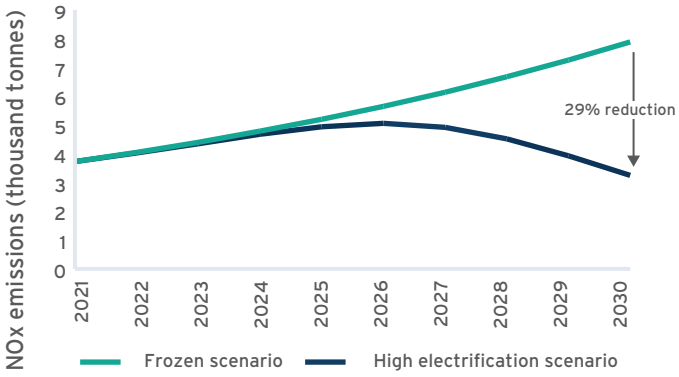
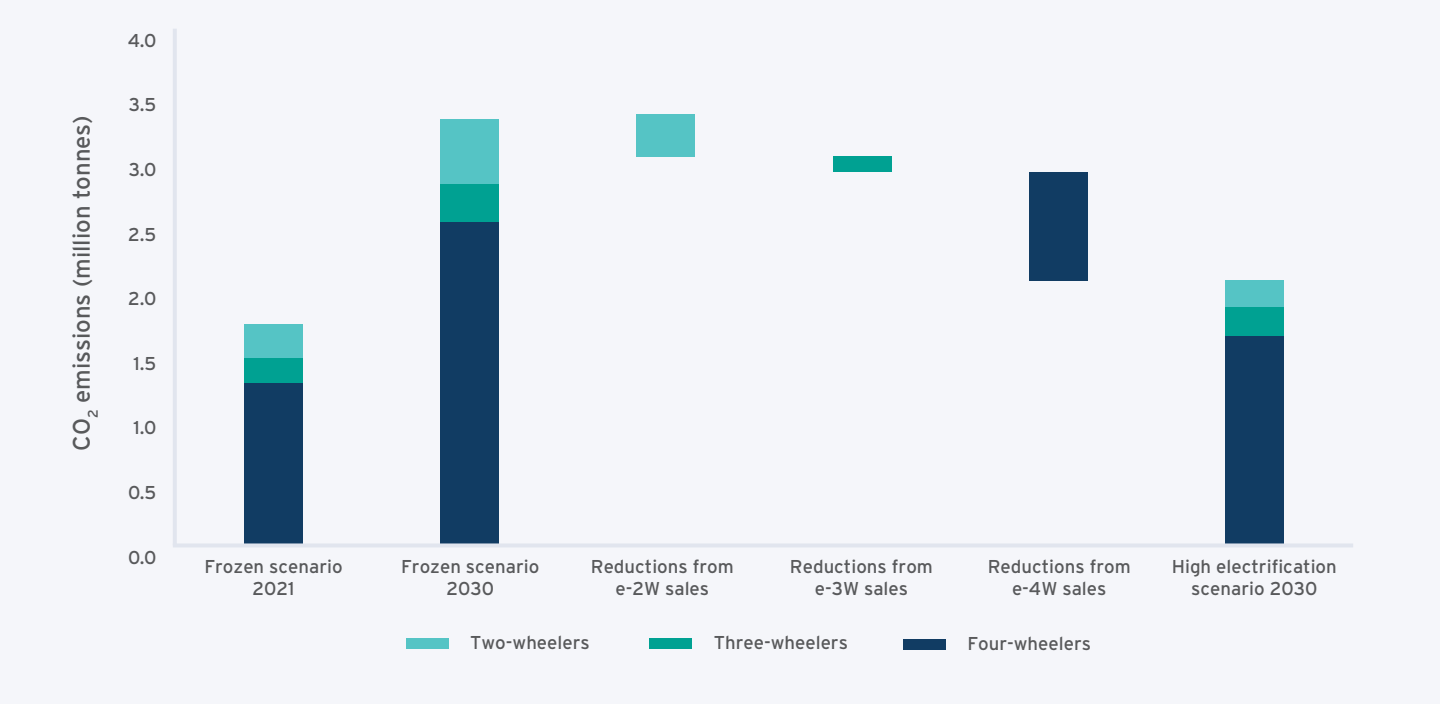



Exhibit 14 **$NO_x$ emission reductions**




EVs also reduce $CO_2$ emissions and reduce negative impact on the environment. By 2030 the electrification of final-mile delivery vehicles can result in a 36% reduction (1.3 million tonnes) in annual $CO_2$ emissions. Electric final-mile delivery vehicles sold from 2022 until 2030 can lead to 14.2 million tonnes of $CO_2$ emission reductions over their operating lifetime, equivalent of 235 million tree seedlings grown for 10 years.[31]

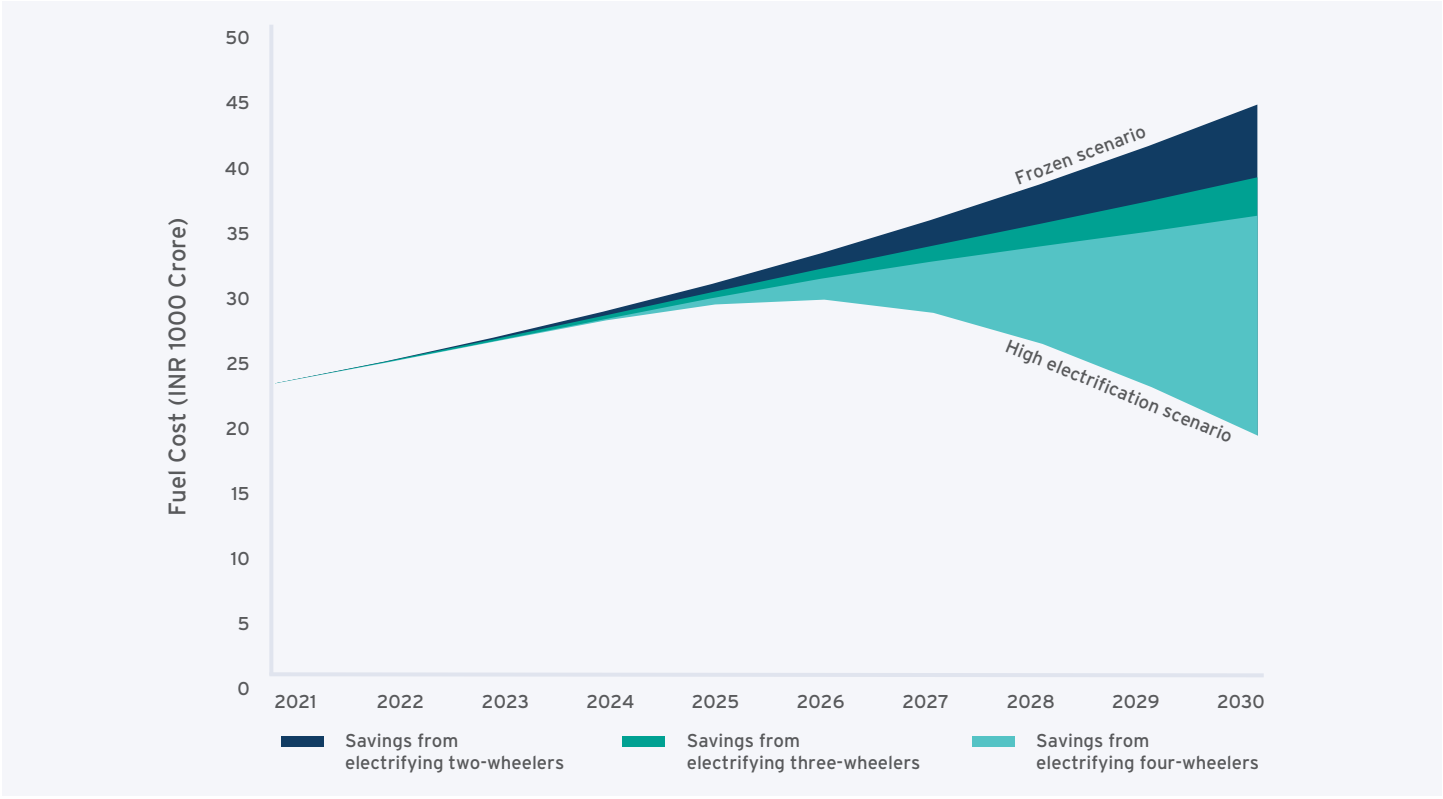
Exhibit 15 **$CO_2$ emission reductions from the electrification of final-mile delivery vehicles**



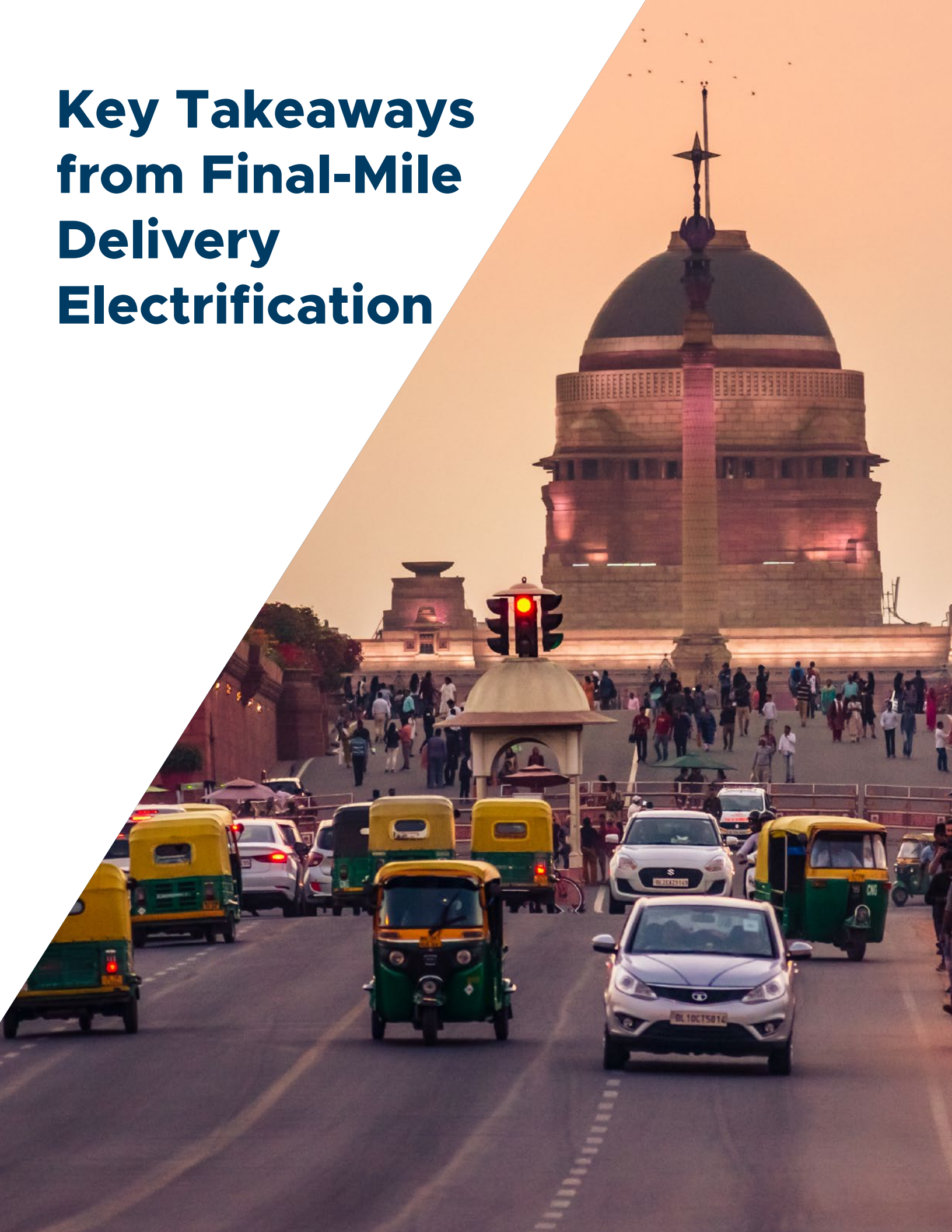
## Expected cost benefits

EV adoption leads to sustained fuel savings and reduction in oil imports. High electrification rates can bring demand for fuel down by 391 million litres of petrol and 1.2 billion kg of CNG through 2030. This will result in INR 70,000 crore savings for consumers by 2030.[32]

Exhibit 16 **Fuel cost savings from the electrification of final-mile delivery vehicles**




# Key Takeaways from Final-Mile Delivery Electrification



# Key Takeaways from Final-Mile Delivery Electrification

A core element of the Deliver Electric Delhi pilot was documenting the design and execution phases. Based on the stakeholder interviews, surveys, and consultations, DDC, RMI, and RMI India analysed strategies that led to successful EV adoption in Delhi and noted further actions required to accelerate EV penetration in Delhi. This section dives deeper into the outcomes and recommendations from the collaboration.

- ***Policy pathways:*** Discusses how fiscal incentives, regulatory measures and public awareness campaigns helped accelerate electric final-mile delivery vehicle adoption within Delhi.

- ***Charging infrastructure insights:*** Outlines how charging infrastructure policies and processes effectively reduced costs and increased the number of public and semi-public charge points throughout the city.

- ***Financing toolkit:*** Frames risk mitigation techniques and outlines steps Delhi has taken and can take to mobilise EV finance and fund new innovative business models to drive EV deployment.

## Policy pathways

The Delhi government fostered industry support by convening stakeholders to identify local and systemic barriers to EV adoption. The insights shared by EV manufacturers, fleet operators, and charging infrastructure providers enabled policymakers to tailor fiscal and nonfiscal incentives and other provisions in the policy to meet market needs. Following the launch of the EV policy and as part of the Deliver Electric Delhi pilot, DDC, RMI, and RMI India formed the Delhi EV Forum to support ongoing discussion around the implementation of the policy and efforts to drive EV adoption. This forum helped the government and partners operationalise policy elements and create processes for activities such as registering vehicles and dispersing subsidies.

The table below outlines the barriers faced by consumers, OEMs, and fleet aggregators during the transition to electric final-mile delivery vehicles and the actions taken by the government to help industry players overcome challenges and scale fleet electrification.

Exhibit 17 **Deployment challenges and interventions**

| Sr. no | Operational Barrier | Government Intervention | Outcome |
|---|---|---|---|
| 1. | **High capital costs and interest rates for EVs** | The Delhi government offers subsidies in addition to FAME II and has established registration fee waivers and a vehicle scrappage programme under the Delhi EV policy. | Lowering capital costs brought EVs toward cost parity with ICE vehicles. Subsidies, registration fee waivers, and scrappage policies have effectively reduced the capital cost of EV purchases. |
| 2. | **A lack of information on available EV models and procurement process** | The government and the Deliver Electric Delhi partners hosted networking forums and developed the Delhi EV website to disseminate information. | Regularly scheduled EV forums and the creation of the Delhi EV website facilitated streamlined information sharing and enabled industry players working on electric mobility solutions to form partnerships. |
| 3. | **Delayed subsidy disbursement and unclear processes for EV registrations** | The government created an incentive disbursement web app and formed Delhi EV cell to aid EV customers. | The processing time for subsidy disbursement was accelerated, and a point of contact for registration inquiries was established within the Delhi Transport Department. |
| 4. | **Plying and idle parking restrictions during certain hours of the day** | The Delhi government notified an amendment waiving plying and idle parking restrictions for electric three- and four-wheeler goods carriers, enabling these vehicles to ply in Delhi at any time of the day. | Electric three- and four-wheeler goods carriers now receive priority access to the city. By permitting electric final-mile delivery vehicles to ply during restricted hours, the Delhi government provided an additional incentive for EV adoption, giving EVs an operational edge over ICE delivery vehicles. |
| 5. | **Limited public awareness regarding EVs** | The Switch Delhi public awareness campaign was launched to educate the public on the economic, environmental, and public health benefits of electrifying transport in Delhi. | The Switch Delhi public awareness drive successfully highlighted the health and environmental benefits of EV adoption. The campaign was able to drive awareness and demand for EVs by educating the public on the impact EV adoption can have on air quality in Delhi. |

## 1. High capital costs and interest rates for EVs

High capital costs are one of the major barriers to EV adoption. Delhi's EV policy provides subsidies to reduce the up-front cost and achieve cost parity with ICE vehicles on a TCO basis. A series of revisions were made to strengthen the draft EV policy based on stakeholder feedback. The Delhi government updated the final version of the policy to include subsidies for four-wheeler goods carriers. The number of e-carriers – electric goods-carrying vehicles – eligible for subsidy also increased from 5,000 to 10,000 carriers. Lastly, the policy set specific targets for electrifying delivery vehicles to increase EV adoption.

Under the Delhi EV policy, payment incentives are offered in addition to the FAME II incentives. A registration fee waiver and road tax exemption are included. Demand incentives work to lower capital costs and reduce loan principal payment, thus strengthening the economic case for fleet electrification. A scrappage incentive was also provided to promote the retirement of older vehicles with high tailpipe emissions.

## 2. A lack of information on available EV models and procurement processes

Many companies looking to electrify their fleets or enter the space find it difficult to obtain information on the varying market players offering EV or charging infrastructure solutions. The pilot helped foster partnerships between vehicle manufacturers, e-commerce providers, and food and grocery delivery companies. For example, during the Delhi UML, DDC, RMI, and RMI India organised a vehicle showcase where aggregators and logistics providers connected with OEMs and tested their products. A shared directory of participants was created to encourage potential partnerships.

The Delhi government also launched the Delhi EV website to facilitate information sharing regarding EV model availability, providing information on eligible EV models and approved dealers. Additionally, the government can directly communicate with EV operators and help users track updates to the Delhi EV incentive process.

## 3. Delayed subsidy disbursement and unclear process for EV registrations

During the initial pilot discussions, fleet aggregators and OEMs said delayed subsidy disbursements presented operational and fiscal challenges. To simplify the incentive approval process and make EV registration easier, Delhi established a state EV fund that centralised all incentive funding to streamline subsidy disbursement. DDC, RMI, and RMI India also established an easy-to-access web application with clear instructions and a process to approve subsidy applications. The government continues to engage with the private sector to identify areas to improve EV registration and subsidy disbursement.

## 4. Plying and idle parking restrictions during certain hours of the day

Commercial vehicles are prohibited from plying and idle parking on arterial roads from 7 to 11 a.m. and 5 to 10 p.m. The Delhi EV policy exempts EVs from these restrictions to incentivise EV adoption and boost EV use. Recently, in coordination with the Delhi Traffic Police, the government has officially notified this exemption allowing electric L5N category three-wheeler goods carriers and N1 category goods carrier vehicles to ply at any hour of the day. The government is working to ensure these exemptions are implemented.

## 5. Limited public awareness regarding EVs

Limited public awareness regarding EV performance is one of the roadblocks to higher EV uptake. According to Deliver Electric Delhi participants, both drivers and customers are wary of EV adoption.

The Switch Delhi public awareness campaign highlighted the role electric vehicles can play in reducing air pollution in Delhi and showcased the incentives offered for EV purchases. DDC, RMI, and RMI India organised several public workshops to exemplify the benefits of final-mile delivery electrification. These webinars aimed to foster EV adoption among logistics providers and fleet aggregators.

## Actionable opportunities

As the EV market matures, it will be essential to evaluate the efficacy of Delhi's EV policy, making additional policy iterations as necessary to drive continued market growth. To continue to scale electric final-mile delivery vehicle adoption, the government can use regulatory measures to further encourage fleet adoption. The potential opportunities listed below could further strengthen the EV ecosystem in Delhi.

- ***EV sales credits:*** Sales regulations establish criteria specifying that a certain percentage of an OEM's new vehicle sales are electric, and this quota can be strengthened incrementally over time. An EV sales credit scheme could be one way to implement such a requirement, as it establishes an EV manufacturing target. To comply, OEMs must sell a certain number of EVs or purchase credits to comply with the policy. Credits are created from selling EVs, and suppliers that sell more EVs than the policy requires can trade excess credits. This type of policy incentivises first adopters and new market entrants by providing an opportunity to earn revenue from selling extra credits. These programmes have been enacted in both the United States and Europe and can help drive market competition and EV model diversification.

- ***Congestion pricing:*** To further strengthen Delhi's plying and idle restriction waiver for L5N and N1 goods vehicles, the Delhi government could implement an additional congestion fee for aggregators operating ICE vehicles and waive this fee for EVs. Implementing this scheme as outlined in the Delhi EV policy could effectively lower pollution levels and give fleet operators an added incentive to procure electric freight vehicles to meet delivery quotas.

- ***Fleet purchase requirements:*** Delhi recently approved a draft policy specifying fleet electrification requirements for aggregators and delivery service providers.[33] The proposed fleet electrification targets are incremental, and over time the government can require that an increasing percentage of light-duty vehicles managed by fleet operators are electric. To implement this policy, the Delhi government shall enact transparent processes and licensing schemes to ensure that aggregators can readily comply with the proposed policy. Delhi shall establish a licensing system for aggregators to monitor compliance. This system can enable the Delhi government to track the number of EVs licensed by an aggregator. The licensing system could also serve as an incentive for fleets to electrify their vehicles, as the fee can be classified based on vehicle segment and fuel type. Implementing this policy can effectively accelerate fleet electrification and help Delhi electrify a critical mass of vehicles.

- ***Measurable policy targets:*** While the Delhi government has already developed a clear policy agenda striving for 25% of new vehicles registered in 2024 to be electric, it could establish additional quantifiable targets to track progress and support this goal. Such targets could include the number of chargers deployed, the proportion of EV loans availed under the interest subvention programme, charger utilisation, etc. Other metrics that might be more challenging to measure, but are still critical, include industry engagement and the enactment of collaborative programmes like the Delhi EV Forum and EV Cell. These metrics would enable policymakers to evaluate the impact of the Delhi EV policy and amend it as needed.

- ***Resource toolkit on fleet electrification best practices:*** New consumers and fleet operators should have access to resources to support their decision-making. RMI, RMI India, DDC, and other partners can document the experiences of first movers through forums and offer recommendations for streamlining EV procurement processes.

- ***EV skills development courses:*** Through the Delhi Skill and Entrepreneurship University, the government is working to launch vocational training for electric three-wheeler drivers and EV maintenance personnel. The development of skills training courses and EV skills centres can support a robust after-sale EV ecosystem. Creating lessons on EV operations, maintenance, and compliance standards will help ensure fleet operators have adequate personnel to support their EV adoption efforts.

Effective implementation of some of the proposed schemes will require the Delhi government to engage with the private sector and local government bodies. Continuing to raise awareness regarding electrification benefits can lead to continued support for EV regulations and incentives. Conducting forums and informational sessions to receive feedback will enable the government to make informed regulatory decisions.

## Charging infrastructure insights

The absence of a wide network of charging infrastructure was identified as a critical barrier to EV adoption. The lack of infrastructure stemmed from the high costs associated with charging station development, upstream infrastructure costs, and a lack of suitable land. To address these concerns, the government took a technology-agnostic approach to scale charging infrastructure, providing incentives to foster both battery swapping and more conventional plug-in charging infrastructure development. Under Delhi's concessional charging tender, the government will provide land concessions and electrical infrastructure subsidies to plug-in and battery swapping stations. Battery swapping is another way to "refuel" an EV. Instead of using a charger to charge a vehicle directly, EV users swap their batteries for fully charged replacements at swapping stations.

To increase charging infrastructure availability throughout the city, the Delhi government enacted a series of schemes and processes to defray charging infrastructure costs. Delhi enacted a single-window process and subsidy scheme to facilitate charging infrastructure development throughout the city. The specific types of chargers eligible for the subsidy and single-window installation are all slow chargers (Level 1) and include AC 001, light electric vehicle (LEV) AC, and Bharat DC 001 chargers. AC 001 and LEV AC chargers have a power output of 3.3 kW per charging port, and the Bharat DC 001 charger has a power output of 10 kW.

The Delhi government also established a working group to further support public and private charging network development and manage interagency and intra-agency coordination. This group consists of representatives from the Transport Department, the Municipal Corporation of Delhi, the Power Department, DISCOMs, and others. Based on Deliver Electric Delhi and Delhi EV Forum feedback, the group develops and modifies regulatory processes to streamline charging infrastructure deployment.

The list below outlines barriers faced by charging infrastructure providers when deploying chargers, and actions taken by the Delhi government to overcome adoption challenges.

Exhibit 18 **Charging infrastructure development challenges and interventions**

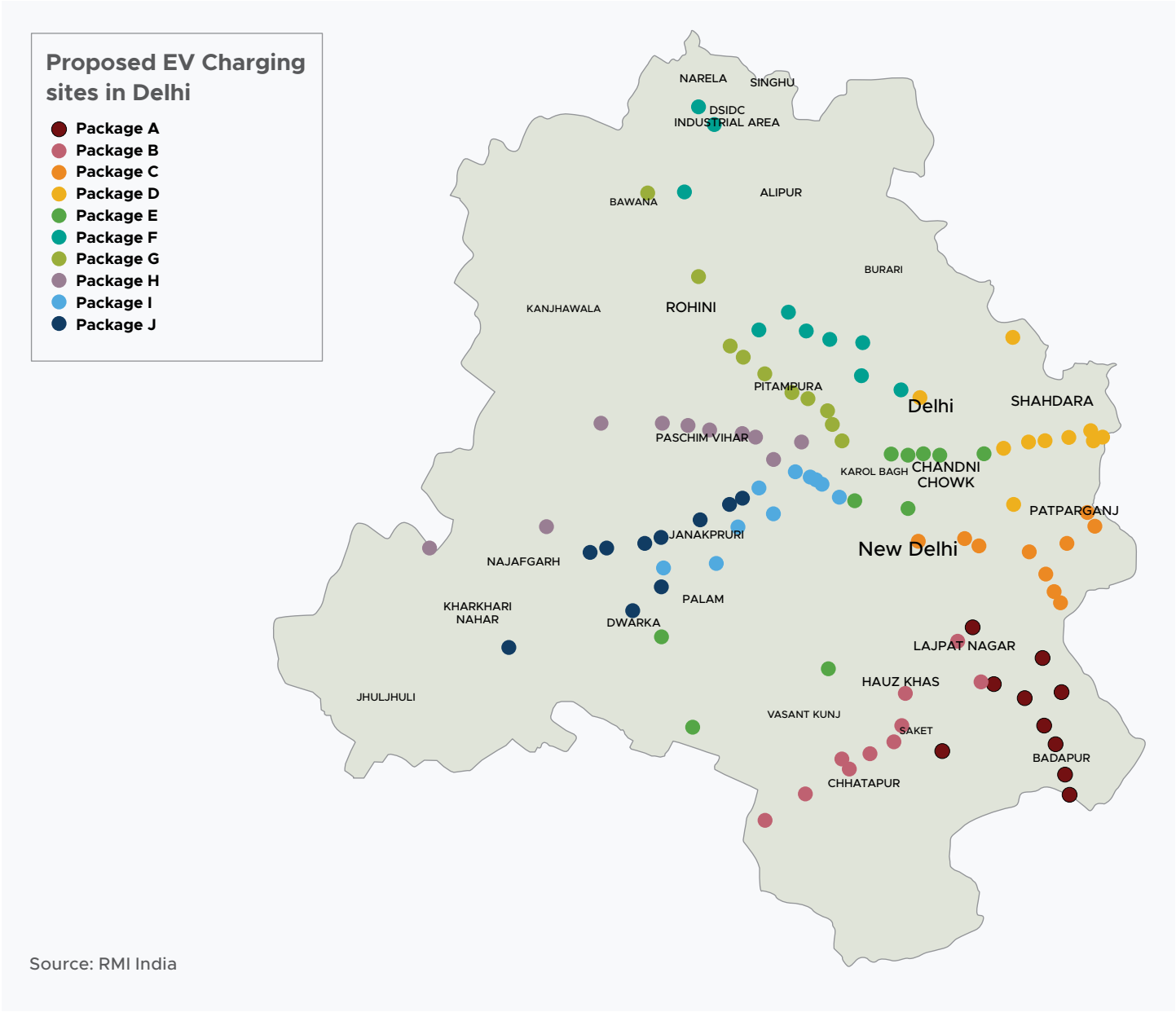
| Sr. no | Operational barrier | Government intervention | Outcome |
|---|---|---|---|
| 1. | **Lack of land availability and high land cost** | Under the latest public charging tender, the Delhi government defrayed land costs and made public land available for lease. | Instead of paying a fixed monthly rent, the charging provider pays a fixed cost per kWh sold, enabling the provider to match cost outflows with revenue generation. |
| 2. | **High upstream electrical infrastructure costs** | The government provides 100 kW load availability for each site as viability gap funding to address upstream electrical infrastructure costs. | This subsidy programme has effectively lowered charging station installation costs and made it economical to set up a more robust charging infrastructure network. |
| 3. | **Lack of EV specific tariffs** | A tariff structure specific to EV charging was implemented. | The costs of EV charging have been reduced, and EV users are eligible to charge vehicles without facing demand charges. |
| 4. | **Cumbersome licensing and charging infrastructure installation processes** | A streamlined process for installing private and semi-public charging points was established. | A single-window clearance process made coordination with DISCOMs easier and streamlined, lowering the soft costs of charging deployment in Delhi. |
| 5. | **The high cost of private charging infrastructure** | A scheme to subsidise private and semi-public charging infrastructure costs was developed. | Enacted charging infrastructure subsidies have effectively reduced the cost of charging infrastructure deployment, and the number of charge points in the city has increased fivefold since the launch of the Delhi EV policy. |
| 6. | **Lack of information on EV charging stations** | The government published guidebooks on charging infrastructure development practices and is launching an online platform to provide information on public charging stations. | Data regarding charging infrastructure deployment best practices and charger availability have helped increase utilisation. |

## 1. Lack of land availability and high land cost

High land costs and the lack of land availability were flagged as key barriers to installing public charging infrastructure. Land is a scarce resource in Delhi; thus, the cost to purchase or lease plots is high. The government issued a public charging tender for 100 concessional charging locations to improve access to public charging. As part of the tender, the government will lease public land parcels to the charging station operators for INR 0.70 per kWh sold, enabling the provider to match cost outflows with revenue generation. [34]

The government also made public land available for lease to build charging stations in regions with high vehicle traffic. The placement of 100 charging locations was chosen based on the following criteria: ease of accessibility, electrical infrastructure feasibility, and high vehicle dwell time. Parking and traffic patterns were analysed to place them in regions where drivers needed them the most. The map below outlines the location of each of the 100 charging stations.

Exhibit 19 **Concessional charging station locations**




Source: RMI India

## 2. High upstream electrical infrastructure costs

Charging stations need a high-power capacity to charge vehicles, and the available load of existing connections is often not enough for vehicle charging. The charging provider must then invest in costly upstream electrical infrastructure, installing new cabling to facilitate a three-phase power supply, adding additional transformers, and upgrading the electrical panel. Additional electrical costs often make setting up public charging stations economically unviable. The government floated a tender for charging station development to reduce electrical infrastructure costs. Charging stations developed under this tender will receive a 100kW sanctioned load at each site to help address upstream electrical infrastructure costs.

## 3. Lack of EV specific tariffs

Delhi follows a two-part tariff structure, and electricity charges are a product of demand and total energy consumed.[35] Public and private charging stations incurred steep fees, since EVs require a high power demand to charge. High electricity fees diminish the operational savings of EV adoption. To help reduce charging rates, the government created a specific tariff schedule that removed demand charges for vehicle charging and reduced total electricity fees. The tariff is INR 4.5/kWh for electricity supply at AC 001, LEV AC, and DC 001 chargers.[36]

## 4. Cumbersome licensing and charging infrastructure installation processes

Deliver Electric Delhi pilot participants highlighted that unclear licensing and difficulties coordinating with utilities and charging installation vendors inhibited them from developing private and semi-public charging infrastructure at malls, schools, and offices. The government introduced a single-window process to streamline the deployment of AC 001, LEV AC, and DC 001 chargers.

Delhi developed a single-window process for customers to procure and install charging stations. This user-friendly online platform allows customers to submit a request, and the DISCOM will then assess if there is an adequate load for a charger at the desired location. The DISCOM provides an estimate for any needed load enhancement work if necessary. Once the customer approves the contractual details of the proposed charging installation, the charging vendor and DISCOM install the charger and implement any electrical work upgrades. The annual maintenance costs of EV chargers purchased and installed through the government's single-window process are covered for three years post installation.

## 5. The high cost of private charging infrastructure

The cost of installing private and semi-public charging infrastructure is a significant expense, and costs depend on the size of the charger installed. For private charging points, the norm is to install a slow charger (LEV AC or AC 001). Currently, the hardware and installation costs of an LEV AC slow charger are roughly INR 8,500. Typically, as the charger's size increases, the hardware and installation costs increase; for example, the hardware costs for a DC 001 (10kW) charger is roughly INR 2 to 3 lakh.[37]

To help customers cover hardware costs, the government introduced an incentive scheme to subsidise 30,000 slow charging plugs (LEV AC or AC 001) installed in homes and workplaces. The subsidy provides up to INR 6,000 per charging plug, covering nearly 70% of maintenance, installation, and hardware costs.[38] This scheme is designed to promote the installation of low-cost AC chargers best suited for two-wheeler and three-wheeler charging. Fleet aggregators who install approved slow chargers in their warehouses or yards are eligible for the subsidy. Under this scheme, the vendor submits the paperwork to receive the charging point subsidy and recoup its costs. This removes the customer's burden of applying and waiting for the subsidy.

## 6. Lack of information on EV charging stations

EV operators found that the lack of information on available charging infrastructure and the relative scarcity of public charging stations made it difficult to rely on public charging. The Delhi government instituted the Centre for Sustainable Mobility to address these challenges. One of the centre's first mandates is to create a single platform providing information on station locations, charging availability, charging rates, and the configuration of charging plugs. Additionally, with the support of its strategic partners, the Delhi government has published guidebooks on best practices for installing workplace and shopping centre charging infrastructure installation.[39]

## Actionable opportunities

Access to charging and battery swapping will be critical for further scaling final-mile delivery EV adoption. The Delhi government can work with DISCOMs to systematically upgrade charging infrastructure and the subsequent electrical infrastructure. Below are steps that can be taken to strategically improve the charging infrastructure network in Delhi and minimise the costs associated with electrical infrastructure development.

- ***Time-of-day option for EV charging:*** Delhi has already enacted a specific EV charging schedule that removes demand charges for vehicle charging. In addition to this schedule, Delhi can extend its existing time-of-day (ToD) tariff scheme to apply to EV charging throughout the year. The existing ToD tariff schedule applies to nondomestic customers with a large, sanctioned load and is only applicable from May to September. The enactment of a ToD tariff for EV charging throughout the year could incentivise charging during off-peak hours — times when there is less energy demand and typically higher renewable energy generation. Such a tariff structure can be a more effective mechanism for DISCOMs to minimise peak loads and manage costs.
- ***Demand-side management through smart charging:*** Delhi can minimise the need for electrical infrastructure augmentation by proactively monitoring vehicle charging. In partnership with DISCOMs, the Delhi government should consider enacting a managed charging programme. Such a programme can be optional, and customers could opt into it to receive preferential electricity rates when they charge their vehicle during off-peak periods. Uncontrolled and uncoordinated EV charging can overload distribution systems.[40] By strategically managing vehicle charging, DISCOMS can optimally meet growing EV charging demand and integrate renewables more effectively.
- ***Utility-ready infrastructure:*** As the demand for charging increases, the need to invest in electrical infrastructure upgrades to satisfy this demand will also rise. To minimise the costs and time associated with electrical infrastructure upgrades, the Delhi government, in coordination with DISCOMs, can develop a utility-ready infrastructure programme. Under such a scheme, the DISCOM maintains and updates electrical infrastructure, except for the actual charger. This programme can help ensure targeted investments are being made to meet the added demand of vehicle charging and can minimise the soft costs associated with charging station installation. The Delhi government can work with DISCOMs on cost socialise schemes and other cost-sharing mechanisms between the charging plug operators and the utility to implement such a programme. The government could also provide financial incentives to DISCOMs for electrical augmentation along highly travelled corridors and within commercial districts.
- ***Storage capacity:*** The Delhi EV policy outlines that charging stations and swapping kiosks that develop on-site renewable energy generation shall have access to energy storage facilities to encourage the use of renewable power for charging.[41] Implementing this programme and expanding Delhi's storage capacity can enable DISCOMs to meet the growing demand for charging with renewable resources and fewer grid investments. Storage availability can help ensure that charging demand can be fulfilled without overbuilding the grid, and with more renewable energy resources. The Delhi government should work with DISCOMs and other energy storage providers to consider how storage could help ease grid congestion and replace peaking plants used to satisfy high demand periods.
- ***Charging station placement:*** Placing charging infrastructure near warehouses, industrial districts, and highways can help promote final-mile delivery electrification. Optimally siting charging stations to suit final-mile delivery vehicles can improve utilisation rates and ensure the long-term viability of charging assets.

Policymakers and DISCOMs play a crucial role in creating a robust charging infrastructure network. The identified opportunities listed above can be strategically implemented to manage future charging infrastructure and minimise the costs associated with electrical infrastructure development.

## Financing toolkit

The majority of final-mile deliveries in Delhi are made by seasonal or gig workers that often require financing to buy vehicles. Many lack credit history and cannot secure favourable loan terms. Unfavourable financing is a key barrier to the deployment of EVs. Interest rates for EV financing are around 20% for electric two-wheelers and are nearly 30% for electric three-wheelers, compared with 12% for ICE two- and three-wheelers. The loan-to-value ratios are low – typically around 70% – and loan terms are short – around three years.[42] Lenders regard the EV market as high risk. Asset risks stem from EV performance concerns and the lack of a clearly defined resale value. Business model risks are associated with a lack of bankability and uncertainty regarding EVs' ability to meet delivery quotas and final-mile delivery demands. Such risks compound lenders' hesitancy and lead to a higher cost of financing. Exhibit 20 outlines financial risks and mechanisms to improve EV bankability and decrease financing costs.

Exhibit 20 **Risk distribution techniques to reduce the cost of EV financing**

| EV market risks | | Pathways to reduce risk | |
|---|---|---|---|
| **Resale risk** | There is no secondary market for EVs. Since resale values for batteries and vehicles are unknown, the risk for the purchaser and lender is compounded. | **Secondary market development** | Establishes a resale value for a repossessed EV asset and enables lenders to recoup some of their losses in the instance of default. |
| **Customer risk** | The nascency of the EV market and fleet aggregators' and operators' lack of credit history means financers fear loan defaults. | **Partial loan guarantee** | Allows lenders to hedge against default risk and enables fleet aggregators and EV operators to secure more favourable loan terms. |
| **Technology risk** | There is concern around EV performance and quality. Battery variability leads to range anxiety. | **Warranties and guarantees** | OEMs offer battery replacement within a set warranty period and guarantee specific vehicle performance criteria. |
| **Utilisation risk** | Financers fear that low utlisation means the TCO of EVs cannot reach parity with ICEs. | **Battery and vehicle leasing programmes** | Enables operators to right size vehicles and batteries and lease vehicles to meet specific delivery quotas. |

The Delhi government has begun implementing programmes to address the identified financial risks and mobilise EV finance. The government has sought to reduce the cost of debt by improving lending terms. Delhi is also working on a series of interventions to address the unfavourable lending terms and improve the bankability of fleet electrification.

- ***Interest subvention:*** To address the unfavourable interest rates, the government, in partnership with Convergence Energy Services Limited (CESL) is developing an interest subvention scheme. Once implemented, the scheme will subsidise 5% of the interest rate on loans from empanelled lenders. To qualify for this programme and receive the government subvention, empanelled lenders must standardise their lending terms.
- ***Demand Aggregation:*** This programme aims to aggregate EV demand in conjunction with CESL. By collaborating with fleet operators, CESL can secure bigger procurement contracts to drive down EV costs. While the scheme is being finalised, fleet operators will need to agree to CESL's procurement terms. If CESL commits to purchasing a significant quantity of EVs, OEMs will be able to manufacture EVs economically. OEMs then provide standard EV warranties and sell vehicles at a reduced bulk price.

Exhibit 21 compares the cost of debt for both EV and CNG vehicle purchases, illustrating the effect of subsidies and interest rates. Currently, CNG vehicles receive more favourable lending. The illustration shows CNG loan characteristics – a 12% interest rate, a three-year loan tenure, and an 80% loan-to-value ratio (LTV). EVs receive less favourable lending terms, and without subsidies, the loan principal for an EV is high. The graph compares the average cost of EV financing terms – 25% interest rate, a three-year loan tenure, and a 66% LTV – with terms for CNG vehicles.[43] The third scenario shows how FAME II, Delhi subsidies, and more favourable lending terms – 12% interest rate, a four-year loan tenure, and an 85% LTV – dramatically reduce EV financing costs. Lastly, Exhibit 22 shows how loan terms affect borrowers' payment schedule, or average monthly loan payments.

Exhibit 21 **Cost of financing an electric three-wheeler (L5N) compared to a CNG vehicle**

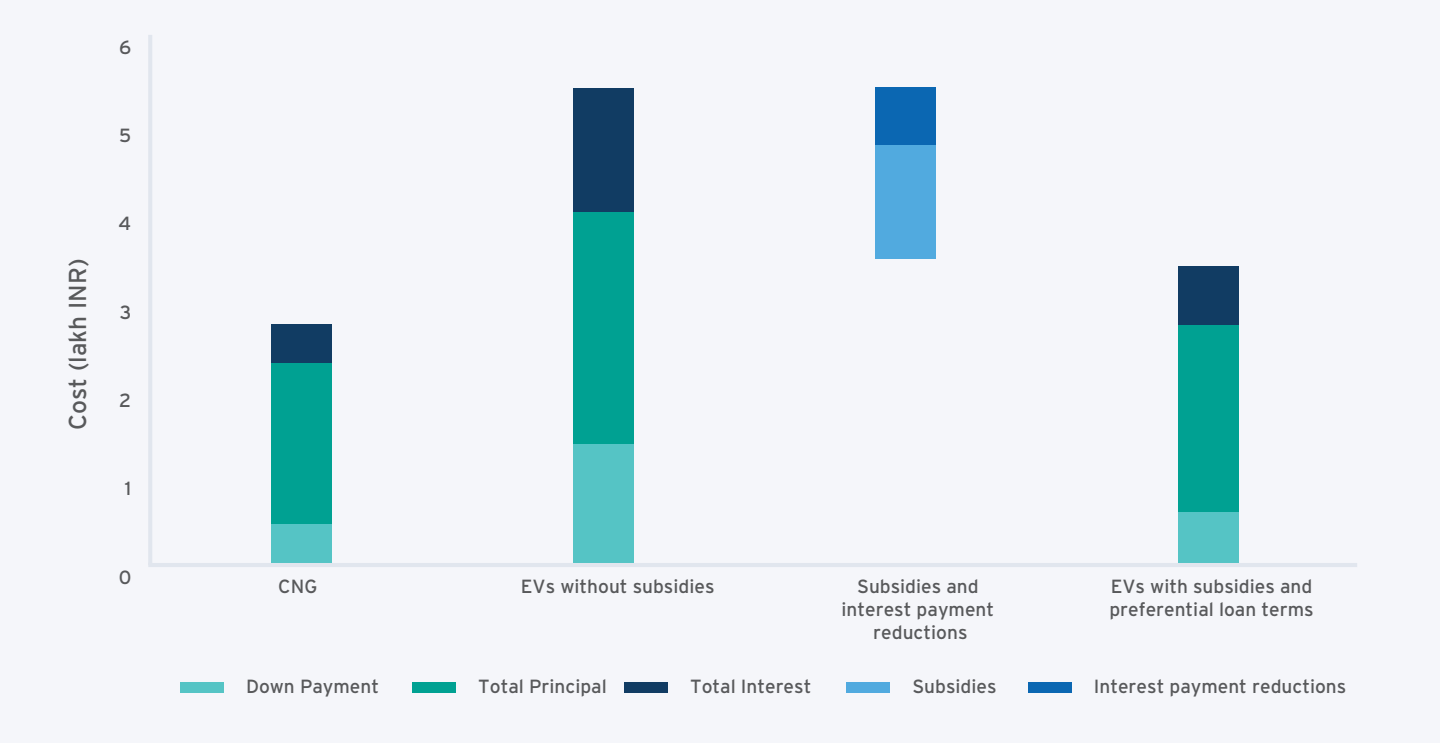
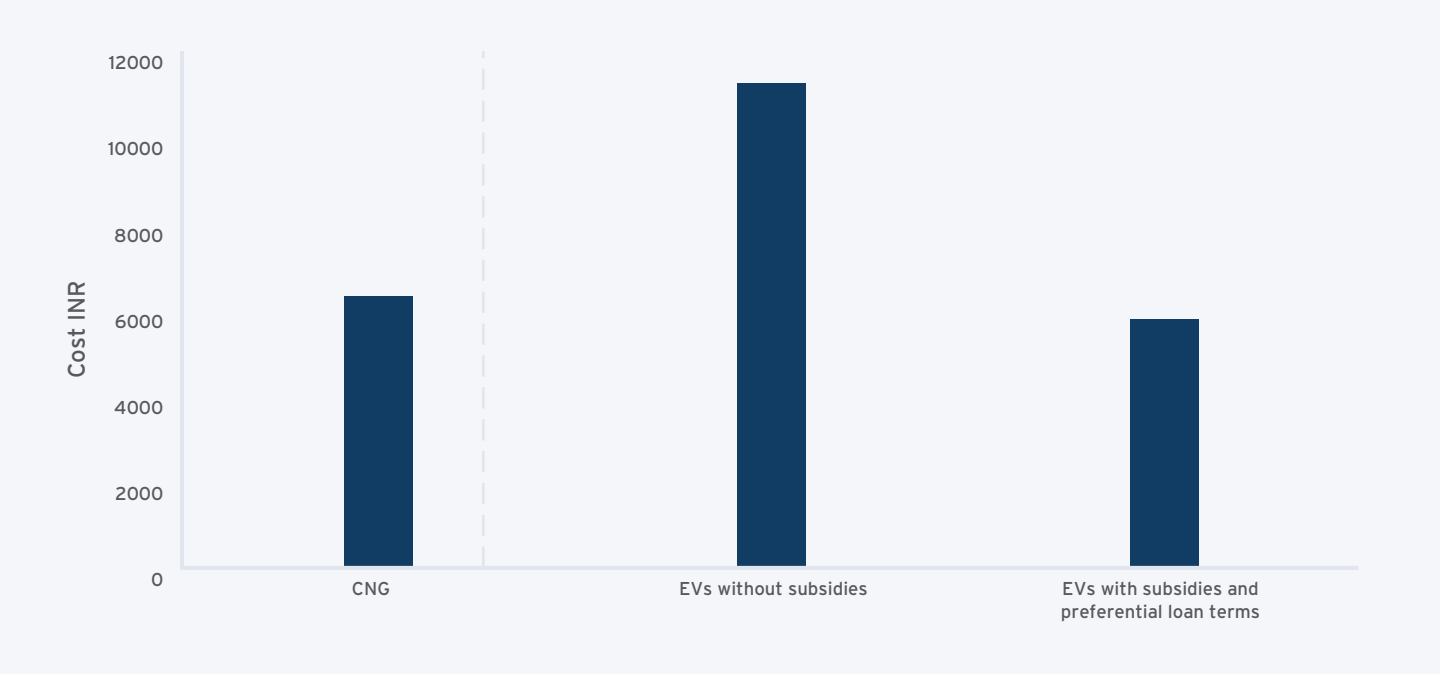


Exhibit 22 **Average monthly loan payment for an electric three-wheeler (L5N) compared with a CNG vehicle**




## Actionable opportunities

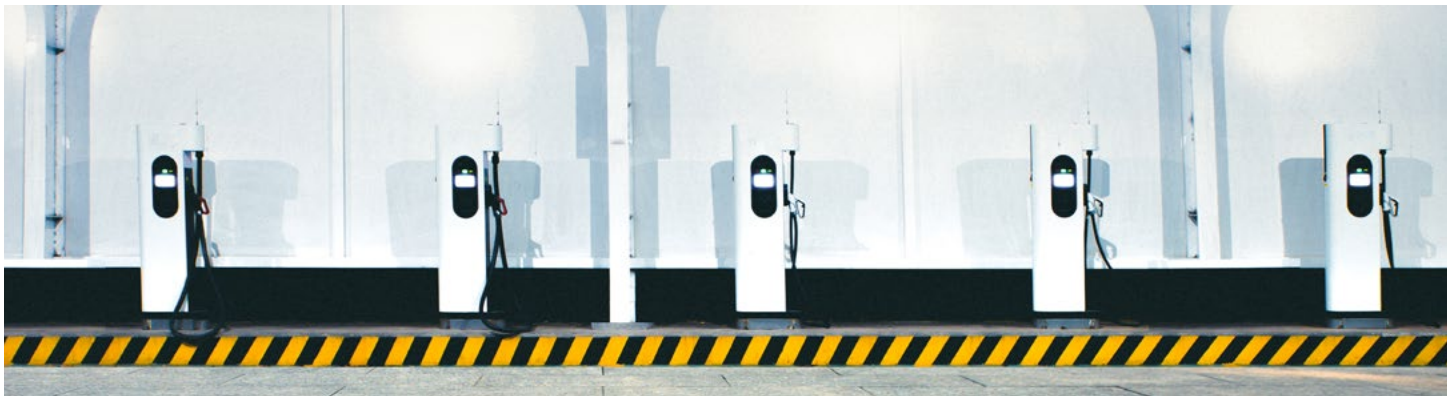
Financing schemes and business models designed to address systemic asset and business model risks can drive the electrification of final-mile delivery vehicles. Additionally, the government and companies can introduce programmes that help distribute customer risk and expand access to credit. Secondary market development reduces lenders' default risk. Alternative credit checks help remove barriers for small operators lacking a formal credit history, thus expanding access to finance.

- ***Partial Loan guarantee:*** If a borrower defaults on an EV loan, the lender typically bears all the default risk. To distribute this risk, the government or external agency can provide a partial guarantee against an instance of default. Such a scheme allows lenders to hedge a portion of their default risk and enables them to expand their loan offerings or lower interest rates for loans availed for EVs.
- ***Secondary market development:*** As the EV market stands today, lenders often fail to recover value from repossessed EV assets. Buyback programmes in which a fleet aggregator or an e-commerce company commits to purchasing a repossessed vehicle can reduce lender risk. Such schemes allow for risk-sharing and can increase EV bankability.
- ***Alternative credit evaluations:*** Evaluating borrowers based on metrics such as asset management, income, and behavioural data can expand small fleet aggregators and individual delivery drivers' access to finance. Under such a scheme, those lacking a formal credit history can receive financing. This type of credit scoring removes barriers for borrowers, streamlines the lending process, and removes biases from the loan review process.
- ***Vehicle leasing scheme:*** Leasing schemes can lower the cost of EV ownership. Leasing adds flexibility as users can lease based on seasonal demand or on specific use cases, leading to higher utilisation. Leasing is a means to manage technology risk, as the user is not liable for the resale and maintenance of the vehicle. The OEM or leasing agency owns the asset, and they are better positioned to manage risks associated with the operability and resale value.

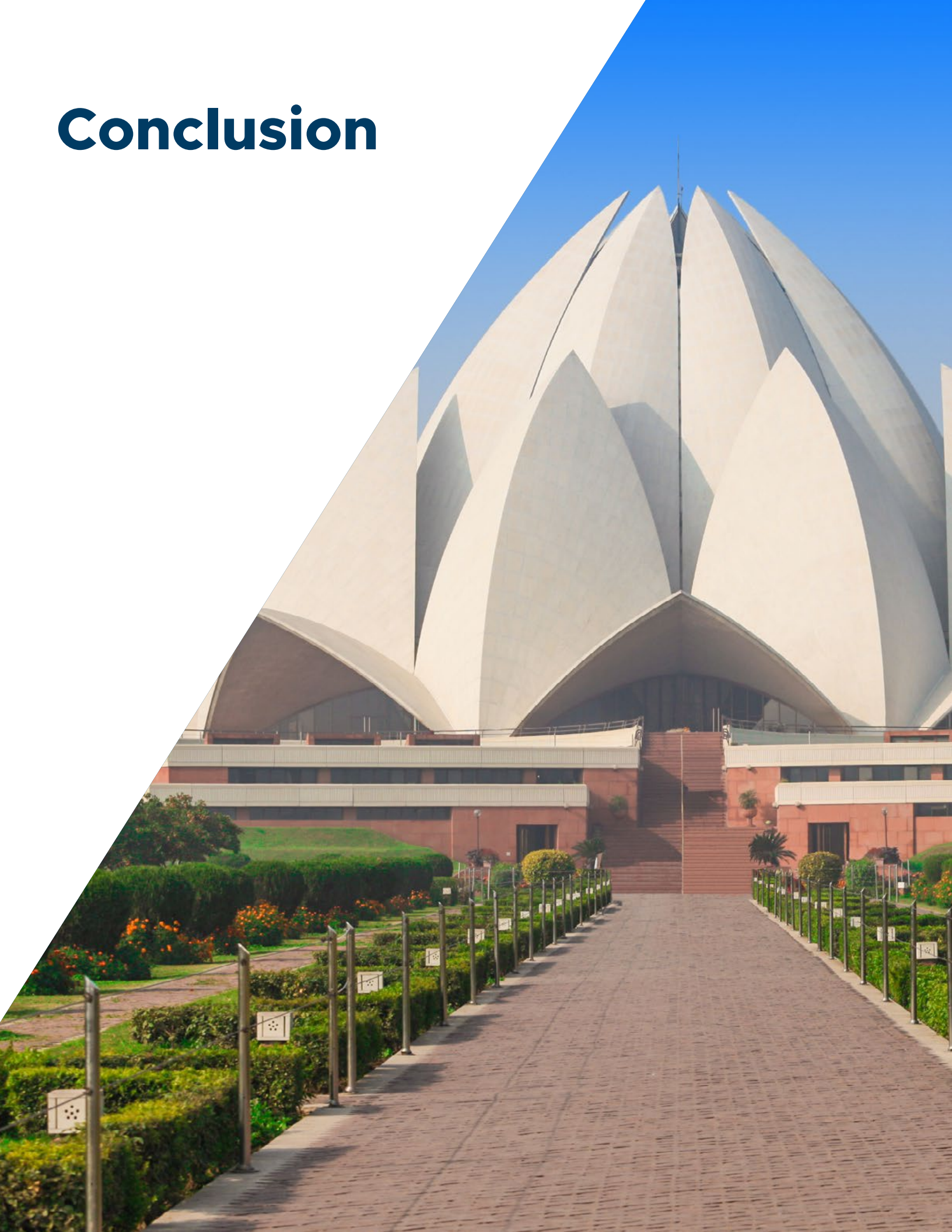
- ***Battery leasing scheme:*** Batteries represent a large portion of EV cost; thus, separating the battery from the overall vehicle asset makes buying an EV less capital intensive. Under a battery leasing scheme, the vehicle is bought separately, and the operator leases the battery from an OEM or battery service provider. This reduces the risk as the OEM is liable for the battery. OEMs can invest in skilled maintenance personnel to service batteries at a lower cost. OEMs are also better positioned to create a secondary market, as they can lease batteries based on the realised range. Operators that run shorter routes may lease used batteries to meet requirements. Normalising leasing and rental models can build confidence in the broader EV ecosystem.

Exhibit 23 **Opportunities to moblise EV finance**

| Tool to Mobilise Finance | Description | Critical Actors and Roles | Benefit | Operational Hurdles |
|---|---|---|---|---|
| **Partial loan guarantee with government/ multilateral guarantor** | The government or an external entity provides collateral if there is a default on an EV loan | **Government:** Agrees to cover a certain percentage of the loan principal in the instance of default | Lenders can hedge against default risk, enabling them to provide low-interest and longer-tenure loans for EVs | The government may not have financial resources or the will to create such a programme |
| **Secondary market development** | Fleet aggregators commit to buying back an EV asset, if one of their full-time driver-partners defaults on an EV loan | **Industry:** Fleet aggregator commits to buying repossessed EV assets securing resale value | Enables lenders to recover losses in the instance of default, increasing bankability | Industry operators, like fleet aggregators often lack the credit or the incentive to buy back EV assets |
| **Vehicle leasing** | An OEM or leasing agency owns the EV asset and leases these vehicles to operators | **Industry:** OEM or private provider owns and leases vehicles | Leasing increases flexibility, reduces technology risks, and improves the utilisation rate for leased EVs | The OEM or leasing agency needs access to a significant amount of capital to procure fleets, and this entity takes on a considerable amount of risk |
| **Battery leasing** | The vehicle is sold separately from the battery, and the operator leases the battery from an OEM or battery service provider | **Industry:** OEM leases batteries and invests in battery leasing ecosystem | Increases bankability by lowering the loan principal and reduces technology risk | The OEM is liable for batteries, increasing risk and potential for default |
| **Alternative credit evaluations** | Uses a novel credit evaluation system, in which behavioural data and asset management information are used to evaluate borrower's credit worthiness | **Banking sector:** Microfinance and fintech companies create innovative credit evaluations, expanding credit access | Alternative credit evaluations help borrowers to receive financing | Data collection challenges |



# Conclusion



# Conclusion

Over the span of three years, the Deliver Electric Delhi pilot served as a platform for the public and private sectors to discuss policy and business strategies to accelerate EV adoption and initiate fleet electrification movement in Delhi. In just over a year of the Delhi EV policy launch and implementation of the Deliver Electric Delhi pilot, EV sales penetration in Delhi increased from 3.3% to 10% of new vehicles registered, making Delhi one of the fastest growing EV markets and a global leader.[44]

Several key lessons can be drawn from the implementation of the Delhi EV policy and the execution of the Deliver Electric Delhi pilot. The policy, charging, financing, and technology solution pathways implemented in Delhi for EV adoption can be used as a case study by other cities and states in India, and beyond. The following steps outline a roadmap to accelerate final-mile delivery electrification in Delhi and these guidelines can be used as a model to fully electrify final-mile deliveries and develop a supportive EV ecosystem.

## Create an effective region-specific EV policy

- ***Develop a policy objective:*** Policymakers should be aligned on a clear problem statement and prioritise policy interventions accordingly. To reduce pollution from ICE vehicles, the Delhi government implemented policies to incentivise and promote the electrification of final-mile delivery vehicles.
- ***Align on a clear goal and set measurable targets:*** Setting clear targets for electrification sends a clear market signal. The Delhi government developed a clear target, striving for 25% of new vehicles registered in 2024 to be electric. To achieve this goal, the Delhi government specifically sought to reach a critical mass of EVs by electrifying goods-carrying vehicles.
- ***Engage with stakeholders at the onset of policy development:*** Engaging stakeholders helps foster industry support and drives regional investment. Consultations allow participants to discuss local and systemic barriers, helping policymakers tailor solutions for the region.
- ***Iterate on policy design:*** Challenges emerge throughout the policy implementation process. Regular stakeholder engagement helps identify obstacles and streamline operations. Building an ecosystem in which feedback was valued helped government agencies improve policy implementation. The government was open to feedback and surrounded itself with technical experts to help businesses and individuals navigate the EV registration and charging infrastructure development processes.

## Break down silos and engage stakeholders

High interest rates for EVs are a major barrier to EV adoption, despite maturity in technology. Policymakers and financing institutions can take steps to address systemic asset and business model risks associated with EVs to reduce the total cost of ownership.

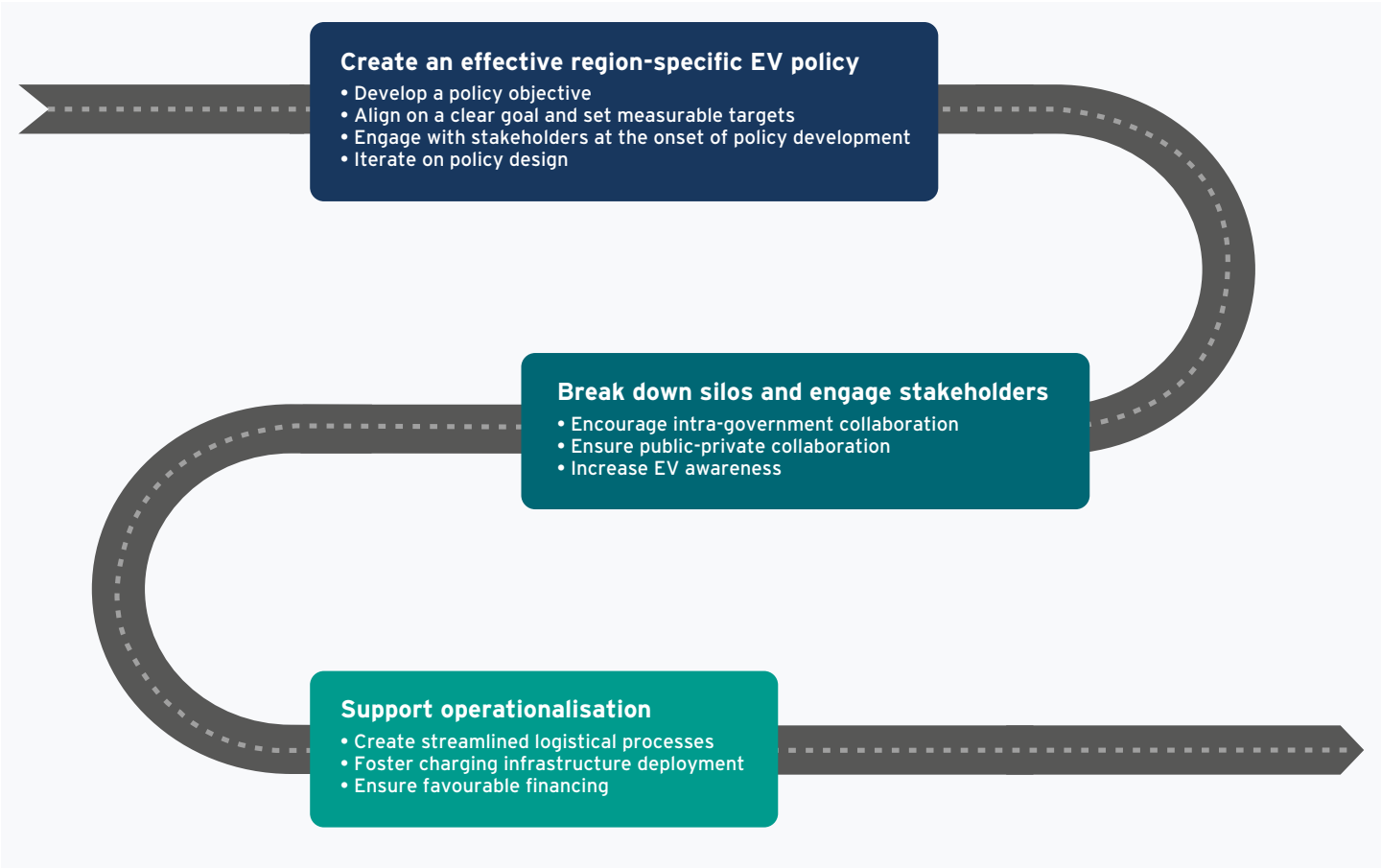
- ***Encourage intra-government collaboration:*** Strong institutional leadership propels initiatives forward. Regulating EVs and facilitating the development of charging infrastructure falls under the remit of many agencies, including the Transport Department, Power Department, Department of Urban Development, and Public Utilities. Effective interagency collaboration was set up during the implementation of incentive schemes and the development of charging infrastructure. This helped create logistical processes, financial mechanisms, and charging deployment schemes.
- ***Ensure public-private collaboration:*** Collaboration across the public and private sectors is the key to getting whole-systems perspective about barriers and challenges with EV adoption. Through pilots like Deliver Electric Delhi as well as platforms like Delhi EV Forum, the Delhi government continuously engaged with the private sector to understand on-the-ground opportunities to craft effective policy and ensure smooth operationalisation.

- ***Increase EV awareness:*** Efforts to educate the public and fleet operators on the economic and environmental benefits of EV adoption will drive demand. The Deliver Electric Delhi pilot showed EVs can meet final-mile delivery demands. The government's Switch Delhi public awareness campaign highlighted the benefits of EV adoption and showcased incentives.

## Support operationalisation

- ***Create streamlined logistical processes:*** Distributing timely subsidies and licenses for EVs and charging stations builds market confidence. Streamlining can reduce processing times, letting EV users receive their demand subsidy in less than one week's time. To create a streamlined process, Delhi developed a single-window method for subsidy disbursements. The government's interactive web portal provides detailed information on vetted EV dealers and certified EV models to make the procurement process smoother.
- ***Foster charging infrastructure deployment:*** Since most EVs rely on public charging in some capacity, a robust infrastructure network is needed. To improve the economic viability of public charging stations, the government established a specific tariff for charging and defraying land costs. Subsidy disbursal schemes were developed for public and private charging infrastructure, and the government worked to empanel DISCOMs to streamline electrical infrastructure upgrades for charging stations.
- ***Ensure favourable financing:*** High interest rates for EVs are a major barrier to EV adoption, despite maturity in technology. Policymakers and financing institutions can take steps to address systemic asset and business model risks associated with EVs to reduce the total cost of ownership.

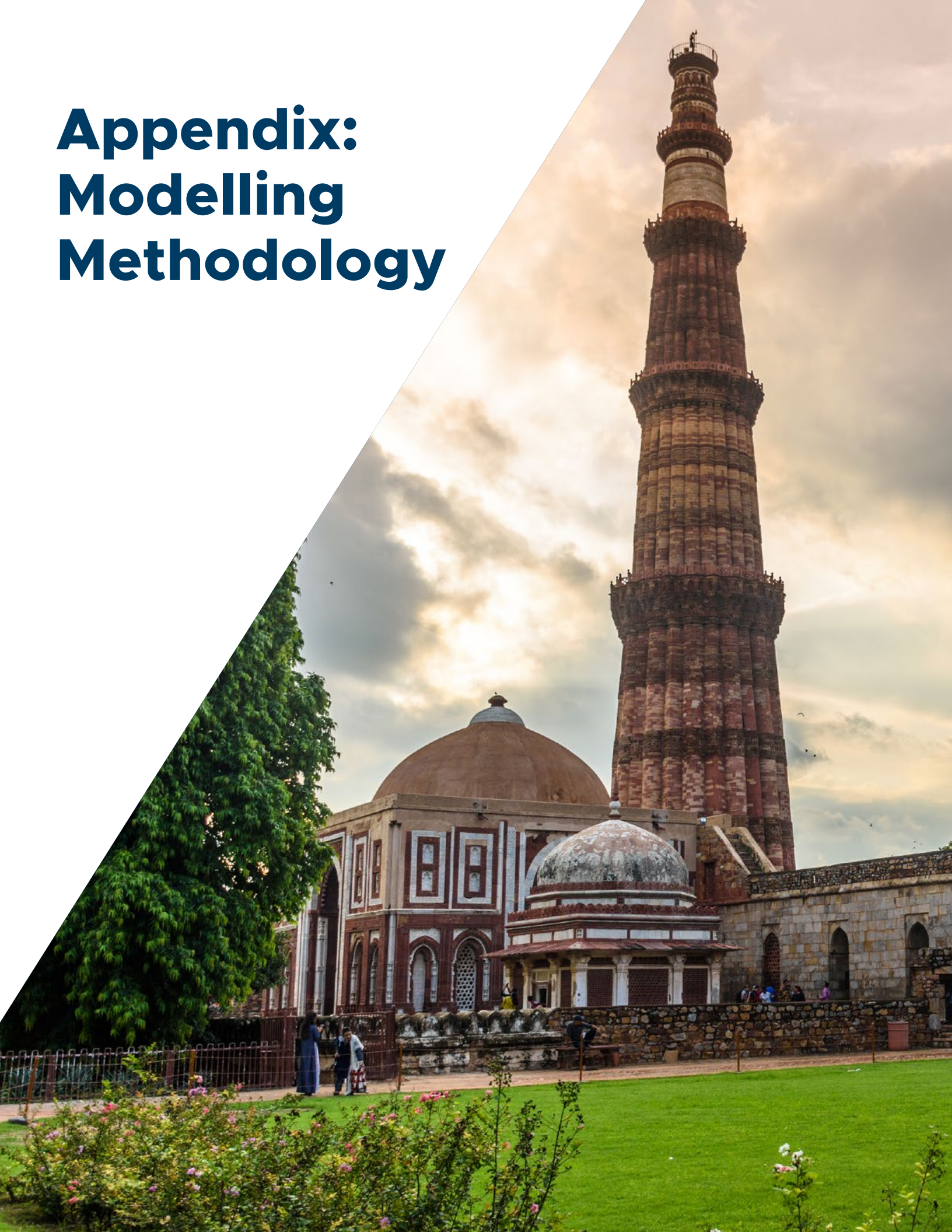
Exhibit 24 **Roadmap for electrifying final-mile delivery vehicles**



Delhi effectively drove EV adoption by creating a supportive EV ecosystem and fostering private-sector leadership. Supportive policies helped seed the nascent market, but private-sector ambition was critical for sustaining EV market growth. For EV adoption to scale effectively, private-sector efforts are needed to complement EV policies and schemes. Logistics providers must adopt ambitious fleet electrification targets and strengthen the secondary EV market by offering vehicle buyback guarantees. OEMs need to invest in their EV manufacturing capacity and provide more robust performance guarantees and longer warrantees to support continued market development. Lenders must continue to improve EV finance opportunities and charging infrastructure providers must develop innovative business models to expand public charging services.

Since the inception of the Deliver Electric Delhi pilot and the Delhi EV policy, the government and its partners have worked to streamline the procurement process, mobilise finance, and strengthen the city's public charging infrastructure network. These partnerships have improved policymaking and business decision-making related to EV adoption. The success of the Deliver Electric Delhi pilot and Delhi EV policy is evidence that coordinated actions among private and public stakeholders can drive EV adoption and help India electrify its transportation sector.

# Appendix: Modelling Methodology



# Appendix: Modelling Methodology

## Emission Reductions Model

Two scenarios were modelled and compared against each other to assess the air pollution reductions, carbon emission reductions, and fuel cost savings that can be sustained from fully electrifying final-mile delivery vehicles. The scenarios focus on electrification of two-, three- and four-wheelers in the final-mile delivery segment. The first scenario modelled was a high electrification scenario, depicting a 100% sale penetration level for final-mile delivery vehicles by 2030. The second scenario depicts a "frozen" use case with zero EV sales penetration growth, and EV adoption rates for final-mile delivery vehicles remaining at 2021 levels – 9.4% of goods-carrying two-wheeler vehicle sales, 16.1% of three-wheeler (L5N) sales, and 0.1% of four-wheeler (N1) sales. The reductions in air pollution and carbon emissions, and the fuel cost savings were derived by calculating the delta between the scenarios year over year.

**Estimating the number of ICE and EV final-mile delivery vehicles in Delhi:** Several input parameters were utilised to model these two scenarios. Firstly, the existing final-mile vehicle stock needed to be estimated. Based on *Road Transportation Yearbook* data, RMI estimates that 4,02,213 final-mile delivery vehicles are in operation in Delhi today. Based on historical research, it is estimated that final-mile delivery vehicle stock will increase 8.8% annually through 2030. By estimating the yearly increase in vehicle stock and assuming a 10-year vehicle life, RMI estimated the number of vehicles sold each year. By multiplying the number of vehicles sold by the EV sales penetration rate under a high electrification scenario and "frozen" scenario, the number of ICE and EVs operating under each scenario were derived.

**Vehicle miles travelled:** Through surveys, RMI was able to gauge how far pilot participants travelled on average and based on this data RMI derived the vehicle kilometres travelled by final-mile delivery vehicles in a year. Using market data and average fuel economy for EVs and ICEs, the model derived the amount of fuel used by each vehicle segment and type.

**PM and $NO_x$ pollution reductions:** RMI calculated the emissions level (g/km) by vehicle segment, comparing petrol two-wheelers to electric two-wheelers and CNG three- and four-wheeler emissions to electric three- and four-wheelers. Using the Bharat Stage VI emission factors for PM and $NO_x$ emissions, the total yearly emission levels of ICE two-, three- and four-wheelers were calculated and compared against EVs which emit zero PM and $NO_x$ emissions at the tailpipe. The high electrification scenario emissions were then measured against the "frozen" scenario emissions to derive PM and $NO_x$ emission reductions from fully electrifying final-mile delivery vehicles.

**Carbon dioxide emission reductions:** To assess $CO_2$ emission reductions, the average emissions from burning a litre of petrol or a kg of CNG were derived from calculating the well-to-wheel emissions of operating ICE vehicles compared with the emissions from generating power to charge EVs. To derive the $CO_2$ of vehicle charging, RMI used Delhi's grid emission factor kg/kWh. Over time, as more renewables come online to meet India's 2030 energy goals, $CO_2$ emissions will decrease. In the high electrification scenario, it was estimated that Delhi's grid emissions would gradually reduce in accordance with the 1.5°C Paris Agreement goal. For the "frozen" scenario, no change was modelled.

## Total Cost of Operations

The table below captures the primary input parameters for deriving the capital and operational costs of EV and ICE final-mile delivery vehicle operations in Delhi:

| Vehicle Specifications | Electric Two-Wheeler | ICE Two-Wheeler | Electric Three-Wheeler | ICE Three-Wheeler | Electric Four-Wheeler | ICE Four-Wheeler |
|---|---|---|---|---|---|---|
| **Ex-showroom price (post-GST) (INR)** | 111,360 | 61,914 | 399,178 | 227,500 | 1,002,796 | 499,500 |
| **Subsidies (INR)** | FAME II: 45,000<br>Delhi: 15,000 | NA | FAME II: 91,140<br>Delhi: 30,000 | NA | FAME II: 1,44,000<br>Delhi: 30,000 | NA |
| **Vehicle life** | 10 years | 10 years | 10 years | 10 years | 10 years | 10 years |
| **Battery cycles** | 2,000 | NA | 2,000 | NA | 2,000 | NA |
| **Battery size (kWh)** | 3 | NA | 8-11 | NA | 14.4 | NA |
| **Average distance travelled in a day (km)** | 100 | 100 | 90 | 90 | 120 | 120 |
| **Interest rate** | 20% | 12% | 25% | 12% | 25% | 12% |
| **Loan-to-value ratio** | 66% | 75% | 66% | 80% | 66% | 80% |
| **Loan tenure** | 2 years | 2 years | 3 years | 3 years | 3 years | 3 years |

***Note:*** *The values listed and modelled represent information obtained through quantitative surveys from Deliver Electric Delhi participants. Marginal variations in TCO exist as costs depend on vehicle utilisation, time of deliveries, and other parameters specific to the vehicle's use case.*

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