



दिल्ली सरकार
आप की सरकार



ACCELERATING DELHI'S MOBILITY TRANSITION

INSIGHTS FROM THE DELHI URBAN MOBILITY LAB





ABOUT THE DIALOGUE AND DEVELOPMENT COMMISSION OF DELHI

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

ABOUT ROCKY MOUNTAIN INSTITUTE

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

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TABLE OF CONTENTS

- ABOUT THIS REPORT**..... 04
- OPPORTUNITY AND NEED**..... 05
- ABOUT THE URBAN MOBILITY LAB AND SOLUTIONS WORKSHOP**..... 09
- DELHI SOLUTIONS WORKSHOP: PROJECTS AND TEAMS**..... 12
- COMBINED TARGETS FOR IMPACT**..... 15
- SYSTEM-LEVEL NEEDS AND OPPORTUNITIES**..... 17
 - > EV coordinating body 19
 - > Single-window clearance 20
 - > Incentives for economic market segments 22
 - > Battery swapping technology 23
 - > Charging and battery swapping infrastructure 24
 - > Reliable and renewable power supply 26
 - > Attractive financing for EVs 27
 - > Ease of EV operations 28
 - > Education, outreach, and capacity building 30
 - > Open mobility data 31
- POTENTIAL ENVIRONMENTAL AND ECONOMIC BENEFITS**..... 34
- THE PATH FORWARD**..... 38
- ENDNOTES**..... 39



ABOUT THIS REPORT

Cities in India are stepping up to build, pilot, and scale urban mobility solutions that are clean, shared, and people-centric. Delhi has a significant role to play in this transition. Most recently, the Delhi government has developed a draft electric vehicle (EV) policy to accelerate EV adoption in Delhi and complement its efforts to address vehicular pollution.

To translate policy action into progress on the ground, the Delhi government, through the Dialogue and Development Commission of Delhi (DDC), and Rocky Mountain Institute (RMI) partnered to host the Urban Mobility Lab—a platform that supports Indian cities in identifying, implementing, and scaling pilot projects and solutions that transform how people and goods move. The Urban Mobility Lab is led by RMI and was announced by NITI Aayog in November 2017.



As part of the Urban Mobility Lab initiative in Delhi, DDC and RMI hosted a Solutions Workshop on 26 and 27 June 2019 to work collaboratively with government and industry leaders to design mobility solutions for implementation. This report is a reflection of

“If we did not have the Urban Mobility Lab, we would not be in a position to bring all these energies together in a very focused manner where the private sector, entrepreneurs, financing companies, and government stakeholders come together to discuss solutions and are now ready to deploy them.”

— Shri Jasmine Shah, Vice Chairperson, DDC

the discussions and work that took place at the workshop. It aims to share experiences, key insights, and lessons learned to support policymaking and the scaling of innovative mobility solutions in Delhi and other Indian cities.

Although the workshop focused on Delhi, public- and private-sector actors across India’s mobility system can take inspiration from these concepts and build on them to accelerate India’s transition to a clean, shared, and people-centric mobility future.

OPPORTUNITY AND NEED

India is undergoing a mobility transition. This transition is most active in cities where rising demand for mobility services is prompting policymakers and business leaders to reimagine how to meet this demand. Mobility solutions are leapfrogging conventional approaches and building on opportunities that have been created by steeply falling technology costs and the emergence of innovative business models.

The current momentum in India's mobility sector is the transition to a mobility future that is "common, connected, convenient, congestion-free, charged, clean, and cutting-edge," which emerged from the Prime Minister Shri Narendra Modi's speech at MOVE, India's first Global Mobility Summit.¹ Building on the principles of clean, shared, and people-centric mobility, India's central and state governments are bolstering this transformation through a number of initiatives. India has heralded the introduction of EVs with the Faster Adoption and Manufacturing of Electric Vehicles (FAME) Schemes I and II. With an outlay of Rs 10,000 crores over the next three years,² FAME II promises to create an electric mobility (e-mobility) ecosystem in India by helping EV-use cases cross their respective thresholds of economic viability. This catalytic effect can initiate mass-market adoption. FAME II and other policy and regulatory reforms from the central government, including the recently launched National Mission on Transformative Mobility and Battery Storage,³ are helping unlock a new mobility future in India.

State governments are building on the central government's initiatives by formulating strategies to transform their mobility systems.⁴ Many states have formulated, or are in the process of formulating, EV policies.⁵ The National Capital Territory (NCT) of Delhi is among the frontrunner states that have called for a rapid move towards a new mobility future.

Delhi has implemented a number of progressive mobility interventions. To address the challenge of pollution from vehicular emissions,⁶ the city transitioned its entire public transport fleet—including buses, taxis, and auto rickshaws—to compressed natural gas (CNG) in the early 2000s. Currently, Delhi has one of the world's largest CNG-propelled bus fleets, which serves nearly 27 percent of the city's trips. The city has also

expanded its metro-rail network to 373 kilometers (km) since its first corridor opened in 2002.⁷ The metro carries nearly 3 million passengers daily, accounting for about 3 percent of the city's trips. Delhi has also experimented with other bold measures, such as its Odd-Even Scheme, to curb pollution.

In its 2018–2019 budget,⁸ the Government of NCT of Delhi introduced its first Green Budget to support long-term initiatives that mitigate rising levels of air pollution.⁹ Delhi's draft EV policy and its plan to adopt electric buses are key initiatives under the government's green budgeting initiative. Box 2 provides an overview of some of Delhi's key mobility policy initiatives that aim to transform the way people and goods move in the national capital.



BOX 1

Quick facts about Delhi's mobility system¹⁰



- Land area: 1,483 km²
- Population size of Delhi: 18.6 million
- Annual income per capita: Rs 3.7 lakh
- Mode share:
 - 35% Walking
 - 27% Bus
 - 15% Two-wheeler
 - 9% Car and taxi
 - 5% Cycle rickshaws
 - 4% Cycling
 - 3% Metro
 - 2% Auto rickshaws
- Total road length in Delhi: 28,508 km (including 388 km of national highway)
- Total registered vehicles in Delhi: 11 million
 - Registered cars: 3.3 million
 - Registered two-wheelers: 7.1 million
- Car ownership per 1,000 population: 180
- Two-wheeler ownership per 1,000 population: 260
- Total service length of Delhi metro: 343.36 km
 - Average daily ridership: 2.54 million
- Total bus fleet size: 5,576 buses
 - Delhi Transport Corporation (DTC) operated: 3,897 buses
 - Cluster buses: 1,679
 - Average daily ridership: 4.3 million

BOX 2

Delhi's mobility policies

OVERVIEW OF SELECT MOBILITY POLICIES IN DELHI	
Delhi Master Plan 2021	The Master Plan lays out two key goals for Delhi's mobility system: (1) have public transport constitute 80 percent of motorized trips by 2021, and (2) reduce vehicular emissions to meet the national ambient air-quality standard. The Master Plan has a vision for "a sustainable urban transport system for the city that is equitable, safe, comfortable, affordable, energy efficient, and environment friendly." ¹¹
Draft Delhi EV Policy	To support the objective of improving Delhi's air quality, the draft EV policy sets an ambitious target for Battery Electric Vehicles (BEVs) to make up 25 percent of new vehicle registrations by 2023. The policy takes a comprehensive, system-level approach to vehicle electrification and offers fiscal and non-fiscal incentives to promote EV adoption in the city. ¹²
Initiatives to procure electric buses	As part of its green budgeting initiative and efforts to reduce vehicular pollution, Delhi has initiated action to procure 1,000 fully electric buses. ¹³ Delhi's draft EV policy also highlights the "target of making 50 percent of the public transport bus fleet zero-emission by 2023". ¹⁴ Agencies like the Delhi Metro Rail Corporation have also initiated actions to procure electric feeder buses for first- and last-mile solutions for Delhi metro passengers.
Maintenance and Management of Parking Rules (Draft)	The draft Maintenance and Management of Parking Rules propose stringent measures to address the city's growing parking challenges. The rules indicate the need for municipal corporations and other government bodies to develop and implement their own area-based parking plans. The rules empower the Delhi Traffic Police and Transport Department to address violations and make special recommendations for EV parking (e.g., preferential provisions for overnight parking for charging electric rickshaws [e-rickshaws] and other EVs). ¹⁵
Non-motorized transport (NMT) initiatives	Delhi has undertaken several policy initiatives to promote non-motorized modes of transport (i.e., walking and cycling). It has prepared the <i>Draft Policy for Enhancing Walkability in Delhi</i> , which aims to offer a framework for transforming Delhi into a pedestrian-friendly city. <i>The Street Design Guidelines</i> and the <i>Draft Transit-oriented Development (TOD) Policy and Implementation Framework</i> aim to enhance the experience and safety of pedestrians and cyclists. The city has also initiated Public Cycle Sharing Schemes, which aim to provide short-distance and first- and last-mile commuter solutions. ¹⁶

Studies indicate that vehicle tailpipe emissions constitute nearly 30 percent of particulate pollution in Delhi. In a city with the highest number of registered vehicles in the country (more than 10 million) that is adding more than 2,000 vehicles every day,¹⁷ reducing vehicular emissions is a priority. The initiatives outlined in Box 2 and other interventions are supporting the development of an accessible, efficient, and clean mobility system for Delhi's citizens. Delhi's draft EV policy aims to address the increasing levels of pollution in Delhi by promoting vehicle electrification. The draft policy suggests interventions to support the electrification of two-wheelers, auto rickshaws, goods carriers, and buses. It commits to an ambitious target of a 25 percent share of BEVs in new vehicle registrations by 2023. Realizing this target will require several pilot initiatives that can help kick start this transition.

The Delhi Urban Mobility Lab is a platform that helps develop such pilot projects and supports their implementation. By offering stakeholder support and addressing system-level barriers to regulatory frameworks and infrastructure availability, the Delhi Urban Mobility Lab can support Delhi's transition to e-mobility and its broader mobility goals. The pilot projects launched through the Urban Mobility Lab in Delhi can serve as early examples and enablers of electrification—establishing markets for vehicle Original Equipment Manufacturers (OEMs), seeding charging and battery swapping networks, and enhancing awareness.



ABOUT THE URBAN MOBILITY LAB AND SOLUTIONS WORKSHOP

“The Urban Mobility Lab is a platform where we bring together government and private players to collaborate and help advance mobility solutions that have the hope of transforming the lives of citizens in the city.”

– Akshima Ghate, Principal, Rocky Mountain Institute

The Urban Mobility Lab is a platform that partners with Indian cities to identify, integrate, and implement mobility solutions that transform how people and goods move. Rocky Mountain Institute (RMI) and NITI Aayog jointly developed the concept of Lighthouse Cities—early leading geographies for testing new mobility solutions—in *India Leaps Ahead*. The Urban Mobility Lab was created in November 2017 to support the development of Lighthouse Cities. It facilitates the development of transformative mobility solutions in cities by offering support for policymaking and pilot projects. RMI leads the Urban Mobility Lab and works

with central, state, and city government partners to implement the program.

Delhi and Pune are the first two host cities for the Urban Mobility Lab. The Dialogue and Development Commission of Delhi (DDC) and the Pune Municipal Corporation (PMC) are RMI’s partners in each city. For each city, RMI and its partner conduct a process (see Figure 1) to support the identification, integration, and implementation of mobility solutions. This process includes an assessment of the city’s mobility needs, the identification and shortlisting of providers that can offer solutions to meet those needs, workshops to support the development of pilot projects and supporting policies, and follow-up support and documentation. You can read more about this process and the history of the Urban Mobility Lab in *Transforming Mobility in Indian Cities: Insights from India’s First Urban Mobility Lab in Pune*.¹⁸



Delegates, DDC, and RMI at the Delhi Urban Mobility Lab’s Solutions Workshop on 27 June 2019

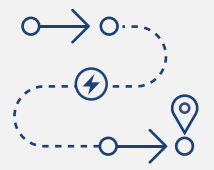
FIGURE 1

The Urban Mobility Lab process


	CITY NEEDS ASSESSMENT	SOLUTION IDENTIFICATION	SOLUTIONS WORKSHOP	IMPLEMENTATION SUPPORT
Overview	Identify needs and opportunities in the city's mobility system	Shortlist potential solutions providers to meet the city's needs	Co-develop mobility solutions with the city during a facilitated workshop	Support the public and private sectors in implementing solutions from the workshop
Activities	<ul style="list-style-type: none"> Review existing plans, policies, and projects Interview key stakeholders Document the findings for the city 	<ul style="list-style-type: none"> Identify solutions providers to meet city's needs Shortlist finalists Invite and prepare solutions providers for the workshop 	<ul style="list-style-type: none"> Develop a custom workshop agenda Host a multi-day workshop Host facilitated discussions with participants 	<ul style="list-style-type: none"> Coordinate between the city and the solutions providers Offer guidance on implementation Collect and share lessons learned

In Delhi, the needs assessment process led to the identification and prioritization of the following thematic areas for the Delhi Urban Mobility Lab:


Passenger




ELECTRIC FIRST- AND LAST-MILE CONNECTIVITY



SHARED E-MOBILITY




NON-MOTORIZED TRANSPORT



MOBILITY DATA SOLUTIONS

Freight



ELECTRIFICATION OF FINAL-MILE DELIVERIES

The Delhi Urban Mobility Lab identified and shortlisted solution providers to develop appropriate pilot projects within these priority themes. On 26 and 27 June 2019, a two-day Solutions Workshop provided an open forum for government and industry stakeholders to discuss action plans for and address barriers related to the selected pilot projects. The objectives of the Solutions Workshop were to build shared understanding and alignment, advance pilot projects to test new mobility solutions on the ground, and generate insights to inform state and national policy frameworks.

For each city, the Solutions Workshop uses a collaborative approach to work towards achieving these objectives. The process involves four key components:

> **Solution development:** Project teams and working groups advance their solutions from ideas to implementable projects through a carefully designed, facilitated process.

> **Coaching and feedback through coaching clinics:** City- and state-level public agencies and industry experts provide coaching and feedback to the solution providers on how to make their solutions relevant to the city's needs and how to address the barriers and challenges expected during implementation.

> **Peer-to-peer learning and collaboration through integration clinics:** Project teams and working groups engage with each other to identify system-level barriers that can benefit from collaborative action and explore integration potential.

> **Vision setting:** Policymakers at the state and central levels of government provide a vision and a call for action for transformative mobility solutions that can accelerate the deployment of clean, shared, and people-centric mobility solutions for Delhi.

Photos from the Urban Mobility Lab Delhi Event June 2019







DELHI SOLUTIONS WORKSHOP: PROJECTS AND TEAMS




The projects selected for the Delhi Urban Mobility Lab focus on the themes that were prioritized through the city needs assessment process. For the passenger segment, nearly 50 applicants from across India applied to participate and 9 were shortlisted for the



Solutions Workshop. For the freight segment, DDC and RMI convened a multistakeholder working group to detail a pilot on the electrification of final-mile delivery vehicles in Delhi.

DESCRIPTIONS OF PASSENGER MOBILITY PROJECT TEAMS

 <p>ENERGY EFFICIENCY SERVICES LIMITED A JV of PSUs under the Ministry of Power</p>	<p>EESL aims to convert the existing internal combustion engine (ICE) fleet of the Delhi government to EVs through its project. They aim to start with 500 EVs and increase it to 1,000. Gradually, they want to enable the uptake of electric cars by private consumers. They also aim to set up 250 public charging stations across Delhi. These stations would be installed as per the Ministry of Power, Government of India guidelines. They are also tying up with fleet operators, aggregators, and OEMs for increasing the utilization of these chargers.</p>
	<p>Ezy Mov Solutions is India's first wheelchair-accessible taxi company and allows people to "Travel with Dignity." Their purpose is to make wheelchair taxis an essential transport service for people with limited mobility. With their specially modified cars and sensitized drivers, their mission is to improve the quality of life of millions of people across India and bring them into the mainstream.</p>
	<p>The IIIT-Delhi team is creating an information architecture for public transit. They aim to build "an Android app (Chartr)" that helps users get from point A to B using public transportation (i.e., buses and metros) and commercial vehicles, like e-rickshaws and feeder buses for last-mile connectivity. To build this app, the team will be working on a few projects to strengthen the backend of data and information that they acquire from transportation agencies.</p>
	<p>Lithium Urban Technologies intends to provide employee transportation services to IT companies and install associated charging infrastructure in private and public locations. Lithium's business model helps replace privately owned ICE commuting vehicles with shared electric vehicles. They intend to deploy 500 electric cars and 50 buses in NCR in the next six months. Lithium has already signed contracts with major real-estate providers in the NCR area, which will allow charging infrastructure at IT parks across the NCR. It will also allow private vehicles to use the charging facilities on a pay-as-you-go model.</p>

DESCRIPTIONS OF PASSENGER MOBILITY PROJECT TEAMS

	<p>Ola Electric Mobility Pvt. Ltd. was established in 2019 with a mission to work with vehicle and battery manufacturers, cities, driver partners, and the mobility ecosystem to make e-mobility convenient, reliable, and affordable. In line with this mission, they plan to deploy a fleet of e- rickshaws in Delhi to help create a reliable, efficient, and clean mode of first- and last-mile connectivity that complements the existing public transportation network and contributes towards increased ridership of these networks.</p>
	<p>SmartE is working with the Delhi Metro to deploy more than 10,000 electric three-wheelers across the entire Metro Network to provide seamless, economical, and electric last-mile connectivity services with an aim to serve more than a million commuters every day. SmartE is also working to create sustainable livelihood opportunities for more than 15,000 people in Delhi. Through its last-mile connectivity services, it aims to also work with the government to fight the battle against pollution.</p>
	<p>SUN Mobility is a global leader in providing energy infrastructure and services to the transportation sector that are faster, cheaper, and more convenient. Piaggio is a leading three-wheeler manufacturer in India, with a dominant market share in cargo and more than 25 percent market share in passenger segment. SUN Mobility and Piaggio have come together to integrate their respective technologies to create a sustainable electric three-wheeler-based mobility solution for intermediate public transportation. The two companies plan to jointly deploy a fleet of Piaggio's efficient electric three-wheelers powered by SUN Mobility's energy infrastructure (Smart Battery™, Quick Interchange Station™, and Smart Network) in Delhi for last-mile connectivity services.</p>

	<p>VA-YU is an on-demand, app-based, electric scooter rental service for first and last-mile connectivity. They plan to offer high-speed scooters for public use through the VA-YU app at Rs 1 per minute. The users will be able to ride for unlimited duration and distance aided by their battery-swapping option. The service will be available shortly in Delhi from metro stations and at other high-footfall areas.</p>
	<p>YULU is providing shared, smart, and sustainable micromobility services for first- and last-mile connectivity for urban commuters via bicycles and lightweight electric bikes (called electric-NMV) powered by state-of-the-art internet of things (IOT) technology.</p>

WORKING GROUP ON ELECTRIFICATION OF FINAL-MILE DELIVERY VEHICLES

<p>Vehicle Manufacturers</p>	<p>Altigreen Propulsion Labs, Euler Motors Private Limited, Evy Mobility Private Limited, Hero Electric, Jitendra New EV Tech Private Limited, Li-ions Elektrik Solutions Private Limited, Mahindra Electric, Onn bikes, Shigan Evoltz Limited, Tata Motors Limited, Tork Motors, VA-YU</p>
<p>Charging and Swapping Station Providers</p>	<p>Charge-Zone, Delta Group, Magenta Power Private Limited, Sun Mobility</p>
<p>E-commerce Companies & Logistics Providers</p>	<p>Amplus Solar, Areon, Bigbasket, Blue Dart Express Limited, DOT, efleet Logix, Flipkart Private Limited, Gati Limited, Grofers, Uber Eats, Zomato</p>
<p>Distribution Companies (DISCOMs)</p>	<p>BSES Rajdhani Power Limited, BSES Yamuna Power, Tata Power Limited</p>

Note: Not all potential pilot participants attended the Solutions Workshop in Delhi. RMI is in the process of finalizing participation of companies in the pilot.

Following the Solutions Workshop, DDC and RMI are continuing to work together to further develop projects, support government agencies and project teams where appropriate, and track and share progress and lessons learned.

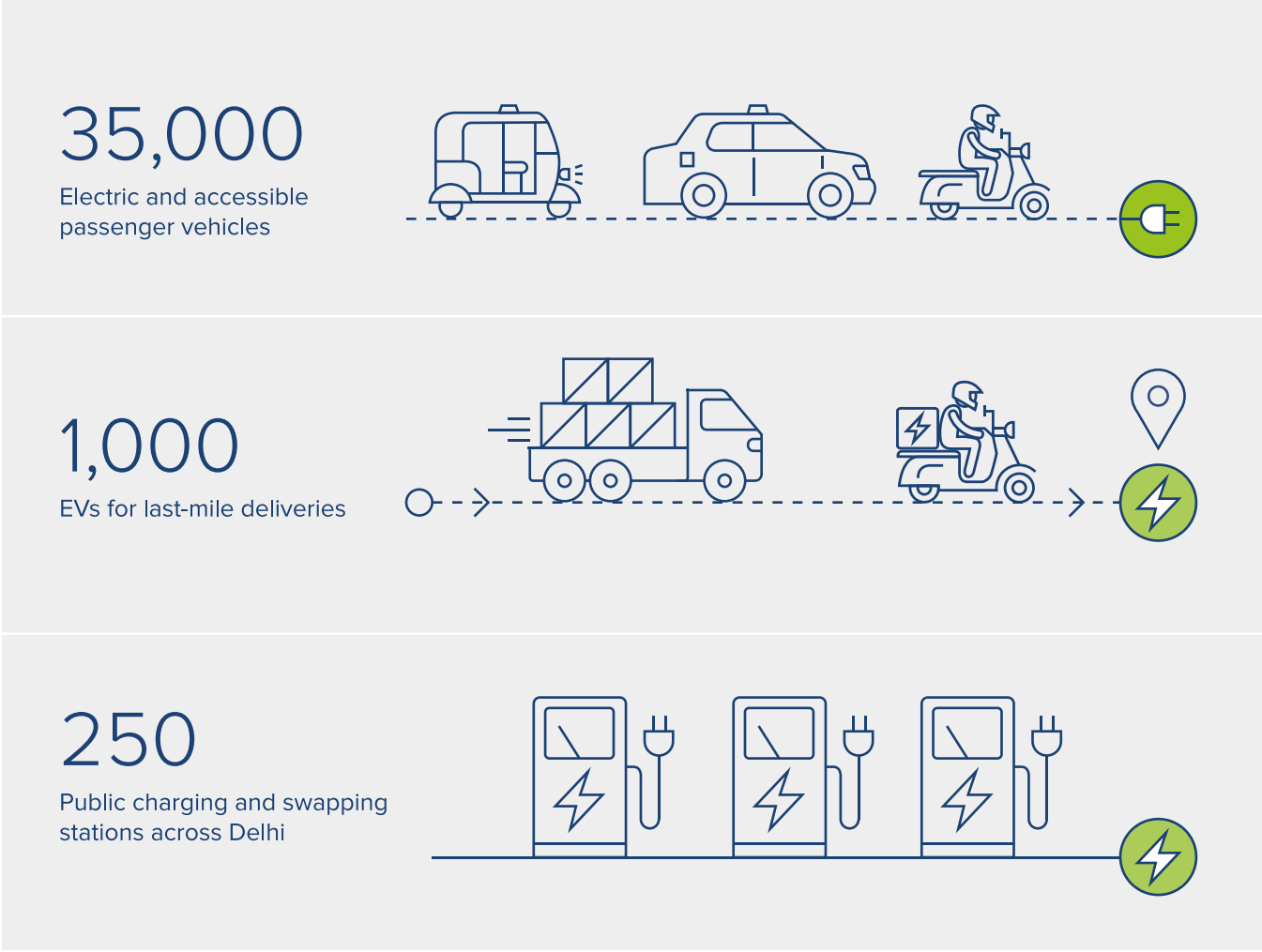
COMBINED TARGETS FOR IMPACT

The solution providers that participated in the Delhi Urban Mobility Lab shared ambitious goals for deploying clean, shared, and people-centric mobility solutions in Delhi. Adding up their goals provides a compelling case for the trajectory of Delhi’s mobility transition. In the next year, the participants intend to deploy nearly 35,000 electric and accessible passenger vehicles, at least 1,000 EVs for last-mile deliveries, and several hundred public charging and swapping stations across Delhi.

The participants aim to provide new products and services for a range of vehicle segments and use cases. They also aim to kick-start the development of Delhi’s public charging network. In addition to

vehicles and hardware, other goals include getting thousands of users onto digital ride-hailing and data-sharing platforms and ensuring that information related to routing, booking, and payment are accessible in multiple formats.

These figures are a sample from a larger ecosystem that has bold plans for Delhi’s mobility system. Turning each goal into a reality will require support from policymakers, industry leaders, and civil society. By working together to test and scale such solutions, these actors can accelerate Delhi’s efforts to provide cleaner air, more accessible transport, and new economic opportunities to its citizens.



BOX 3

Deliver Electric Delhi

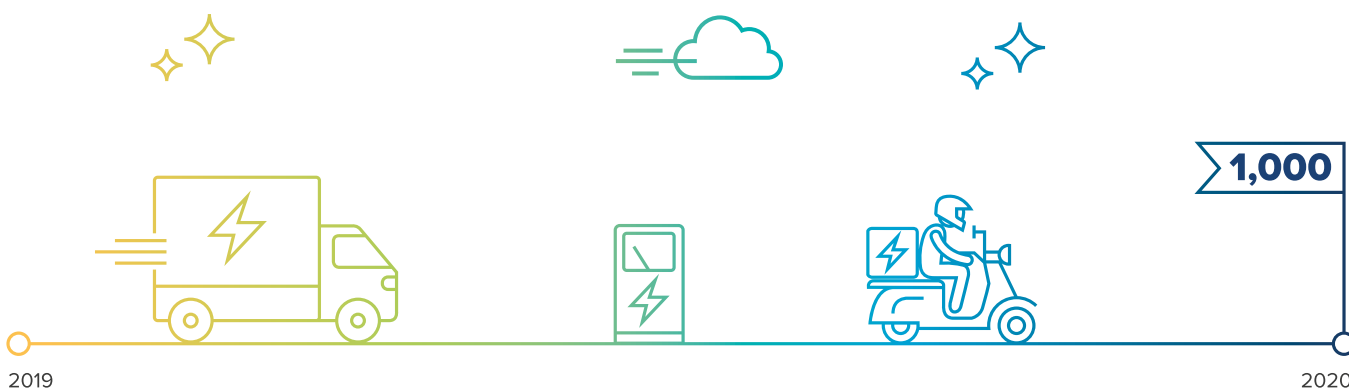
DELIVER ELECTRIC DELHI: A MULTISTAKEHOLDER PILOT TO ELECTRIFY FINAL-MILE GOODS DELIVERY VEHICLES IN DELHI

Delhi government and RMI are jointly developing a pilot project on the electrification of final-mile delivery vehicles in Delhi. The electrification of goods-carrier vehicles used for short-haul deliveries is one of the key focus areas of the draft Delhi EV policy. A designed and documented pilot has the potential to inform policymaking and infrastructure design process in Delhi and support the private sector in maximizing the value of their EV operations, creating a replicable model for other cities.

There are five phases of freight pilot development and implementation:

- **Phase 1:** Stakeholder outreach. Understand the current state of urban-freight movement and the stakeholder ecosystem in Delhi and identify potential partners for the pilot.
- **Phase 2:** Pilot design. Finalize the specifications of the pilot by working with the public and private sectors. On 1 May 2019, RMI and DDC hosted a stakeholder roundtable discussion to initiate the pilot design process.
- **Phase 3:** Pilot detailing at the Solutions Workshop. Pilot was announced at the Delhi Urban Mobility Lab's Solutions Workshop on 26 and 27 June 2019. The working sessions addressed key issues related to pilot rollout and finalized several pilot details, including the data collection strategy.
- **Phase 4:** Pilot execution. Implement the roadmap for vehicle deployment. For the following year, DDC and RMI will coordinate with the public and private sectors to launch vehicles, collect data on vehicle operation, troubleshoot, and track progress.
- **Phase 5:** Pilot documentation. Research products on the pilot will include data analysis and program evaluation, a report on findings and lessons learned, and a roadmap of final-mile delivery electrification for Indian cities.

The urban freight pilot aims to support the launch of 1,000 electric delivery vehicles in Delhi by January 2020.



SYSTEM-LEVEL NEEDS AND OPPORTUNITIES

Mobility leaders from government and industry participated in the 26 and 27 June 2019 workshop that the Urban Mobility Lab hosted in Delhi. Electric and urban mobility were focal points of the event. The diversity of participation and timing of the workshop created an opportunity to take the pulse of India's mobility ecosystem at an important moment in the transition to a clean, shared, and people-centric mobility future.

Through two days of generative dialogue, industry participants expressed a variety of needs, insights, and potential solutions to support the mobility transition in Delhi and beyond. The following 10 system-level needs and proposed solutions were identified and elaborated at the workshop. Each one represents an opportunity to amplify Delhi's initiatives in electric and urban mobility.

Although the workshop focused on Delhi and the proposed solutions are specific to the city, the needs and insights are relevant to other states and cities. Public- and private-sector actors across India's mobility system can take inspiration from these concepts and build on them. By addressing the 10 opportunities discussed below, states and cities can enhance their efforts to achieve their ambitious mobility goals.

"As the capital city of potentially the second-largest metropolitan area in the world, Delhi sends a signal to others. It sends a signal to other cities, it sends a signal to other states in India, and it sends a signal to other nations."

—Clay Stranger, Principal, Rocky Mountain Institute



TABLE 1

Summary table of proposed solutions by category

CATEGORY	PROPOSED SOLUTIONS
EV coordinating body	Greater coordination across government agencies in support of EV-related policymaking, permissions, and enforcement
Single-window clearance	Clearer, simpler processes for both registering and permitting EVs, and commissioning charging and battery swapping infrastructure
Incentives for economic market segments	Pursue opportunities to incentivize the electrification of economic market segments
Battery swapping technology	A technology-agnostic approach to registering and incentivizing EV products
Charging and battery swapping infrastructure	An optimally sized public charging network to meet the needs of EV operators
Reliable and renewable power supply	Reliable and renewable vehicle charging power supply
Attractive financing for EVs	More attractive financing options for EVs
Ease of EV operations	Preferential treatment and easier visibility for registered EVs
Education, outreach, and capacity building	Greater awareness of EVs and their environmental and economic benefits
Open mobility data	Greater understanding of transport demand, modal integration, and traffic patterns

EV COORDINATING BODY



Greater coordination across government agencies in support of EV-related policymaking, permissions, and enforcement

Context:

Successful implementation of new mobility solutions, including the deployment of new vehicle technologies, requires intra- and inter-governmental collaboration among agencies that are responsible for mobility planning, vehicle registration and permissions, implementation, and enforcement. Institutional frameworks can increase coordination and collaboration to support the faster adoption of new mobility solutions.

PROPOSED SOLUTION(S) FOR DELHI

1. Create an EV Cell within the Delhi government to centralize and coordinate all EV-related activities for passenger and freight transport

Suggested actions to create the EV Cell:

- Convene a meeting of all relevant stakeholders with an objective of developing a governance structure, operational guidelines, and execution strategy to create the EV Cell.

Suggested role and tasks of the EV Cell:

- The EV Cell could be tasked with and empowered to take on the following activities:
 - Clearly outline and standardize all registration, permission, and operating requirements and processes for EVs for each vehicle segment, including timelines for approvals.
 - Design and develop integrated policies, regulations, and plans to promote e-mobility initiatives.
 - Design and develop procurement standards, processes for aggregation of commercial vehicles, and strategies for charging infrastructure deployment.
 - Develop standardized processes for companies to lease public land to install charging and battery swapping infrastructure.
 - Disperse fiscal incentives as detailed in the draft EV policy.
 - Guide processes for standardizing, centralizing, and digitizing all processes and documents.
 - Provide oversight functions to ensure that government agencies are appropriately administering central, state, and city EV policies and regulations.
 - Create communication strategies and engagement opportunities to raise awareness about EVs.
- The EV Cell could also coordinate with relevant government agencies to establish clarity on the legal nature of the following points:
 - Registering vehicles without fixed batteries (i.e., vehicles with swappable battery systems)

- Requirements for contract carriage permits and availability of subsidy for electric buses operating in business-to-business (B2B) models
- Commercially operating two-wheelers for passenger and freight applications
- Registering vehicles operating in multiple modes (i.e., private and commercial, passenger and freight, etc.)

WHO IS INVOLVED

Government agencies

- EV policymaking bodies
- Urban local bodies with mobility and land management directives
- Electricity regulators
- Public transit providers
- Vehicle registration, permitting, and enforcement agencies

Industry

- Charging and battery swapping infrastructure providers

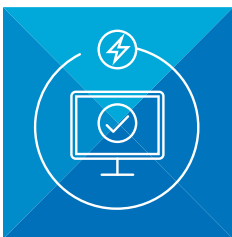
- Mobility solution providers, including fleet aggregators, ride-hailing companies, etc.

- Vehicle OEMs

Other

- DISCOMs
- Academic institutions and mobility-focused non-governmental organizations (NGOs)
- Auto rickshaw unions

SINGLE-WINDOW CLEARANCE



Clearer, simpler processes for both registering and permitting EVs, and commissioning charging and battery swapping infrastructure

Context:

Simplifying registration and approval processes can increase the ease of doing business for individuals and firms aiming to both own and operate EVs and commission and operate charging and battery swapping infrastructure. It also has the potential to reduce the administrative burden of various government agencies.

PROPOSED SOLUTION(S) FOR DELHI

1. Work with Transport Department, Power Department, DISCOMs and other relevant agencies to create a single-window clearance system for both EV registration and approvals and EV charging and battery swapping infrastructure approvals. The system should enable the submission of all required information at a single location or to a single nodal authority.

PROPOSED SOLUTION(S) FOR DELHI

Suggested actions to create the EV Cell:

- Convene a meeting of all relevant stakeholders to develop a governance structure, operational guidelines, and implementation strategy for single-window clearance systems for (1) EV registration and other permissions and (2) EV charging and battery swapping infrastructure approval.
- Discuss appropriate time bounds for vehicle registration and approval processes for charging and battery swapping infrastructure deployment. The private sector is keen to see vehicle registration approvals within 48–72 hours of submitting the required information to the approving agency.
- Identify opportunities to make amendments to policies and guidelines that determine timelines for establishing new power connections for EV charging and battery swapping infrastructure. The private sector is keen to see power connections established within two months; eight months is the current standard in the Delhi Electricity Regulatory Commission (DERC) guidelines.

2. Standardize, centralize, and digitize all processes and documents for greater efficiency.

- Shift to digital formats for processes, documents, and payment where possible to consolidate information in one place and make for easier submission and more efficient approval. The entities responsible for EV registration and EV charging and battery swapping infrastructure approval could host instructions, required forms, and an electronic document submission portal online.

WHO IS INVOLVED

Government agencies

- EV policymaking bodies
- Urban local bodies with mobility and land management directives
- Electricity regulators
- Vehicle registration, permitting, and enforcement agencies

Industry

- Charging and battery swapping infrastructure providers
- Mobility service providers, including fleet aggregators, ride-hailing companies, etc.

Other

- DISCOMs
- Information technology agencies

INCENTIVES FOR ECONOMIC MARKET SEGMENTS



Pursue opportunities to incentivize the electrification of economic market segments

Context:

Light duty four-wheelers are an important vehicle segment in urban parcel delivery. As is the case with two- and three-wheelers, the four-wheel segment would benefit from subsidies to get closer to cost parity with ICEs. By electrifying two-, three-, and light-duty four-wheelers, a larger portion of the urban freight ecosystem can become electric sooner.

PROPOSED SOLUTION(S) FOR DELHI

1. Extend similar incentives to electric four-wheel light-duty goods carrier vehicles.

- Offer incentives to electric four-wheel light-duty goods carriers that are similar to those that the 2018 draft Delhi EV policy offers to electric three-wheel goods carriers. These incentives include purchase incentives; road tax, registration fee, and one-time parking fee waivers for eligible e-carriers; and exemptions from parking and entry restrictions during specific hours.

2. Explore opportunities to incentivize other market segments and use cases as their economics improve over time.

WHO IS INVOLVED

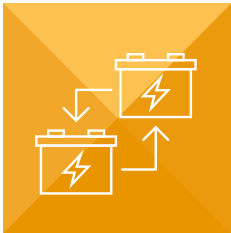
Government agencies

- EV policymaking bodies
- Vehicle registration, permitting, and enforcement agencies

Industry

- E-commerce companies
- Logistics providers
- Vehicle OEMs

BATTERY SWAPPING TECHNOLOGY



A technology-agnostic approach to registering and incentivizing EV products

Context:

Many EV policies and regulations do not yet have specific provisions for battery swapping technology. This lack of clarity can lead to challenges with vehicle registration and other requirements. To support vehicle electrification, a range of technologies would benefit from testing and learning. A clear definition, equitable incentives, technology-specific registration requirements, and other processes should be established for each vehicle technology that meets a state or city's desired performance characteristics and is in line with its e-mobility vision.

PROPOSED SOLUTION(S) FOR DELHI

- 1. Establish clear definitions and requirements for battery swapping technology. Make registration and incentives available for EVs with fixed and swappable batteries, as well as charging and battery swapping infrastructure.**
 - Consult stakeholders who are working to deploy battery swapping vehicles in Delhi to understand the most pressing implementation challenges that they are facing.
 - Based on input from such a stakeholder consultation, host a multistakeholder convening to develop definitions, processes, and strategies around each of the challenges. From the Delhi Urban Mobility Lab, some challenges and recommendations may include:
 - An unclear definition for battery swapping technology. According to participants, FAME II lacks a clear definition for a vehicle that uses swappable batteries. What constitutes a vehicle that employs battery swapping technology should be defined in policy.
 - Inequitable incentives for different EV technologies and a lack of clarity on which incentives are applicable for battery swapping vehicles. Clear incentive packages for battery swapping vehicles that are similar to those currently available for other technologies should be considered.
 - A common process for registering battery swapping vehicles that adheres to central government guidelines and state policy. Various agencies seem to have different interpretations and applications of existing notifications and policies.

WHO IS INVOLVED

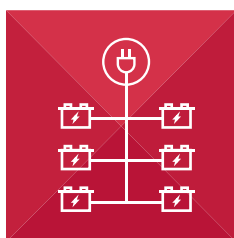
Government agencies

- EV policymaking bodies
- Vehicle registration, permitting, and enforcement agencies

Industry

- Battery manufacturers
- Battery swapping infrastructure providers
- Vehicle OEMs with battery swapping vehicles

CHARGING AND BATTERY SWAPPING INFRASTRUCTURE



An optimally sized public charging network to meet the needs of EV operators

Context:

Access to charging and battery swapping infrastructure is a key driver of EV adoption. Potential EV operators and charging infrastructure providers are experiencing challenges associated with a lack of charging and battery swapping infrastructure due to limited public land availability, long timelines for power connections, and a lack of standards. Cities have important roles to play in supporting the buildout of public charging networks that enable EV operators to conveniently charge their vehicles. An optimally sized network of public charging and battery swapping infrastructure should be adequate in quantity and spatial distribution. A city should design its network to provide a least-cost investment approach to support the expected vehicle fleet and its duty cycles.

PROPOSED SOLUTION(S) FOR DELHI

1. Provide greater access to affordable land for charging and battery swapping infrastructure.

- Create a favorable regulatory landscape, appropriate guidance and incentives for ownership and operation, and potentially a set of pilot projects to learn how best to build charging and battery swapping network.
- Provide EV charging and battery swapping service providers with greater access to affordable land. One strategy for doing so is to work with industry to identify mutually beneficial public locations for which the government can offer discounted land rentals.

2. Outline technical standards for charging and battery swapping infrastructure.

- The Ministry of Power's guidelines suggest that all charging stations in India should use three charging standards: the Indian Bharat, the European Combined Charging System (CCS), and the Japanese CHAdeMO. Currently the Bharat standard is most economical due to its lower upfront cost and higher

PROPOSED SOLUTION(S) FOR DELHI

market share; because of its lower voltage, it serves two- and three-wheelers, which make up the majority of EVs in India.

- Delhi government should provide clarity on technical standards for charging and battery swapping infrastructure that it will support under its EV policy. It should also finalize and notify the infrastructure siting conditions and standards.

WHO IS INVOLVED

Government agencies

- EV policymaking bodies
- Charging infrastructure nodal agencies
- Urban local bodies with land management directives
- Public transport hubs

Industry

- Charging and battery swapping service providers
- Vehicle OEMs

Other

- DISCOMs

CASE STUDY

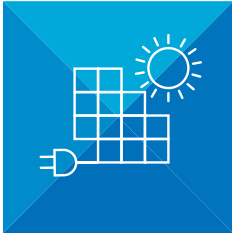
Charging and battery swapping infrastructure requirements

- The European Commission completed a study in 2016 on siting EV charging infrastructure, in which it identified population density, power grid net costs, and parking areas, public transport hubs, and commercial real-estate properties as relevant locational criteria. According to the model, 8 million Level-2 (L2) chargers would be required to charge 4 million EVs. Of the 8 million, 10 percent were public charging stations and the rest were home charging stations. The forecast for L2 public charging stations is similar to US estimates (i.e., 100 L2 public chargers per 1,000 EVs), in addition to 130 DC fast chargers.¹⁹

2018 draft Delhi EV Policy²⁰

- Infrastructure siting
 - Section 4.2.1 and 4.2.2 of the 2018 draft Delhi EV policy outlines a plan for “accessible public charging facilities within 3 km travel from anywhere in Delhi” and “concessional charging stations” in “existing public parking zones, bus depots and terminals, metro stations and other GNCTD identified locations such that they offer easy entry and exit.”
- Infrastructure standards
 - Section 4.2.1 of the 2018 draft Delhi EV policy defines the specifications for public charging infrastructure as “the existing BEVC-AC001 and DC001 specifications notified by the Government of India and any subsequent changes thereon.”

RELIABLE AND RENEWABLE POWER SUPPLY



Reliable and renewable vehicle charging power supply

Context:

Although EVs may create a significant load for the power grid, they represent a near-term opportunity for renewable energy integration and a long-term opportunity for interactive grid services. Integrated planning with the power sector will be required to ensure that new loads can be served with electricity from renewable sources and charging services, including fast charging, can be accommodated without creating system failures.

PROPOSED SOLUTION(S) FOR DELHI

- Establish a working group to ensure that system-level planning in the power sector is proactively planned for a greater uptake of EVs.
- Conduct a comprehensive study to understand the ability of the electricity sector's distribution infrastructure to serve current and future EV generated loads, including slow and fast charging and battery swapping. In the analysis:
 - Identify necessary network upgrades and opportunities to minimize the required investment while ensuring that infrastructure can serve demand.
 - Explore smart charging opportunities, such as peak shaving, load shifting, and demand response through time-of-use pricing to minimize infrastructure investments.
 - Evaluate utility business models that can help offset the cost of infrastructure upgrades.
- Consider developing incentives for DISCOMs to help offset infrastructure upgrade costs.

WHO IS INVOLVED

Government agencies

- Transmission and distribution planning and oversight agencies
- Electricity regulators

Industry

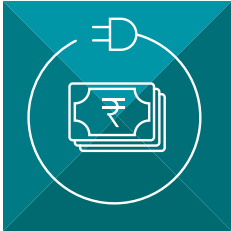
- Private distribution companies

- Fleet aggregators
- Charging and swapping infrastructure providers

Other

- DISCOMs
- Renewable energy developers
- EV operators

ATTRACTIVE FINANCING FOR EVs



More attractive financing options for EVs

Context:

Although battery costs are declining,²¹ capital costs of EVs are still higher than similar ICE vehicles. In conjunction with higher capital costs, interest rates for auto loans tend to be higher for EVs. Interest rates are higher because there is no established secondary market for EVs in India. Without such a market, it is difficult for banks to provide securitized loans for EVs with similar interest rates to ICEs, as there is no structured market in which banks could resell vehicles they repossess as collateral if an EV owner defaults on their car loan. Together, high capital costs and loan interest rates are creating challenges for buyers to purchase EVs (particularly in commercial vehicle segment). Attractive financing options can support EV adoption by decreasing financial risk for consumers, manufacturers, and banks.

PROPOSED SOLUTION(S) FOR DELHI

1. Develop a government-led interest rate subvention scheme.

- A Delhi government entity could offer a subsidy on the interest rate that consumers pay on their auto loans. A discount of tens of basis points to several percentage points could offer significant savings to an EV owner given the effect of compound interest.
- The financial industry could play a supporting role by developing discounted loan products. Several banks are already exploring discounted loans for EVs, including the State Bank of India (SBI), which recently announced a “green car loan” that offers a discount of 20 basis points relative to current auto loans and a repayment period of up to eight years.²²
- Section 3.2.6 of the 2018 draft Delhi EV policy proposes a “5% interest subvention.” The subvention “will be provided subject to the loan amount being capped at Rs 2,50,000 and a maximum loan tenor of 3 years” and “finance providers will be empaneled by the Delhi Financial Corporation.”²³

2. Study the feasibility and effectiveness of government- or OEM-led buy-back programs.

- To support the early development of a secondary market for EVs in Delhi, a Delhi government entity or vehicle OEMs could create buy-back programs in which either entity agrees to purchase repossessed EVs from banks at pre-negotiated rates.
- There is a significant opportunity for government and industry actors to collaborate in the formation of a secondary market for EVs in Delhi and beyond. If both government and industry were to create buy-back programs, the size of the secondary market would be larger than if only one were to do so. Also, if multiple state-level governments were to design and implement similar programs and vehicle OEMs were to extend their programs across multiple states or nationally, again the potential market

size would increase. A larger secondary market for EVs would allow banks to offer auto loans with lower interest rates.

3. Explore opportunities for innovative financing mechanisms.

- One option is a cooperative commercialization model that Shenzhen, China, has pioneered to enable bus operators to purchase electric buses without bearing the upfront cost of the batteries, which is one of the most expensive components of the vehicle.²⁴ The bus operator purchases the buses without batteries and an electric utility purchases the batteries and leases them to the bus operator. In the case of Shenzhen, state-owned Potevio and China Southern Power Grid lease batteries to the Shenzhen Bus Company.
- A similar model, Pay As You Save (PAYS) for Clean Transport, was developed by Clean Energy Works and has been utilized in several US and global cities.²⁵ Such innovative financing mechanisms can support EV adoption by simultaneously decreasing financial risk for multiple parties.

WHO IS INVOLVED

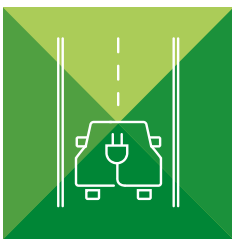
Government agencies

- EV policymaking bodies
- Government lending institutions

Industry

- Auto loan providers
- Vehicle OEMs

EASE OF EV OPERATIONS



Preferential treatment and easier visibility for registered EVs

Context:

To encourage the adoption of EVs and the electrification of vehicle kilometers traveled, government agencies can explore preferential incentives and infrastructure that support the operation of EVs in cities. To help distinguish EVs from ICEs and thereby simplify enforcement, a special license plate scheme can be implemented.

PROPOSED SOLUTION(S) FOR DELHI

1. Design and implement a green license plate scheme for EVs

- Create a license plate scheme where EVs receive uniquely colored license plates (e.g., green).

PROPOSED SOLUTION(S) FOR DELHI

2. In conjunction, develop EV-specific incentives, supportive infrastructure, priority access, and enforcement norms to support the operation of EVs in Delhi.

- The Delhi government and/or EV Cell (see section: EV Coordinating Body) can explore the following suggestions that are in addition to the 2018 draft Delhi EV policy:
 - Designing and implementing a portfolio of regionally contextualized fiscal and non-fiscal incentives
 - > Road toll fee reduction or exemption
 - > Low-emission zones
 - Developing supportive and preferential infrastructure
 - > Priority access, such as reserved parking spaces
 - > EV-only loading zones for freight vehicles, cab aggregators, and ride-hailing providers
 - > Overnight parking zones for electric freight vehicles
 - Encouraging enforcement of rules and regulations
 - > Enforce rules and regulations to ensure that EV operators are receiving the desired benefits. For example, non-EVs that are illegally using EV-specific parking and loading zones should be ticketed and/or moved to keep the space open for EV operators.
 - > Build capacity within enforcement agencies to ensure that they are aware of EV-specific rules for freight and passenger vehicles.

WHO IS INVOLVED

Government agencies

- EV policymaking bodies
- Vehicle registration, permitting, and enforcement agencies
- Planning and implementing bodies with mobility and traffic directives

Industry

- E-commerce companies
- Freight logistics providers
- Mobility service providers, including fleet aggregators, ride-hailing companies, etc.

EDUCATION, OUTREACH, AND CAPACITY BUILDING



Greater awareness of EVs and their environmental and economic benefits

Context:

Education campaigns and capacity-building programs can expose all segments of society to EV-related policies and the benefits of EV technology and services, including new job opportunities. These campaigns can also be designed with government audiences in mind to help inform them of new EV policies and regulations.

Campaigns can range from generating EV awareness and performance characteristics of EVs for private vehicle owners to teaching industry about new policies and regulations to vocational training for new commercial-based operators of EVs, including the informal market.

These campaigns will be important to encourage early adopters of EVs and to ensure that government agencies are appropriately enforcing new rules and regulations.

PROPOSED SOLUTION(S) FOR DELHI

1. Develop educational programs to support consumer awareness and adoption of EV technologies and services.

- Create a campaign to promote the Delhi EV policy, e-mobility services, and the environmental and economic benefits of going electric.
- Host learning sessions for industry and civil society to learn about the Delhi EV policy and its inclusions.
- Host learning sessions for relevant government bodies to learn about the Delhi EV policy and its inclusions, especially with respect to the enforcement of rules and regulations.

2. Develop training programs for the informal sector on new technologies, service providers, and current rules and regulation for the operation of EVs to ensure safe transportation and realize the potential of the informal sector.

- Provide support to businesses that are operating in accordance with Delhi's rules and regulations.
- Engage the Department of Social Welfare within the Delhi government to identify drivers in unorganized segments, such as independent e-rickshaw operators, and offer them formalized training to ensure that they have an understanding of operational requirements and rules of the road.
- Collaborate with private companies in the e-rickshaw segment and ride-hailing industry to create formal job opportunities for drivers that are currently operating in the informal sector, including drivers and mechanics.

WHO IS INVOLVED

Government agencies

- EV policymaking bodies
- Vehicle registration, permitting, and enforcement agencies

Industry

- E-commerce companies

- Freight logistics providers
- Transportation providers, including fleet aggregators and ride-hailing companies
- Vehicle OEMs

Other

- Civil-society organizations

OPEN MOBILITY DATA



Greater understanding of transport demand, modal integration, and traffic patterns

Context:

Data is an important enabler in the adoption of new mobility solutions that promote clean, shared, and people-centric mobility. For example, sharing transit data being collected by cities and solution providers can expand transportation markets, link users with solution providers, help city planners, and enable seamless multimodal transportation. A clear policy and process for collecting, standardizing, aggregating, and sharing real-time, but anonymous, transit data can increase the interoperability of data and lead to a more efficient mobility system.

PROPOSED SOLUTION(S) FOR DELHI

1. Create open data standards and begin collecting, sharing, and analyzing anonymized mobility data

- Appoint a transport data champion and allocate appropriate resources to help develop initiatives.
- Identify and prioritize data use cases based on the city's needs.
- Establish a baseline for the city's current data collection, availability, policy, and stakeholder landscape for each use case.
- Acquire necessary data and/or develop a repeatable process for acquiring data to support the selected use cases. Several cities in the US—including Chicago, Los Angeles, and New York City—are developing uniform, detailed, and secure requirements to share mobility data between public and private entities.
- Work with public transportation operators and shared mobility and fleet operators to streamline data format and accessibility while addressing any privacy and commercial concerns they may have.

- Where possible, and appropriate, implement existing processes or infrastructure (e.g., the common payment card to facilitate payment across multiple modes).

2. Equip public transit vehicles with appropriate infrastructure (e.g., Global Positioning System [GPS] units) to capture and transmit real-time data to appropriate departments

- Equip vehicles with the required infrastructure, including GPS units and transmitting devices, to capture and share real-time location data with the transit agency
- Make data, both static and real-time, available so that riders can better plan trips that rely on public transit and mobility service providers can integrate with public transit, for example, to provide first- and last-mile connectivity options.

WHO IS INVOLVED

Government agencies

- EV policymaking bodies
- Information technology bodies
- Public transit providers

Industry

- GPS and communication device providers
- Mobility service providers, including fleet aggregators and ride-hailing companies

BOX 4

Whole-system approach

A whole-system approach to mobility transformation in Delhi

The Urban Mobility Lab takes a whole-system approach to mobility transformation. It works with cities across a variety of mobility themes to support their transitions to clean, shared, and people-centric mobility futures.

In Delhi, the 2021 *Master Plan* lays out a vision for an urban transport system that is equitable, safe, comfortable, affordable, energy-efficient, and environmentally friendly. To realize this vision, the Delhi government is pursuing a portfolio of initiatives, from building out the Delhi Metro to working towards developing citizen-friendly, non-motorized transport infrastructure. Most recently, the Delhi government has developed an EV policy to accelerate EV adoption in Delhi and complement its efforts to address vehicular pollution. For the Delhi Urban Mobility Lab, vehicle electrification is a priority theme. DDC and RMI are working to support the public and private sectors in their efforts to develop a supportive ecosystem and pilot projects for e-mobility in the NCT.

In addition to their work on EVs, DDC and RMI are supporting Delhi's broader mobility goals. Accessible transport, NMT, and mobility data are three themes that require more attention and collaborative action from government, industry, and civil society. Opportunities exist to support each of these themes in Delhi and nationally by:

- **Accessible transport:** Defining, normalizing, and expanding accessible transport services
- **NMT:** Building out safe walking and cycling infrastructure and NMT mobility solutions, like public cycle sharing schemes
- **Mobility data:** Identifying a data champion, developing open mobility data standards, and collecting, analyzing, and sharing mobility data and insights

Each of these opportunities is an important aspect of Delhi's mobility transition. Integration across all of them is critical to ensure that Delhi achieves a whole-system mobility transformation.

POTENTIAL ENVIRONMENTAL AND ECONOMIC BENEFITS

Delhi government released its draft EV policy in November of 2018. It aims to establish policy mechanisms to enable the rapid adoption of EVs, which will help reduce vehicular emissions and improve local air quality.

“The primary objective of the Delhi EV Policy 2018 is to bring about a material improvement in Delhi’s air quality by bringing down emissions from transport sector. To do so, this policy will seek to drive rapid adoption of BEVs...”²⁶

Vehicle electrification can help Delhi realize significant decreases in transportation-related carbon dioxide (CO₂) and PM_{2.5} (fine particulate matter of 2.5 micrometers or smaller) emissions, while also helping reduce oil and liquid natural gas (LNG) imports. In order to quantify the potential benefits of meeting Delhi’s EV registration target, an analysis was performed to project the energy and emissions savings associated with achieving 25 percent EV registration by 2024. The analysis calculated emissions, energy, and fuel savings over the lifetime of the EVs relative to internal combustion engine (ICE) alternatives.

If Delhi achieves the 25 percent BEV registration target by 2024, approximately 500,000 EVs of various kinds will be operating in the city. For reference, Norway—a global leader in EV deployment—had 230,000 registered BEVs as of May 2018.²⁷ Deploying these EVs will result in net CO₂ emissions savings of 4.82 million tonnes over the lifetime of these vehicles, a 44 percent reduction relative to an equal-sized ICE fleet (figure 3) and equivalent to CO₂ emissions avoided from nearly 100,000 petrol cars over their lifetime. About 80% of the CO₂ emissions savings come from the electrification of two-wheelers and buses (figure 4). In addition to CO₂ savings, approximately 159 tonnes of PM_{2.5} tailpipe emissions can be avoided—a conservative estimate since the PM_{2.5} emissions are not adjusted for real-world driving conditions (e.g., idling in traffic).²⁸ Achieving these reductions is a priority for Delhi, as PM_{2.5} emissions have a considerable impact on life expectancy, pollution related deaths, and health costs.²⁸

Transitioning to EVs can also produce significant economic savings for the country. EVs registered through 2024 would require 120.8 petajoules less energy than an equal-sized ICE fleet and avoid 865



FIGURE 2

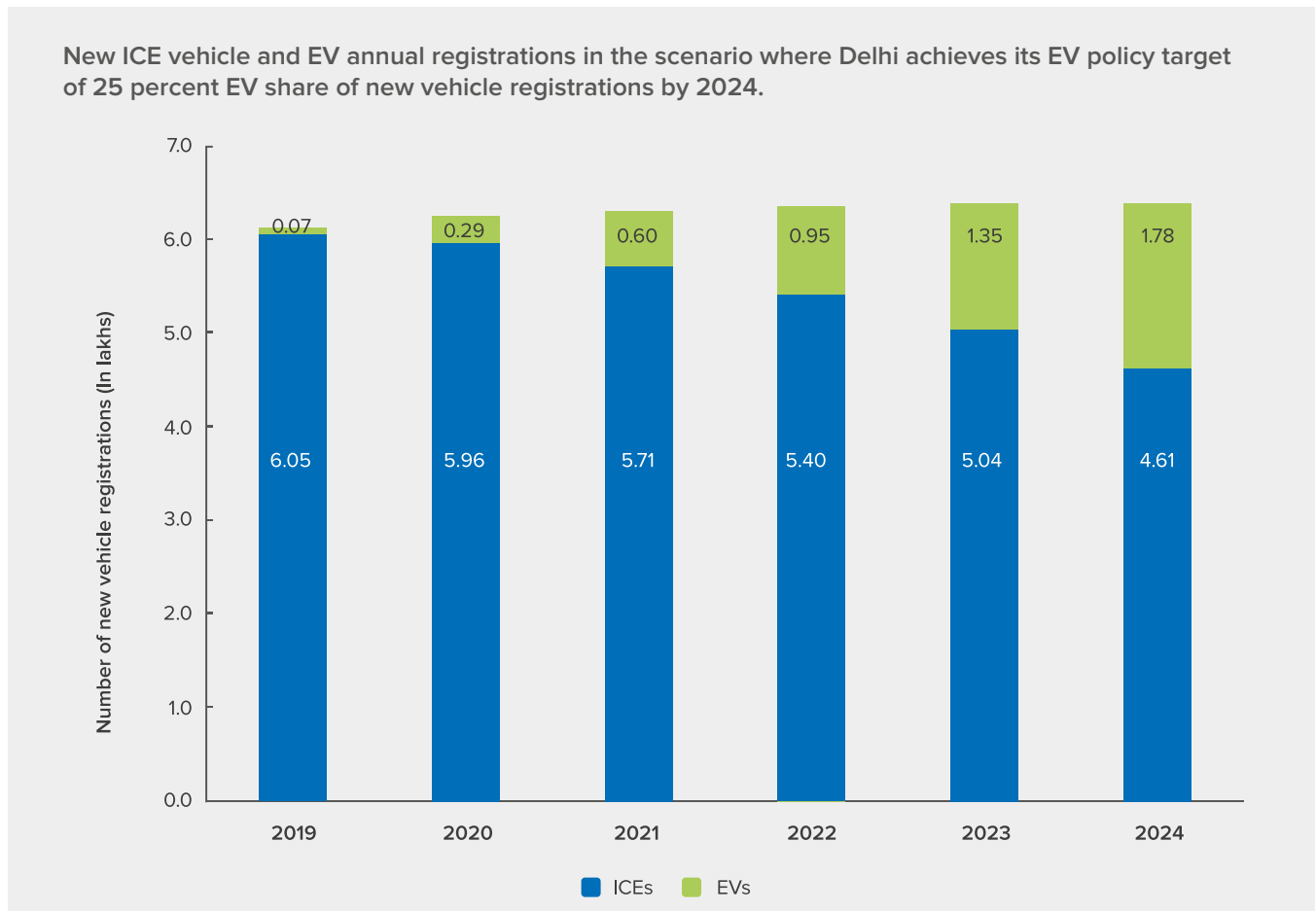


TABLE 2

Potential savings from EV registrations from 2019–2024 calculated over the lifetime of the vehicles. Savings are calculated relative to an equal-sized ICE fleet. In the analysis, approximately 500,000 new EVs are registered from 2019 through 2024.

	Fuel savings		Energy		Emissions		
	Quantity	Fuel import cost savings	Net savings (well-to-wheel)	Percent reduction	CO ₂		PM _{2.5}
					Net savings (well-to-wheel)	Percent reduction	Savings (tonnes)
Petrol- and diesel-related savings	6.76 million barrels of oil equivalent	453 million USD	33.93 petajoules	82%	2.04 Mt CO ₂	60%	98 tonnes
CNG-related savings	2,084 million kg	412 million USD (in LNG)	86.89 petajoules	78%	2.77 Mt CO ₂	37%	61 tonnes
Total		865 million USD	120.8 petajoules	79%	4.82 Mt CO ₂	44%	159 tonnes

Note: CO₂ emissions calculations are for well-to-wheel for both ICE vehicles and EVs. PM_{2.5} emissions are from tailpipes only.”

FIGURE 3

Lifetime CO₂ emissions of EVs by year of registration compared to an equal-sized ICE fleet. By 2024, EVs are 25 percent of all new vehicle registrations.

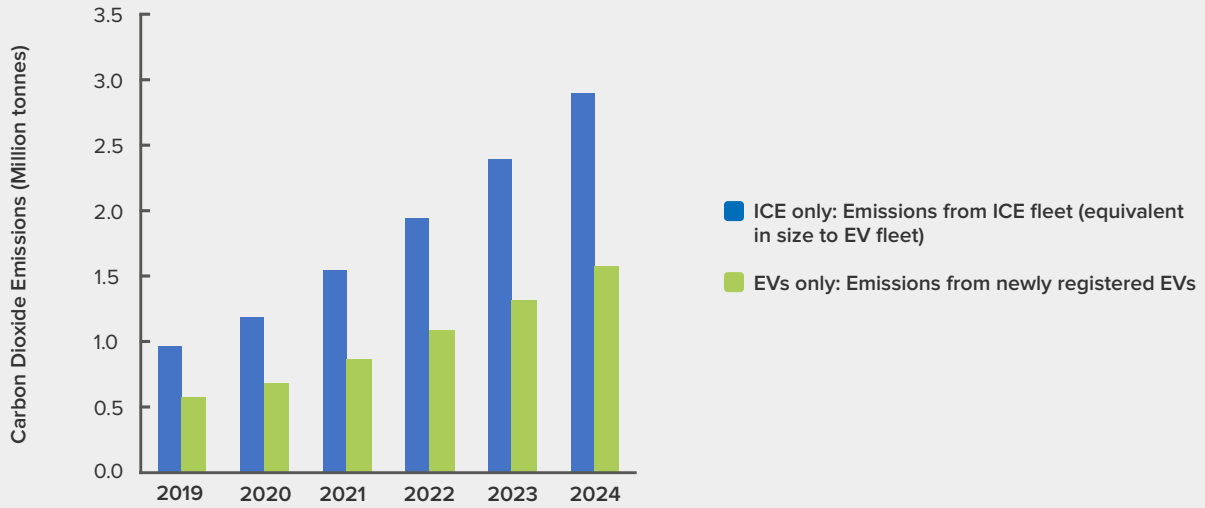


FIGURE 4

Percent contribution by EV segment to net CO₂ emissions savings (for EVs registered between 2019 and 2024).

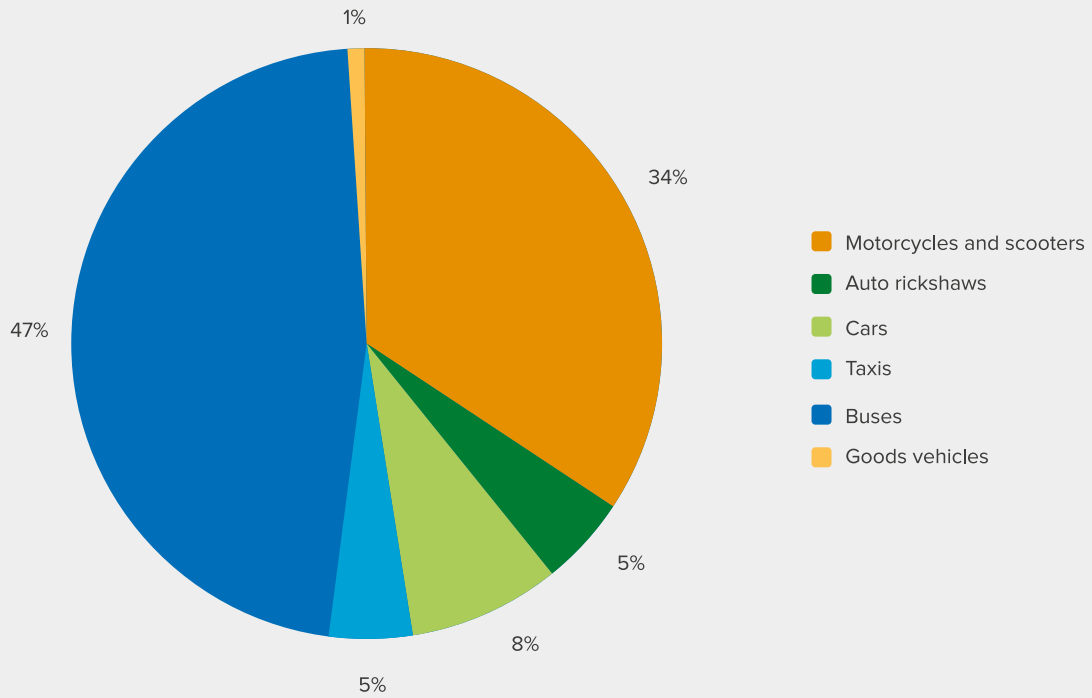
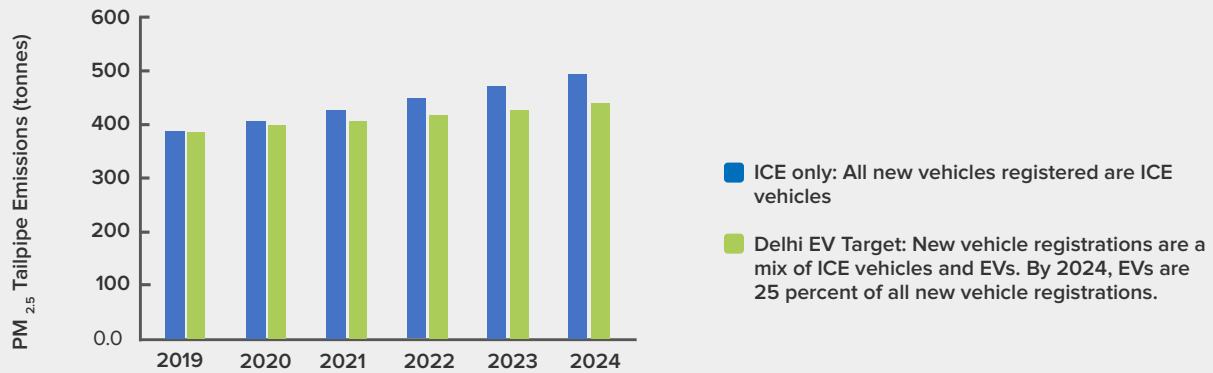


FIGURE 5

Lifetime $PM_{2.5}$ emissions of all new vehicles registered in the specified year. 159 tonnes of $PM_{2.5}$ emissions can be avoided.



APPROACH TO ESTIMATING THE POTENTIAL ENVIRONMENTAL AND ECONOMIC BENEFITS OF MEETING DELHI'S EV REGISTRATION TARGET

Approach to calculate potential savings from EVs that would have to be registered by 2024 to meet Delhi's draft EV policy target of 25% BEVs in new vehicle registrations by 2024

- Project total number of vehicles registered by segment through 2024 using historical trends
- Calculate number of new vehicles registered per vehicle segment per annum
- Calculate number of EVs registered per annum to meet the policy targets—total EV registration growth is assumed to be linear, reaching approximately 25 percent of new vehicle registrations in 2024

Inputs and assumptions

- Segments modeled: modes included in Delhi's draft EV policy, including motor cycles and scooters, auto rickshaws, cars and jeeps, taxis, buses, three-wheel light motor vehicles-goods (LMVs)
- Fuel types modeled per vehicle segment: petrol, diesel, CNG, electric
- Fuel mix (petrol, diesel, or CNG) for ICE vehicle fleet is held constant

- All publicly/commercially operated auto rickshaws, taxis, buses, and LMVs are CNG in Delhi
- Same vehicle lifetime kilometers are assumed for EV and ICE vehicles and same fleet size
- Grid emissions factor: Nationally Determined Contributions (NDC) compliant electricity grid with 175 gigawatts of renewable power capacity by 2022
- CO_2 emissions calculations are for well-to-wheel for both ICE vehicles and EVs
- $PM_{2.5}$ emissions are from vehicle tailpipes only
- $PM_{2.5}$ emissions by vehicle types are calculated based on BS-VI equivalent emission factors for new vehicles²⁹
- Crude oil price: USD 67/barrel
- LNG price: USD 10/million British thermal units (mmBtu)
- All cost (import) saving calculations in current prices
- Share of imported LNG in CNG: 40%
- INR to USD conversion rate of 70:1

THE PATH FORWARD

The Urban Mobility Lab has helped focus the mobility industry's attention on India's capital. During the 26 and 27 June 2019 workshop, many stakeholders recognized Delhi as an early leading geography for collective action in electric and urban mobility. The workshop hosted many critical conversations and led to the development of new ideas and partnerships. Moving ahead, DDC and RMI will be working as coordinators to support the government and industry in their efforts to turn such ideas into action.

Through the Urban Mobility Lab, DDC and RMI plan to support the path forward by:

> Supporting policy and process development:

In relation to the 10 opportunity areas discussed above and others, DDC and RMI will work to support ongoing policy development and process improvement to accelerate the implementation of clean, shared, and people-centric mobility solutions in Delhi.

> **Hosting follow-up convenings:** To collect feedback on policies, review/design new processes, and educate industry players about new developments, DDC and RMI will continue to host stakeholder consultations related to electric and urban mobility.

> **Supporting the implementation of mobility solutions:** DDC and RMI will support solution providers in coordinating with relevant agencies and potential partners with respect to implementation activities.

> **Collecting data and reporting on performance:** RMI will collect technical and economic data related to the EVs deployed under the "Deliver Electric Delhi" pilot to make the case for broader adoption of EVs for urban delivery vehicles.

> **Documenting and sharing lessons learned:** Regular updates with insights related to policy and solution implementation will help government and industry track progress, understand what is working well, and adjust where appropriate.

Following the workshop, DDC and RMI are working to address the needs that the participants identified through policy work and process improvement. The Urban Mobility Lab will continue to serve as a platform for supporting government and industry in their efforts to bolster Delhi's leadership role in India's mobility transition.

"If we can convert a billion kilometers of urban journeys to sustainable wheels, I think the impact is going to be for all of our children and the citizenry of Delhi to experience."

— Sanjay Krishnan, Founder, Lithium Urban Technologies



"The plan of Delhi government is to create collaborations and provide manners and platforms like the Urban Mobility Lab through which we can constantly be in dialogue with all the stakeholders who are serious about implementing electric mobility solutions in Delhi, and partner and collaborate with them to ensure that Delhi becomes the electric vehicle capital of India."

— Shri Jasmine Shah, Vice Chair Person, DDC

Do you want to learn more about the Urban Mobility Lab or get involved? Please contact RMI India at info.india@rmi.org.

ENDNOTES

- ¹ MOVE: Global Mobility Summit, 2018. <https://www.movesummit.in/about.php>; Press Information Bureau Government of India Prime Minister's Office, "Text of PM's address at the Global Mobility Summit-MOVE," 2018. <http://pib.nic.in/newsite/PrintRelease.aspx?relid=183324>.
- ² Government of India, Department of Heavy Industries, "Notification of FAME India Scheme Phase-II," 2018. <https://dhi.nic.in/writereaddata/UploadFile/publicationNotificationFAME%20II%20March2019.pdf>.
- ³ NITI Aayog, "National Mission on Transformative Mobility and Battery Storage," 2018. <https://www.niti.gov.in/niti/>.
- ⁴ MOVE: Global Mobility Summit, "State/UT Strategies for Transforming Mobility," 2018. <http://movesummit.in/files/State-Summary-Final.pdf>.
- ⁵ NITI Aayog and Rocky Mountain Institute (RMI), "India's Electric Mobility Transformation: Progress to date and future opportunities," 2019. <https://rmi.org/wp-content/uploads/2019/04/rmi-niti-ev-report.pdf>.
- ⁶ Hindustan Times, "Delhi-NCR ranks worst in vehicular pollutions: Study," 2018. <https://www.hindustantimes.com/delhi-news/delhi-ncr-ranks-worst-in-vehicular-pollution-study/story-v867fE0oIPQprku1s5ZrEI.html>.
- ⁷ Delhi Metro Rail Corporation Ltd., 2017. <http://www.delhimetrorail.com/projectpresent.aspx>.
- ⁸ "Budget Speech 2018–2019," 2018. <https://aamaadmiparty.org/wp-content/uploads/2018/04/FinalBudgetSpeechEnglish.pdf>.
- ⁹ The Times of India, "Delhi govt passes 'green' budget 2018–19," 2018. <https://timesofindia.indiatimes.com/city/delhi/delhi-govt-passes-green-budget-2018-19/articleshow/63493280.cms>.
- ¹⁰ Planning Department, Government of NCT of Delhi, "Economic Survey of Delhi 2018–19," 2019. <http://delhiplanning.nic.in/content/economic-survey-delhi-2018-19>.
- ¹¹ Delhi Development Authority, "Master Plan for Delhi – 2021," 2010. <https://dda.org.in/ddanew/pdf/Planning/reprint%20mpd2021.pdf>.
- ¹² Transport Department, Government of NCT of Delhi, "Draft Delhi Electric Vehicle Policy 2018," 2018. <http://transport.delhi.gov.in/sites/default/files/All-PDF/Electric%20Policy%202018.pdf>.
- ¹³ Planning Department, Government of NCT of Delhi, "Economic Survey of Delhi 2018–19," 2019. <http://delhiplanning.nic.in/content/economic-survey-delhi-2018-19>.
- ¹⁴ Transport Department, Government of NCT of Delhi, "Draft Delhi Electric Vehicle Policy 2018," 2018. <http://transport.delhi.gov.in/sites/default/files/All-PDF/Electric%20Policy%202018.pdf>.
- ¹⁵ Transport Department, Government of NCT of Delhi, "Notification of Draft Delhi Maintenance and Management of Parking Places Rules, 2019 to sought objections or suggestions," 2019. <http://transport.delhi.gov.in/content/notification-draft-delhi-maintenance-and-management-parking-places-rules-2019-sought>.
- ¹⁶ Delhi Development Authority. <http://dda.org.in/ddaweb/index.aspx>.
- ¹⁷ Planning Department, Government of NCT of Delhi, "Economic Survey of Delhi 2018–19," 2019. <http://delhiplanning.nic.in/content/economic-survey-delhi-2018-19>.
- ¹⁸ Pune Municipal Corporation and Rocky Mountain Institute, "Transforming Mobility in Indian Cities: Insights from India's First Urban Mobility Lab in Pune," 2018. <https://rmi.org/insight/urban-mobility-lab-pune/>.
- ¹⁹ ARENA and CEFC, "Australian Electric Vehicle Market Study," 2018. <https://arena.gov.au/assets/2018/06/australian-ev-market-study-report.pdf>.
- ²⁰ Transport Department, Government of NCT of Delhi, "Draft Delhi Electric Vehicle Policy 2018," 2018. <http://transport.delhi.gov.in/sites/default/files/All-PDF/Electric%20Policy%202018.pdf>.
- ²¹ Bloomberg New Energy Finance, "2018 Battery Price Survey," 2018. <https://www.bloomberg.com>.

- ²² Sunil Dhawan, Financial Express, “SBI Car Loan: Interest rates, eligibility, repayment period and discount for electric cars,” 2019. <https://www.financialexpress.com/money/sbi-car-loan-interest-rates-eligibility-repayment-period-and-discount-for-electric-cars/1556309/>.
- ²³ Transport Department, Government of NCT of Delhi, “Draft Delhi Electric Vehicle Policy 2018,” 2018. <http://transport.delhi.gov.in/sites/default/files/All-PDF/Electric%20Policy%202018.pdf>.
- ²⁴ Marquis et al., Stanford Social Innovation Review, “China’s Quest to Adopt Electric Vehicles,” 2013. https://www.hbs.edu/faculty/Publication%20Files/Electric%20Vehicles_89176bc1-1aee-4c6e-829f-bd426beaf5d3.pdf.
- ²⁵ Clean Energy Works, 2019. <http://www.cleanenergyworks.org/>.
- ²⁶ Transport Department, Government of NCT of Delhi, “Draft Delhi Electric Vehicle Policy 2018,” 2018. <http://transport.delhi.gov.in/sites/default/files/All-PDF/Electric%20Policy%202018.pdf>.
- ²⁷ Norsk Elbilforening, “Norwegian EV Policy: Norway is Leading the Way for a Transition to Zero Emission in Transport,” 2018. <https://elbil.no/english/norwegian-ev-policy/>.
- ²⁸ Anenberg et al., “A Global Snapshot of the Air Pollution-related Health Impacts of Transportation Sector Emissions in 2010 and 2015,” The International Council on Clean Transportation, 2019. https://theicct.org/sites/default/files/publications/Global_health_impacts_transport_emissions_2010-2015_20190226.pdf; Michael Greenstone and Claire Qing Fan, “Introducing the Air Quality Life Index: Twelve Facts About Particulate Air Pollution, Human Health, and Global Policy,” Energy Policy Institute at the University of Chicago, 2018. <https://aqli.epic.uchicago.edu/>.
- ²⁹ Gaurav Bansal and Anup Bandivadekar, “Overview of India’s Vehicle Emissions Control Program: Past Successes and Future Prospects,” The International Council On Clean Transportation, 2013. https://theicct.org/sites/default/files/publications/ICCT_IndiaRetrospective_2013.pdf.



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