

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

T E R I. 2020. Road map for Electrification of Urban Freight in India. New Delhi: The Energy and Resources Institute

About Shakti: Shakti Sustainable Energy Foundation seeks to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies in the following areas: clean power, energy efficiency, sustainable urban transport, climate change mitigation, and clean energy finance.

Project Team

Project Reviewers

Mr IV Rao, Visiting Senior Fellow

Mr Shri Prakash, Distinguish Fellow

Principal Investigator

Mr Sharif Qamar, Associate Fellow

Team Members

Ms Aakansha Jain, Research Associate

Mr Aravind Harikumar, Research Associate

Ms Palak Thakur, Research Associate

Mr Promit Mookherjee, Research Associate

Ms Sugandha Pal, Research Associate

Secretarial Assistance

Mr P Santosh Kumar

TERI Press

Ms Sushmita Ghosh, Sr Editor

Mr Rajiv Sharma, Graphic Designer

Mr Santosh Gautam, Sr Visualizer

Mr Raman Kumar Jha, Graphic Designer

Mr Sudeep Pawar, Graphic Designer

Mr Vijay Nipane, Senior Illustrator

Disclaimer: The views/analysis expressed in this report/document do not necessarily reflect the views of Shakti Sustainable Energy Foundation. The Foundation also does not guarantee the accuracy of any data included in this publication nor does it accept any responsibility for the consequences of its use.

*The reports produced as part of this study are for private circulation.

Acknowledgements

TERI would like to express its deep gratitude to Shakti Sustainable Energy Foundation (SSEF) for supporting this study. In particular, we would like to thank Mr Vivek Chandran, Mr Ruchir Shukla and Ms Chetna Nagpal of SSEF for their constant support, valuable and insightful inputs at various stages of the study. We would also like to extend our gratitude to Tata Motors and Rocky Mountain Institute for peer reviewing the report.

TERI also acknowledges the support of a large number of stakeholders, including sector experts, government agencies, private sector stakeholders, think tanks, Agriculture Produce & Livestock Market Committee (APMC), Original Equipment Manufacturers (OEMs), Transport service providers for their valuable inputs for the study. In particular, TERI would like to express its gratitude to the following organizations for sparing their valuable time and providing constructive inputs that were helpful in writing the report.

- Surat Municipal Corporation
- Society of Manufacturers of Electric Vehicles (SMEV)
- Mail Motor Service, India Post, Bengaluru
- Three Wheels United
- Ujjivan Small Finance Bank Ltd
- LetsTransport
- Tata Motors Ltd
- Mahindra & Mahindra Ltd
- Piaggio Private Ltd
- Gayam Motor Works (GMW) Private Ltd
- Etrio Technologies

The project team would also like to thank TERI's Southern regional chapter at Bengaluru for all their help and support provided to the project team for Bengaluru case study, including Mr Ashfaq Ahamed, ex-Regional Transport Officer. We would also extend our thanks to Mr Kamlesh Yagnik and Mr Mehul Patel for their guidance and support in Surat for stakeholder engagements.

The project team would also like to thank survey agency for conducting surveys in Delhi APMC area. Lastly, we would also acknowledge the support of interns Aashish Malik, Disha Khanna, Mohit Jaine, Arjun J and others in conducting the telephonic surveys and validating the data. TERI is also grateful to all the respondents of the survey; the study team gained tremendously from the responses of all the survey participants. The project team is also thankful to the entire TERI Press team for helping with the publication of this report.

EXECUTIVE SUMMARY

Introduction

Urban freight movement forms a crucial part of the urban ecosystem. It is a fundamental part of the overall transportation supply chain. Movement of goods originating from or outside the urban periphery which enters into an urban area through commercial road vehicles forms the urban freight network. Such movement is usually catered by both light commercial vehicles (LCVs) and medium and heavy commercial vehicles (M/HCVs) depending upon volume of goods carried, distance travelled, and the service area to be catered.

Urban freight comprises both essential and non-essential commodities which are required by individual households, businesses, and industries on a day-to-day basis. Development of urban areas plays a primary role in increasing the demand for goods and services which, in turn, directly impact the demand for freight movement.

Conventionally, urban freight movement has comprised distribution of agricultural produce, building and construction materials, wholesale distribution of daily essentials, FMCG, electronics, water and milk supply, etc. which have been catered majorly by LCVs and M/HCVs. However, recent advent of ecommerce supply chains has even brought two-wheelers under the purview of freight vehicles for last mile deliveries.

Recently with the expansion of India cities, a demand boom has been observed in a very specific segment within LCVs the Small Commercial Vehicles (SCVs) which are <3.5 tonne GVW vehicles comprising both three-wheelers and four-wheelers. These vehicles due to their size, ease of operation (inter-changeable use), and efficiency cater to most of the mid-mile and last mile delivery services in urban centres and around the peripheral areas. Over the past decade, LCVs have overtaken the market share from M/HCVs, within the LCV segment also mini trucks and pick-up trucks (SCVs) have outpaced the growth of higher tonnage LCVs.

Objectives of the Study

- Capturing best practices (Indian and International), current scenario in Indian context, and benefits of electrification of urban freight sector
- Potential and barriers to electrify freight transport: Case Studies of Bengaluru, Surat and Delhi
- Estimation of energy and emission savings by electrification of urban freight
- Potential areas of electrification of urban freight vehicles in the country
- Stakeholder engagement and road map for electrification of the urban freight sector

Importance of electrification of urban freight vehicles

Presently, the freight vehicles in India primarily rely on diesel and account for the highest share of diesel consumption within the sector. This not only has an impact on energy security of the country but also is a cause of several negative externalities such as greenhouse gas (GHG) emissions, air pollution. Hence, high reliance on diesel remains a cause of concern both from environmental and economic perspective. Within the freight vehicle segment, SCVs also ply on diesel in India.

While some metro cities have shifted to CNG-based SCVs in order to reduce the quantum of urban air pollution, other smaller cities have still not been able to tap the benefits of cleaner alternative due to unavailability of the fuel itself. Considering the fact that growth in urban areas is likely to create huge demand for urban freight vehicles, there is a need to identify alternative technology



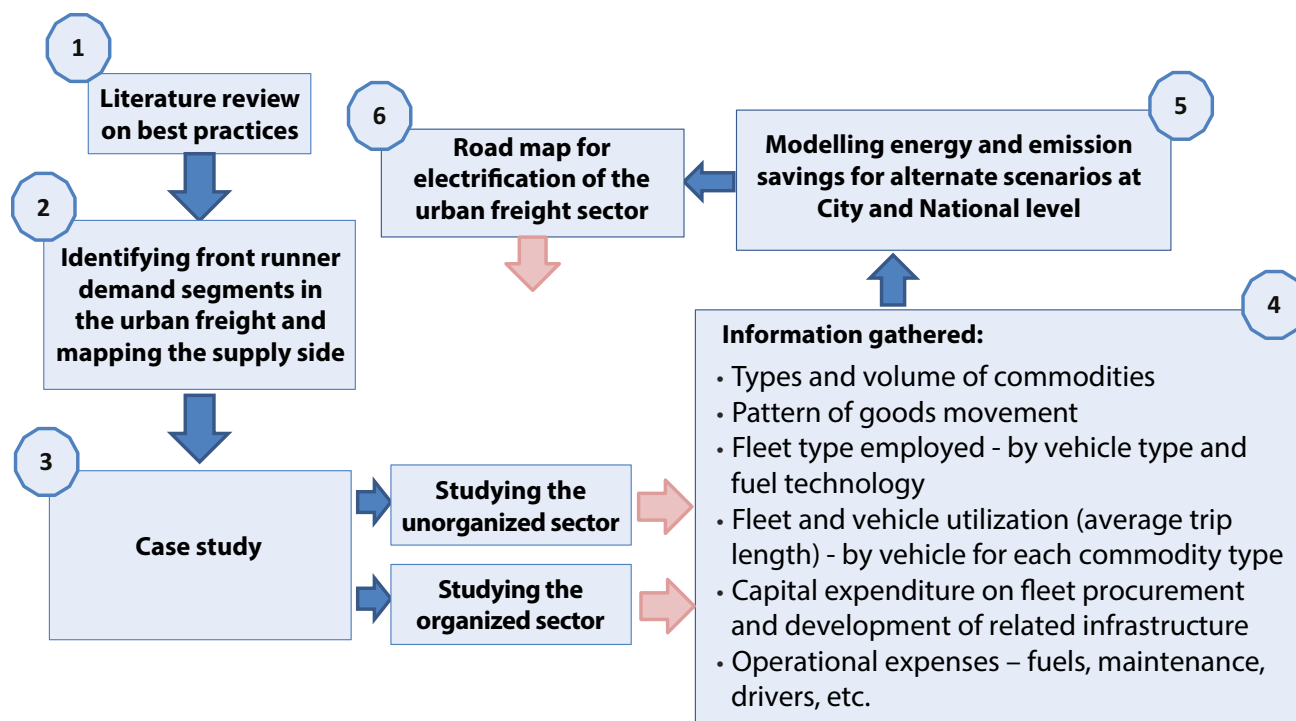


Figure 1 Research strategy - TERI's Urban Freight Study

solutions which can be easily made available across the cities. Electrification of urban freight vehicles is one of the key policy proposals that can help decarbonize the sector up to a large extent and also maximize economic savings at national level and at an individual owner/driver level.

Given the fact that at present much remains unknown about the technology adoption rate, barriers, consumer awareness, market scenario, etc. in the freight vehicle segment, this study aims to assess the operational and financial feasibility of electric vehicles in the urban freight segment by undertaking a survey based analysis of different sectors across cities.

In order to undertake this exercise detailed analysis has been done of both organized and unorganized freight services in Bengaluru, Surat, and Delhi. Based on case studies of freight movement in postal services, third party logistics, textile industry, solid waste management, agricultural produce market a road map for electrification of urban freight vehicles has been prepared.

Global Scenario of e-Urban Freight

Transport sector is responsible for 28% of the global energy demand and 23% of total energy-related CO₂

emissions (IPCC, 2019). Among which freight transport consumed almost 45% of the total transport energy. In order to mitigate the GHG impact of ICE urban freight vehicles, electric freight transport vehicles are being promoted globally with projects such as Freight Electric Vehicles in Urban Europe (FREVIEW), e-mobility NSR, Electric Vehicle City Distribution (ELCIDIS), European Association of Cities interested in Electric Vehicles (CITELEC) in Europe, electric three-wheelers in China, and electric vans in North American states. The application of these vehicles has been varied, ranging from grocery delivery, Courier, Express, Parcel (CEP) to waste collection and disposal.

In the **USA**, a large number of delivery companies are adopting electric vehicles into their fleet.

Freight accounts for only 15% of the total vehicles in **China** (excluding motorcycles), yet they contribute to more than 50% of vehicle carbon dioxide (CO₂) (Green BIZ, 2017). In 2006, the Chinese government began to promote new energy vehicles (NEVs, including plug-in electric vehicles). China has also set the charging infrastructure target of 120,000 stations and 4.8 million electric vehicle charging posts by 2020. By 2016, China also imposed restriction in urban operations and registration of diesel vehicles.



The **UK** has designed an aggressive strategy for reduction in all the sectors, including urban freight (Department of Transport Britain, 2017). In 2009, Electric Vehicle Delivery Plan for London was launched. Under the same, charging infrastructure, vehicle subsidy and communication programmes were initiated. Clean Air zones were demarked to encourage investment in e-mobility. Electric vehicles qualify for 100 % congestion charge discount and tax benefits. Electric vans are exempt from van benefit charge for five years.

Indian Scenario of e-Urban Freight

In India several policy interventions have been proposed both at national and state levels which aim to support the transition to electrification of the freight segment. At national level, the National Electric Mobility Mission Plan (NEMMP) envisaged electrification of LCVs and projected penetration of 30,000–50,000 LCVs by 2020. The plan was further supported by Rs 10,000 crore-FAME scheme, which has provision of incentives for electrification of LCVs. These policies further nudged the states to create an ecosystem for electric vehicles.

For instance, **Karnataka Electric Vehicle and Energy Storage Policy (2017)** proposes a transition of mini goods carriers (three-wheelers/four-wheelers) in Bengaluru to electric in a phased manner to achieve 100 % electrification by 2030.

Uttar Pradesh Electric Vehicle Manufacturing and Mobility Policy (2019) plans to phase out all conventional commercial fleets and logistics vehicles (EV-3 Wheelers, 4-Wheelers, mini Goods vehicles) and achieve 50% electric vehicle mobility in goods transportation in identified 10 electric vehicle cities by 2024 and all cities by 2030.

Under **Tamil Nadu EV Policy (2019)** there will be no requirement of a permit for the three-wheeler goods, e-carriers as well as electric light goods carrier and 100% road tax exemption has been given to all e-carriers registered till March 2022.

The Delhi EV Policy 2020 encourages fleet owners to adopt electric goods carriers (e-carriers) by providing 1) a purchase incentive of Rs 30,000 to the first 10,000 e-carriers to be registered in Delhi, and 2) Interest subvention of 5% on loans and/or hire purchase scheme for purchase of e-carriers.

In addition to government policies several manufacturers and business are formulating their policies to increase the uptake of electric vehicles in urban freight segment. From manufacturing perspectives OEMs are already working to introduce small commercial vehicles in 2020.

The work on electric variants of Tata's Ace and Mahindra & Mahindra's Jeeto are in progress. There are several electric vehicles, which are being used in freight activities such as waste collection and e-carts for deliveries - manufactured and assembled by Indian companies. E-commerce firms such as Flipkart, Grofers, Big Basket, Gati, and many others have already begun or have planned to include electric vehicles in their supply chain.

Market scenario of ICE and Electric urban freight vehicles

Presently, the ICE four-wheeler freight carrier market is dominated by Mahindra & Mahindra Limited and Tata Motors with a sales share of 51.3% and 37.4%, respectively. Mahindra & Mahindra has been the prime manufacturer of goods carrier four-wheelers. The sales have increased from 14,573 in 2000 to 324,500 in 2016–17. The gradual increase in the share of Tata Motors in the electric vehicles has also been observed from 2000 to 2016. In 2011–12, Ashok Leyland also entered in the four-wheeler goods carrier space and is third in terms of market share followed by Piaggio, Isuzu, and Force motors. In the three-wheeler segment, the dominant player is Piaggio with 49.8% sales share. Piaggio has constantly held a high share in the three-wheeler market. The other players in the three-wheeler segments are Mahindra, Bajaj, and Atul Auto with sales share of 18.7%, 12% and 16.5%, respectively.

With the Indian policy landscape supporting electrification, many small and large players have entered the urban freight market. These players are producing freight vehicles in both the three-wheeler and the four-wheeler variants. Both the models are available with lead-acid and lithium-ion battery technology and their prices vary as per the battery size and technology.

Among the key ICE players, M&M and Tata Motors are coming up with their four-wheeler electric variants Mahindra e-Suprocargovan and Tata e7 Ultra, respectively. Apart from these, there are two other companies, Croyance and Altigreen, in the four-wheeler segment



manufacturing four-wheeler electric cargo vehicles. Some companies such as Inncrypto Technologies and ETrio are manufacturing retrofitted electric four-wheeler cargo vehicles. Among the electric three-wheeler cargo vehicles, Atul Auto is a pioneer among the existing big ICE players.

There are also other many smaller electric three-wheeler market players such as Kinetic, Lohia, Gayam Motors, Goenka Ecoyan, Adapt Motors among others who are manufacturing both lead-acid and lithium-ion batteries. Players like Altigreen and Volta are also involved in retrofitting of the electric three-wheelers.

Selection of Cities

From literature review and stakeholder discussions, it is assumed that an urban area's gross domestic product (GDP), population, road length, per capita income, and its size contribute positively to the quantum of urban freight in it. The study used raw and estimated data of the same derived from the Census 2011 to compare all the tier-I and tier-II cities in India. The variables were standardized and the cities were ranked based on the averages across the variables. The tier-I and tier-II cities were ranked separately.

From the basic assessment carried out, among tier-I cities, *Delhi NCT* ranked at the top indicating high urban freight operations. Delhi was followed by Mumbai, Kolkata, and Bengaluru. To make the selection more robust, a few more qualitative variables were assessed. As this project concerns with the electrification of the urban freight sector, the political position of the city and state administrations is crucial for adoption of electric vehicles in urban logistics. Other important factors include local base of TERI, average weather, availability of alternative technologies such as CNG, LPG¹ and power generation mix of the state.

Amongst the remaining four metropolitan cities **Bengaluru** has a premier advantage in terms of adoption of renewable energy sources for power generation and is also the capital of Karnataka, which is one of the early states to come up with their electric vehicle policy. Further, Bengaluru has minimal share of alternative technologies such as CNG and LPG; hence the opportunity cost of switching to electric is higher in Bengaluru as compared to other cities. Hence, considering the aforementioned factors and the added advantage of Bengaluru as a technology and innovation hub of India, the city has been selected for deep dive assessment of electrification of urban freight vehicles.

A similar approach was adopted while selecting a tier-II city for the purpose of this project. The tier-II cities were ranked based on GDP, per capita income, population, road length, and their sizes. The variables were standardized and the cities ranked based on the averages of the variables. The obtained cities were then assessed on the positions of the city administrations regarding electrification of transport and availability of alternative technology options. After the assessment, the city of **Surat** in Gujarat was selected for the purpose of this project.

The next step in finalizing the case studies was the selection of front runner sectors in these three cities. For this purpose a holistic analysis of various sectors, industries, and businesses was undertaken in all the three cities along with some stakeholder consultations related to feasibility of carrying out the data driven exercise. The factor of scalability was also one of the key criteria while selecting the cities.

Approach for data collection

Data collection for five case studies has been done through a mix of primary surveys, secondary data collection, and stakeholder consultations.

¹ Availability of alternative technologies in a city implies a lower opportunity cost of not switching into electric vehicles.



Table E 1: Data collection for case studies

Case Study	Data Collection Mechanism	Data Sources
India Post	Secondary sources	Trip schedules provided by Bengaluru MMS
LetsTransport	Primary surveys and stakeholder interviews	Vehicle driver surveys
Surat Textiles Industry	Primary surveys and stakeholder interviews	Vehicle driver surveys
Solid Waste Management	Secondary sources and stakeholder interviews	Surat Municipal Corporation
Azadpur and Okhla APMC	Primary surveys, secondary sources and stakeholder interviews	Vehicle driver surveys and data provided by APMC

Table E 2: Findings from Different Case Studies

Survey Parameters	LetsTransport	Surat Textile	Delhi APMC
Ownership and Purchase Method	74% of the drivers were owners 77% of the owners bought the vehicles through loan. Loan procurement - 66% through formal sources and 34% through informal sources. EMI amount - Rs 11,220 EMI duration - 35 months	96% of vehicles surveyed were self-owned by the interviewed driver Of the self-owned vehicles, 84% were purchased through EMI 79% of the vehicles are brought using formal financing mechanisms.	About 98% of the surveyed drivers were transporting the goods for someone else and hence can be classified as for “third account”. Only about 5% of the surveyed drivers were transporting the goods on “own account”. 87% of the respondents owned the vehicle but only 4% of respondents owned the goods being carried in them.
Fleet Characteristics	Share of BS-IV vehicles was 39% The Tata Ace models are used by 90% of the drivers Of the SCVs 96% run on diesel One-third of the drivers are using second-hand vehicles.	26% of the vehicles captured in the survey were three-wheeler goods vehicles. Of the vehicles captured in the survey, 35% and 39% were mini trucks and pick-up trucks, respectively. The SCVs surveyed were on average 4.5 years old. The average odometer reading of the surveyed vehicles was 93,275 km. About 29% of the vehicles are BS IV vehicles.	Six different types of vehicles were captured in the survey, namely, Goods 3W (37%), Passenger 3W (12%), Jugaad (3%), Pick-up truck (10%), Mini Truck (30%) and E-rickshaw (8%). Majority of the vehicles classified from the survey under goods 3W category were models from Bajaj, Mahindra and Piaggio. Tata Ace was primarily used in the mini truck segment and Mahindra in the pick-up segment.



Table E 2: Findings from Different Case Studies

Survey Parameters	LetsTransport	Surat Textile	Delhi APMC		
Vehicle Usage and Costs	On average drivers work for 29 days in a month and have a daily shift of 10 hours covering a distance of 71 km	The daily total distance travelled by three-wheeler goods, mini trucks, and pick-up trucks are 51 km, 78 km, and 96 km, respectively.	Just the 635 vehicles surveyed are responsible for 11.3 Million Tonne kilometre (MTkm) of urban agricultural freight each day.		
	Monthly fuel expenditure - Rs 11,500		The vehicles surveyed from Azadpur APMC operate 9.1 MTkm of agricultural urban freight every day. Similarly, the sample from Okhla operates 2.2 MTkm of daily agricultural freight every day.		
	Monthly maintenance costs - Rs 3,568		The total operational costs are the highest for pick-up trucks with the owners spending Rs 12,500 monthly on average.		
	Annual insurance costs - Rs 18,793		Three-wheelers goods in Delhi incur approximately Rs 6,000 monthly on overall operations of the vehicle.		
	Fitness certificate costs - Rs 3,391				
Pick-up and Drop-off Locations	One pick-up point and multiple drop locations.	Top O-D pairs-	Outbound traffic from APMCs		
	Drop locations are within a catchment area of 10 km.		Vehicle Category	APMC	Top Destinations for Outbound Traffic
	55% of the services are provided at door-step of the customer. Delivery to retail shops, which is a B2B service, accounts for 34% of the total trips and the remaining 11% account for the mid-mile trips from warehouse to distribution centres.				
			Mini Trucks	Azadpur	Jahangir Puri
			Pick-up Trucks	Azadpur	Noida
			Goods Three-wheelers	Azadpur	Rohini
	Okhla	Badarpur			



Table E 2: Findings from Different Case Studies

Survey Parameters	LetsTransport	Surat Textile	Delhi APMC
Commodities and Payloads	The drivers carry 44% e-commerce goods followed by groceries and FMCG at 29% and 21%, respectively. On average the vehicles carried a load of 702 kg.	The survey revealed that on average, three-wheeler goods vehicles carried 945 kg per trip. Mini trucks and pick-up trucks carry 1590 kg and 1799 kg, respectively. There is considerable overloading in all the vehicle types studies here.	Mini trucks - Average payload of 896 kg and daily total distance of 47.6 km. Pick-up trucks - Average payload of 929 kg and daily total distance of 73 km. Goods three-wheelers - Average payload of 497 kg and daily total distance of 54.1 km
Spatial Analysis/ Parking Characteristics	The survey analysis and the related spatial mappings suggest that while the traffic originates from all zones in Bengaluru except the western part, majority of the trips and traffic is concentrated in the southern part of the city. From our survey we found that almost 38% of the drivers park their vehicle on road-side at night.	An average of 5 hour was spent idle by vehicles while loading and unloading goods. As 95% of the SCVs in the survey spend at least 2 hour and 30 minute on average in the central zone, it is an ideal location for establishing charging infrastructure for encouraging adoption of electric vehicles. While loading, 50% of the vehicles are parked on the roadside, 39% are parked inside the factory, and 11% are parked in a commercial parking facility. At commercial parking facility 61% of the vehicles are parked while being unloaded.	All vehicles in Azadpur are parked inside the APMC premises while loading the vehicle. In Okhla, 55% of vehicles are parked outside the mandi for loading. Drivers were also asked where the vehicle is parked when it is idle between the trips. All the drivers from Azadpur stated that the vehicle is parked within the mandi premises when idle. However, there was a diverse response from the drivers loading goods from Okhla - 47% of the vehicles are parked in and around the mandi premises, 43% are parked in private spaces and 10% are parked on the roadside.



Table E 2: Findings from Different Case Studies

Survey Parameters	LetsTransport	Surat Textile	Delhi APMC
Awareness and Preference for Electric Vehicles	The survey outcomes reflect a significant information gap in terms of familiarity of drivers with the new technology. Almost 63% of the ICE vehicle drivers stated that they have not heard about electric vehicles or do not have any knowledge of the same. Of the 37% of the drivers who were aware about electric vehicles, only 25% were willing to shift to electric vehicles in the future. Among those who were aware about electric vehicles just 10% of the drivers knew about government incentive schemes. We found that performance of the vehicle is one of the major key concerns of drivers, which included range of the vehicle, the speed and payload carrying capacity. Another factor that hinders drivers' decision is the lack of information on available models.		Only 1.4% of the 635 drivers knew about the existence of electric vehicles. Drivers were also asked if they would be willing to switch to electric vehicles irrespective of their knowledge about the same and 2.4% of the drivers said yes and showed their willingness towards electric vehicles. It is interesting to note that a higher proportion of the drivers who are willing to shift are those who do not know about the technology yet, that is, 1.6% of the people who said they are willing to shift are from the pool of drivers who had not heard about electric vehicles and only 0.8% of the drivers had an affirmative response to both the questions.



Additional Case Studies

1. IndiaPost - Bengaluru Regular Parcel Collection and Delivery Services



Figure 2: Findings from short-haul trip analysis

Fixed Route Services

- All the trips for fixed route services originate from National Sorting Hub in the city and cover an average daily distance of 95 km spanning over 9 to 19 stops. The average trip duration of these services is 12 h 25 min, which is longer than the short haul regular parcel service trips and these vehicles also have long stops at key collection hubs for around three times in a day.
- From the mapping we found that of the total 61 drop points, only 4 points lie outside the Bengaluru city boundary and rest all lie in the urban Bengaluru. Additionally, 70% of the locations lie within the 10 km radius of the pick-up point.

2. Surat Solid Waste Management Vehicle Movement

Presently, about 2200 million tonne of solid waste is produced in Surat daily; of which about 2150 million tonne is collected and transported. Surat city is divided into seven different administrative zones, the SWM activities are carried out separately in each zone. The door-to-door waste collection system was introduced in 2004. Currently, door to door collection accounts for around 55% of total collection. The whole door to door collection system is leveraged to private operators to ensure better efficiency. There are five different agencies involved in door to door collection on a contractual basis. The private operator is responsible for the capital and the entire operational costs. The waste is collected twice daily – between 7 am and 2 pm and from 5 pm to 10 pm.

Range of the vehicles: Aggregate annual data related to distance travelled by these vehicles was obtained from the Surat Municipal Corporation (SMC). Across zones, the average daily distance travelled by a vehicle ranged from 30 km in the central zone to 53 km in the southeast zone. On average, vehicles made around three trips in a day, the per trip average distance travelled ranged from around 9 km to 16 km.

Payload: Aggregate yearly data on payload carried was obtained from SMC, per trip payload was obtained by using the average number of trips completed in a day. Average payload per trip ranged from 607 kg in the Central Zone to 1.04 tonne in East Zone (B). There are also seasonal changes in the daily waste collected. To capture seasonality average daily SWM collection in each month was analysed for the year 2012. The highest collection is seen June. This is likely because this is the month in which monsoon tends to reach Surat and the rainfall increases the weight of the waste. The other months with higher waste collection are March and October, which could be attributed to festivals during this period.



Charging infrastructure: Each zone has its own dedicated transfer station, the civil work for the transfer stations is facilitated by the Surat Municipal Corporation but the operations are contracted to private agencies while investments for machineries and equipment is borne by the operator. The vehicles in each zone have the same origin and destination, i.e. the transfer stations. As a result, these stations provide the ideal place for setting up charging infrastructure. The expenses for the infrastructure would have to be borne as a one-time expense by the municipal corporation. The private operators assigned for primary collection can bear the cost of the electricity used by entering into agreement with the agency running the transfer station.

3. Electric Vehicle Pilot - Bengaluru

LetsTransport is currently doing a pilot of electric vehicles in major cities of India. The vehicles that are being used by the drivers include electric three-wheeler and retrofitted four-wheeler (E-trio). To develop a better understanding of vehicle performance and consumer perception, we conducted a small survey of 11 electric vehicle drivers. Key findings from the survey are presented here:

Survey Parameters	Findings
Vehicle Model	Out of 11 vehicles, 8 vehicles are retrofitted electric four-wheeler (Tata Ace) and the remaining 3 are electric three-wheeler.
Daily Km and Payload	The electric three-wheeler covers a distance of 34 km while the electric four-wheeler runs for approximately 83 km daily. The payload carried by electric four-wheelers is around 250 kg, electric four-wheeler carry around 700 kg of goods.
Charging and Parking	- The vehicles take approximately 5 to 6 hours for a full charge. Most of the drivers charge the vehicle only once in a day and only 3 of 11 drivers charge it twice in a day. The average mileage of an electric three-wheeler is 50 km while that of electric four-wheeler is 95 km. - Drivers park their vehicles at the pick-up hub/clients location where charging facility is available. - Parking and charging facilities are available free of cost to these drivers.
Savings Potential	- All the drivers reported that their monthly operational and maintenance costs have reduced after switching to electric. - Drivers reported that on an average they are able to save Rs. 8000 per month on fuel and maintenance costs.



Comparative TCOs

The TCO was calculated assuming a 7-year life of vehicles. This was the lower bound for vehicle lifetime identified from literature and stakeholder consultations. Taking a shorter lifetime provides conservative estimates for the electric vehicles as with time the TCO favours electric vehicles more due to lower operating costs. To make the analysis more representative, all vehicles were assumed to be purchased through a vehicle loan, with 80% of the value being paid through EMIs over 36 months. The costs associated with electric vehicles are adjusted to reflect government incentives such as FAME-II subsidy and discounts on insurance premiums.

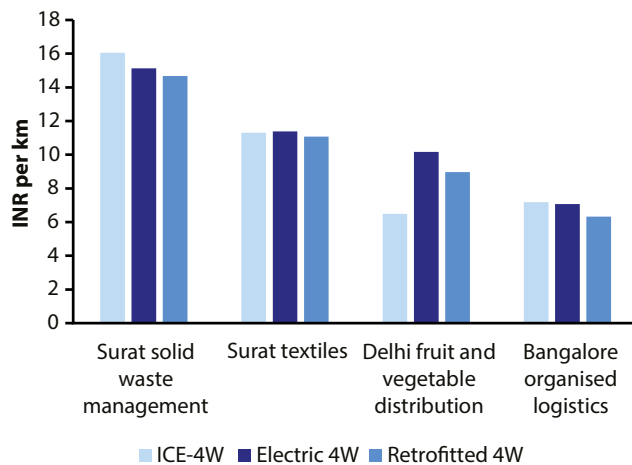


Figure 3 Comparative TCO per km (net present value) for four vehicles across use cases

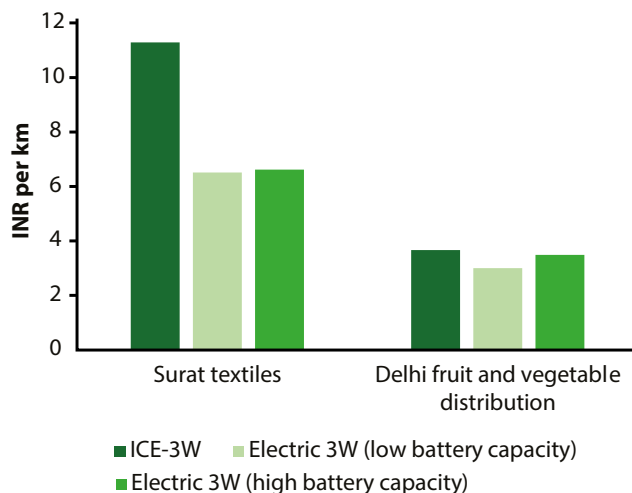


Figure 4 Comparative TCO per km (net present value) for three-wheelers across use cases

Policy Recommendations

Short-Term Measures (Within 1-2 years)

Policy Interventions

- **Ease in the freight movement and timings:** The cities can ease the movement of electric freight vehicles within the cities at all times for the initial period or increase the mobility time for electric freight vehicles.
- **Demarcation of electric vehicle zones:** The city can identify e-zones in the commercial areas or the trade areas where electric freight vehicles can be given preferences.
- **Urban E-freight studies:** The municipal corporation can initiate electric vehicle feasibility studies in the city-specific identified freight sector.
- **Parking incentive:** The electric urban freight vehicles can have reduced parking fees or no parking fees. They can also have a dedicated parking spot in the city transport hub or other freight centres with the provision of charging.
- **Ease in the registration process:** The registration process should be less cumbersome and should be paced up for the urban freight electric vehicles as this can reduce the time for accessing EMI and finances.
- **Increased awareness among RTO official:** Although policies for registering electric vehicles are in place, the knowledge among RTO officials regarding electric vehicles is low. This leads to increased time and problems with registering vehicles and obtaining documents. Training RTO officials regarding specific policies and process related to electric vehicles should be carried out for smoother operations.

Partnerships

- The city/government agencies can encourage private-public partnership for plying electric urban freight vehicles. A preference-based mechanism can be adopted for the selection of operators for city-based urban freight tasks. Different models such as lease based, rental platforms can be encouraged for adoption within the cities for electrification of urban freight segment.
- Online platforms can be developed for these logistics service providers and retailers



Financial Interventions

- **Incentive schemes:** The regional transport authorities can give incentives to the drivers for scrapping old vehicles and investing in the new electric urban freight vehicles. Some regional transport offices have these schemes to passenger three-wheelers which can be extended to the commercial vehicle segment as well. The RTO can be part of the loan guarantee mechanism to aid vehicle finance. The incentive scheme can also be extended to retrofitted technologies.
- **Reduced interest loans:** The financial institutions can facilitate reduced interest for electric freight vehicle. They should also provide loans to retrofitted vehicles to encourage the transition to electric.
- **Risk sharing mechanisms:** One of the key problems identified from financiers was related to the perceived risk associated with individual freight vehicle owner, especially three-wheeler drivers. Loans provided to these segments require lots of monitoring and micro-management. This kind of loans is best provided by smaller special finance banks or NBFCs. However, in order for nationwide scaling of these loans the government and the bigger banks should enter into co-agreements with the smaller banks so that the risk is shared and also the loans are managed well.

Medium-term Measures (3–5 years)

Policy Interventions

- **State action plans for electrification of urban freight:** The state can encourage the use of electric freight vehicles in the industrial areas and other state freight services. Specific incentives can be provided within the state policies for the usage of electrification of the urban freight to the third party or other private operators. States should encourage and sensitize the trade unions and *mandi* board for incentivizing the parking and other fees for electric vehicles. Additional support for charging infrastructure should be provided within these areas.
- **City plans:** The exiting city planning documents such as Master plans, mobility plans, smart city plans should identify and integrate electrification potential of urban freight sectors wherever possible.

Pilot Implementation

- The states should conduct pilot projects for small conversion of small electric freight vehicles which can be further scaled up. The pilot project will also provide a tailor-made solution to access the suitable charging model as well for the pilot.

Financial Interventions

- **Integrated platform:** The states should have an integrated platform which provides one access point to all the schemes and policies. The platform should be integrated with the financial institutions and manufacturers for easy access.
- **Financial credibility framework:** Developing a financial credibility framework for the manufacturers and drivers so that there are transparency and awareness regarding the financial loan process based on the company.

Long-Term Measures (6 years)

Policy Intervention

- **National programme:** Most of the European cities have led a countrywide national programme for electrification of urban freight sector. Similarly, in India, the Ministry of Road Transport and Highways could launch a nationwide programme specific to the urban freight sector. Since the market availability is more of the urban freight small commercial vehicles, therefore, they become a viable option for implementation.
- **Electric freight procurement schemes for government sectors:** The government can initiate the green procurement schemes for government delivery services such as postal services, banking services, airport freight management and other services.
- **Integration with other government interventions:** The government can integrate the electrification of the freight sector with its other schemes and programmes such as Swachh Bharat Mission, Smart City Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), among others.
- **National programme for charging infrastructure:** Mass adoption of charging infrastructure within the



cities along with clean grid initiatives. This is more of a blanket initiative which would accelerate the adoption of both passenger and commercial vehicles.

- **Scrapping policy:** The nationwide scrapping policy programme should focus and should be pushed in cities.

Institutional Instruments

- National committee to focus on urban freight should be encouraged. The committee should focus on

enabling manufacturing capabilities within the country for creating a constructive ecosystem for faster adoption of electric vehicles in the freight sector.

- Developed an impact assessment framework for measures applied to urban–interurban freight transport interfaces.



