

# Electrification and its influence on trip rates and vehicle choice in urban freight - Case study of Delhi

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The rapid electrification of goods vehicles in India, particularly in urban centers like Delhi, has transformed last-mile freight dynamics. This study has analyzed the impact of electrification on trip rates and vehicle choice within Delhi's urban freight sector. Using vehicle registration data, trip rates from the trip generation study, and vehicle count surveys, we have examined the shift from traditional light commercial vehicles (LCVs) toward electric goods three-wheelers (3WTs). The findings have revealed a significant rise in 3WT registrations and trip frequencies, alongside a relative decline in LCV usage. The projected sales of the 3WT segment have shown a steady rise from around 12,500 in 2025 to over 20,000 units by 2030, while the sales of LGVs have declined to 11,000 by 2030. Key drivers of this modal shift included operational advantages, fewer restriction on EV's entry timings, and supportive government policies promoting electric vehicle adoption. These insights highlight the changing nature of freight mobility in Indian cities and the need for strategies to further support sustainable urban logistics.

**Keywords:** Electric Vehicles, Freight Trips, Regression Analysis, Trip Generation

## 1 Introduction

Urban freight transport plays a critical role in the economic and logistic functions of rapidly growing cities like Delhi. As e-commerce, retail, and intra-city delivery services expand, so too does the pressure on road infrastructure, emissions levels, and energy demand. Traditionally intra city commodity delivery has been dominated by Light Goods Vehicles (LGVs) such as diesel vans and small trucks. However, last-mile delivery operations in Indian cities are increasingly undergoing a transition toward smaller, more efficient electric three-wheelers (3WTs). This shift is driven by multiple factors including rising fuel costs, government incentives for electric vehicle adoption, improved 3WT technology, and the suitability of compact electric vehicles for short-distance, high-frequency deliveries.

Delhi, as one of India's largest urban agglomerations, provides a compelling case to study this modal transition. Over the past five years, the city has witnessed a rapid rise in the registration and deployment of electric 3WTs for goods movement, coinciding with a stagnation and subsequent decline in LGV use. These changes indicate a transformation in urban logistics, where electric three-wheelers are beginning to replace

traditional delivery vans not only in terms vehicle registrations but also in actual usage.

This study investigates the nature and extent of this transition through a multi-source analysis involving vehicle registration data from Parivahan (2020 to 2025), traffic volume counts in East Delhi, and district wise trip rate surveys conducted in 2022 and 2025. By analysing these datasets together, the paper aims to quantify the shift in urban freight mode share, validate registration trends with ground-level traffic data, and understand how vehicle use behaviour has evolved across districts.

### 1.1 Literature Review

Urban freight transport has become an important focus in sustainable city development due to its impact on congestion, air quality, and energy use. The development of electric freight vehicles, particularly electric three-wheelers (3WTs), is seen as an important solution for addressing last-mile delivery challenges in densely populated urban environments like Delhi. This section reviews global and national trends in freight, the operational advantages of EV's, and the modal shift from Light Goods Vehicles (LGVs) to electric 3WT's.

The shift toward EV's is gaining momentum across the world, mostly driven by climate goals, stricter emission norms, and city-level policy interventions.

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Electric 3WTs and light commercial vehicles have been shown to significantly reduce tailpipe emissions, making them well-suited for urban logistics<sup>1</sup>. In European cities, the introduction of regulatory measures such as low-emission zones (LEZs) have led to transition towards cleaner and zero-emission vehicles, particularly through EV adoption<sup>2</sup>. China presents one of the most aggressive EV adoption models, where government subsidies have been shown to significantly accelerate electric vehicle uptake across regions, according to the Rocky Mountain Institute, in recent years Shenzhen has deployed nearly 60,000 electric light trucks and vans for urban freight, representing around one third of its delivery vehicle fleet in the city<sup>3</sup>.

India's urban freight ecosystem is dominated by small commercial vehicles, particularly in the form of diesel and CNG-powered LGVs. However, the electrification of this sector is increasing exponentially, especially in cities like Delhi, where policies have created environment for transition. The Delhi EV Policy (2020) has been instrumental in promoting electric 3WT adoption by offering incentives, subsidies, and operational benefits<sup>4</sup>. In Ahmedabad, Surat, and Delhi, analysis shows that electric freight three-wheelers can achieve significantly lower total cost of ownership compared to conventional fuelled freight vehicles with reductions of around 17–18%<sup>5</sup>, which makes them economically viable for last-mile deliveries. However, the pace of adoption is still constrained by factors such as range anxiety and limited availability of charging stations<sup>6</sup>.

Electric 3WTs tend to be more operationally efficient than traditional LGVs. Their lower running costs, fewer mechanical components, and regulatory exemptions contribute to higher trip rates and utilisation. A study conducted in Amritsar found that electric three-wheelers are 15–35% more cost-effective on a cost of ownership (TCO) basis, with operating costs of 2.5 INR/km, compared to 2.9–3.3 INR/km for CNG, diesel, or petrol variants. Around 18% of the city's diesel three-wheeler fleet has already transitioned to electric three-wheelers by December 2024<sup>7</sup>, reporting a higher vehicle utilisation rate for electric freight vehicles, highlighting that electrification not only affects ownership patterns but also alters daily operational behaviour. These findings align with the current study's district-wise trip rate analysis, which shows that 3WTs experienced a 35% increase in average trip rates between 2022 and 2025.

The observed decline in LGV usage and simultaneous rise in 3WT registrations point to a structural modal shift in urban freight transport. WRI<sup>8</sup> documented a similar transition in other Indian metros, where the economics of 3WTs combined with urban traffic restrictions on diesel vehicles make them more suitable for congested city environments. The growth of e-commerce has further intensified the demand for fast, flexible, and cost-effective delivery solutions, reinforcing the preference for compact electric vehicles. This shift is particularly relevant in Delhi, where LGV registrations have declined by over 30% since 2022 to 23, while 3WTs now comprise over 40% of all goods vehicle registrations.

## 2 Materials and Methods

### 2.1 Study Area

Delhi, the capital city of India, is a major metropolitan hub located in northern India, and is chosen as the study area for analyzing urban freight characteristics and developing trip generation models. The National Capital Territory (NCT) of Delhi is administratively divided into 11 districts: Central, East, New Delhi, North, North East, North West, Shahdara, South, South East, South West, and West Delhi as shown in Fig. 1. Spanning an area of approximately 1,483 square kilometers, Delhi had a population of 16.8 million as per the 2011 Census<sup>9</sup>, with estimates suggesting a population of over 20 million by 2021. The city's land use distribution reflects its complex

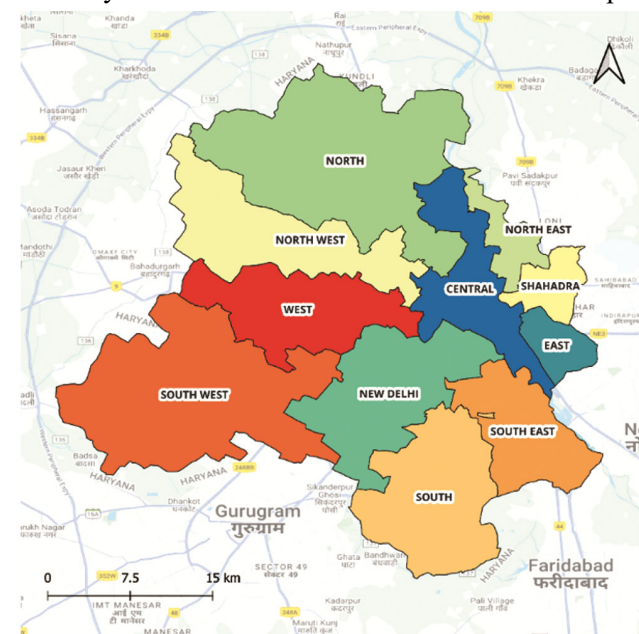


Fig. 1 — Districts of Delhi.

urban structure: around 52% of the area is built-up, including residential, commercial, and industrial zones<sup>10</sup>, 28% is under agricultural use; 13% is covered by forest land; and about 8% is occupied by transport infrastructure such as roads, railways, and airports<sup>11</sup>. While district-level land use data is limited, general patterns indicate that Central and New Delhi districts are predominantly commercial and administrative, South and South East Delhi include high-income residential and institutional areas, North West and South West Delhi are rapidly urbanizing with mixed land uses, and East and North East Delhi are dense residential zones with informal markets and mixed development. Industrial activities in Delhi are concentrated mainly in Shahdara (housing around 9.98% of Delhi's industries), Sadar Bazar (8.21%), and Tri Nagar (7.89%)<sup>12</sup>, with significant industrial clusters also present in Okhla (South Delhi), Naraina and Mayapuri (West Delhi), and Jhilmil (East Delhi). Commercial hubs are primarily located in Central Delhi (Connaught Place), South Delhi (Nehru Place, Saket), and West Delhi (Rajouri Garden), along with several decentralized district centers like Bhikaji Cama Place, Janakpuri, and Netaji Subhash Place developed by the Delhi Development Authority (DDA). This varied spatial and functional land use pattern significantly influences freight movement and underlines the importance of district-level planning in urban freight modeling.

## 2.2 Data collection and methodology

Freight travel behavior data collected manually for the districts of Delhi as part. A simple questionnaire was prepared and the main components of the questionnaire include freight information, trip information, mode choice preference, frequency of trip, type of commodity and type of vehicle considered for freight. Freight information includes details of establishment, type of commodity, number of workers, amount of import and export goods in tons, distance from Origin to Destination etc.

Whereas trip information includes details of travel time (min.), travel distance (km), trip frequency (per week) of freight trips. Freight travel behavior data collected manually across all districts of Delhi. A simple questionnaire was prepared and the main components of the questionnaire includes, freight information, trip information, mode choice preference, frequency of trip, type of commodity and type of vehicle considered for freight. Freight information includes details of establishment, type of commodity, number of workers,

amount of import and export goods in tons, distance from Origin to destination etc. Whereas trip information includes details of travel time (min.), travel distance (km), trip frequency (per week) of freight trips.

The type of commodity includes total amount of commodity like groceries, agriculture product, automobile, construction material, petroleum product, health care, public sector etc. It is very important that the amount of loads in tons depends on the type of vehicle either, whether it is Light commercial vehicles (LCV) or Goods Auto (3WT).

A total of 832 establishment samples of freight from different land use zones were collected in 2022. The maximum percentage of trips are generated within the city (52% Internal to Internal and 48% of total trips are external to Internal (E-I). Very few trips were observed from Internal to external. From the commodity type distribution, it was observed that Major distribution is Groceries (30%) followed by construction materials (27%). Small and Large scale sector distribution is 16% and Health care products also contributes 7%. A similar survey was repeated during 2025 in which 72 samples were collected.

## 3 Result and Discussion

Urban freight generation depends on industrial activities, commercial type activities and service activities. Industry type activities include agriculture, mining products, construction material, automobile products, light and heavy manufacturing and transportation equipment. Commercial activities include whole sale (Food grains and textiles), retail shopping (Groceries) and service sectors includes government, education, health services, hotels and other services. Visakhapatnam is growing city and this city has high industrial area in the core of the city and therefore the mode wise and zone wise trip rate estimation is very much essential to the planning agency to estimate generation of freight traffic in various zones.

### 3.1 Mode share of mini LCV and goods auto from registration data

Analysis of registration data from Parivahan reveals a significant shift in urban freight mode share, the growth of Light Goods Vehicles (LGVs) and an increasing share of 3-wheelers (3WT). From 2021 to 2025, the growth rate of LGVs steadily decreased. Over the past five years, three wheelers (3WTs) have become much more popular, while LGVs are being used less in Delhi. In 2020 - 21, only 1,412 three-wheelers were registered, but by 2024 - 25, this number increased to 10,370. When it comes to LGV

registrations initially grew from 9,582 (2020-21) to 21,794 (2022-23), they have declined by -19% (2023 to 24) and -15% (2024 to 25), likely due to competition from cheaper and more efficient electric 3WTs, which saw explosive growth from 1,412 (2020 to 21) to 10,370 (2024 to 25), with maximum at 118% CAGR (2021 to 22) before slowing to 6% (2024 to 25) as shown in Table 1. This trend suggests a transition in last-mile transport, where businesses and operators are increasingly favoring compact, electric 3WTs over traditional LGVs, possibly influenced by fuel costs, policy incentives, and urban logistics demand. The decline in LGVs indicated the rise of 3WTs, indicating a direct substitution effect accelerated by EV adoption. This happened because electric 3WTs are cheaper and easier to use for short trips. Meanwhile, registrations of

bigger vans (LGVs) grew at first but then dropped sharply after 2022 to 23, likely because many businesses switched to using electric three-wheelers instead. This shows a clear shift that people and companies are choosing small electric vehicles over traditional diesel vans for city transport and deliveries.

An analysis as shown in Table 2. of the mode share of 3WT and LGV indicate an increase in the share of the 3WT over years. The mode share of 3WT has grown steadily from 12.8% in 2020-2021 to 40.9% in 2024-2025, representing a 28.1 percentage point increase over five years. Between 2022-2023 and 2023-2024 3WT's increased 12.5 percentage points (from 23.2% to 35.7%). By 2024-2025, 3WTs accounted for nearly 41% of new registrations which is three times their initial share. The Fig. 2 clearly shows the increase in the number of electric three wheelers autos over the years. EV penetration has increased from 0 % to 31 % in just 3WT and LGV.

Table 1 — Growth of LGV and 3WT in Delhi

| Year      | Vehicles |       | CAGR |      |
|-----------|----------|-------|------|------|
|           | 3WT      | LGV   | 3WT  | LGV  |
| 2020-2021 | 1412     | 9582  |      |      |
| 2021-2022 | 3078     | 14418 | 118% | 50%  |
| 2022-2023 | 6570     | 21794 | 113% | 51%  |
| 2023-2024 | 9822     | 17668 | 49%  | -19% |
| 2024-2025 | 10370    | 15003 | 6%   | -15% |

### 3.2 Mode share analysis from volume counts

For the purpose of analysis, traffic volume counts near Anand Vihar in East Delhi were also analyzed to check the trend of 3WT (Table 3) and LGV (Table 4) with respect to the registration data. The

Table 2 — Change in share of EV's by year

| Vehicle Type | 2020-21 | 2021-22 | 2022-23 | 2023-24 | 2024-25 |
|--------------|---------|---------|---------|---------|---------|
| 3WT P        | 12%     | 10%     | 9%      | 12%     | 12%     |
| 3WT EV       | 0%      | 7%      | 14%     | 24%     | 29%     |
| LGV P        | 87%     | 82%     | 77%     | 63%     | 57%     |
| LGV EV       | 0%      | 0%      | 0%      | 1%      | 2%      |

P is all other fuel types, EV is electric vehicles

Table 3 — Volume count of 3WT near Anand Vihar area

| Location Name                            | 3WT      |       |       |      |      |  |
|--|----------|-------|-------|------|------|--|
|  | Vehicles |       |       | CAGR |      |  |
|  | 2022     | 2023  | 2025  | 2023 | 2025 |  |
| Chaudhry Charan Singh Marg- Flyover      | 18066    | 18245 | 20434 | 1%   | 6%   |  |
| Chaudhry Charan Singh Marg- Service Road | 18160    | 25629 | 32498 | 41%  | 13%  |  |
| Anand Vihar Railway Station              | 8729     | 9918  | 14703 | 14%  | 22%  |  |
| Anand Vihar ISBT                         | 11703    | 14257 | 19965 | 22%  | 18%  |  |
| Patparganj Industrial Area               | 1504     | 1653  | 2875  | 10%  | 32%  |  |

Table 4 — Volume count of LGV near Anand Vihar area

| Location Name                            | LGV      |      |      |      |      |  |
|--|----------|------|------|------|------|--|
|  | Vehicles |      |      | CAGR |      |  |
|  | 2022     | 2023 | 2025 | 2023 | 2025 |  |
| Chaudhry Charan Singh Marg- Flyover      | 635      | 521  | 485  | -18% | -4%  |  |
| Chaudhry Charan Singh Marg- Service Road | 285      | 314  | 267  | 10%  | -8%  |  |
| Anand Vihar Railway Station              | 44       | 46   | 40   | 5%   | -7%  |  |
| Anand Vihar ISBT                         | 452      | 461  | 429  | 2%   | -4%  |  |
| Patparganj Industrial Area               | 953      | 1039 | 831  | 9%   | -11% |  |

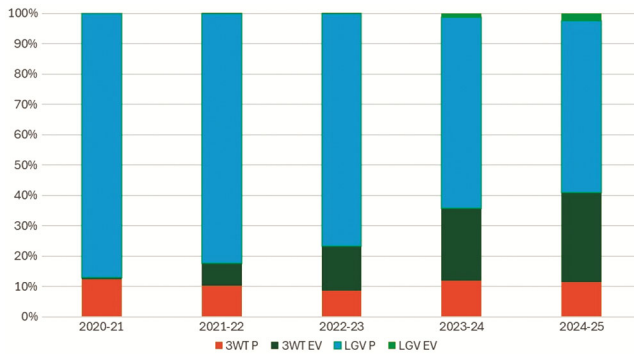


Fig. 2 — Change in mode share of goods auto and LCV (source : PariVahan,2025).

Table 5 — District wise trip rate (100 Sq.mts per week).

| District name     | LGV   |      | 3WT  |      |
|-------------------|-------|------|------|------|
|                   | 2022  | 2025 | 2022 | 2025 |
| Southwest         | 7.2   | 6.6  | 16.3 | 22.7 |
| North             | 14.1  | 14.5 | 28.6 | 36.6 |
| Northwest         | 8.2   | 7.8  | 17   | 25.2 |
| West              | 10.65 | 10   | 17.9 | 20.4 |
| New Delhi         | 4.5   | 4.2  | 10.3 | 13.1 |
| Central           | 6.5   | 6.4  | 12.9 | 18.8 |
| Northeast         | 8.9   | 8.2  | 15.8 | 19.9 |
| Shahdara          | 10.18 | 10.3 | 17.4 | 24.4 |
| East              | 8.7   | 8.6  | 10.9 | 14.2 |
| SouthEast         | 9.35  | 9.6  | 22.7 | 31.1 |
| South             | 8.6   | 8    | 21.4 | 30.8 |
| Average Trip Rate | 8.8   | 8.6  | 17.4 | 23.4 |

decrease in LGV traffic strongly corroborates the registration data showing shift from light goods vehicles to three-wheelers as shown in . As LGV counts fell by 4-24% at various location between 2022-2025, including in major commercial and industrial area like Patparganj Industrial Area. This trend in volume counts shows how decrease in LGV usage directly reflects the registration shift, as operators replace traditional delivery vans with electric three-wheelers. The highest LGV traffic decrease (18-24%) occurred when three-wheeler registrations surged by 12.5 percentage points (2022-2024). 3WT adoption shows inverse elasticity of -0.48 for every 1% LGV traffic decrease 3WT registration increase by 0.48%.

Confirming that the shift from the LGV to 3WT in registration data in actually shown traffic patterns. This traffic data provides a validation that the registration trends represent a shift in urban goods movement.

**3.3 District wise trip rate**

The zone wise trip rates are estimated per hundred square meter per week for commercial land use was

calculated. Survey in 2022 and 2025 were compared to analyze the effect of change in mode share of 3WT and LGV on their respective trip rates as shown in Table 5d.

LGV’s trip rates remained same across districts with an average trip rate of 8.8 to 8.6 trips, 3WT’s trip rates increased drastically in all districts, with average trips increasing from 17.4 to 23.4 which is 35 % growth. The also data shows a clear inverse relationship where districts with higher 3WT trip growth saw higher decrease in the LGV trip rate. The Central district showed the largest difference 3WT and LGV trip rate in 2025. These trip patterns strongly correlate with the registration trends, confirming that increased 3WT adoption directly shows higher utilization rates, while LGVs are being phased out of daily operations even after stable fleet numbers. The uniform growth across all districts shows that this is a city level shift.

**3.4 Trip rate forecast based on registered vehicles**

To forecast trip rates based on vehicle registrations numbers, a multiple linear regression (MLR) analysis was developed using district level data on registered vehicles. The goal of this analysis is to develop a predictive model that estimates the freight trip rate based on the number of registered electric three-wheelers (3WTs) and Light Goods Vehicles (LGVs) in each district. Vehicle registration serves as an indicator of trip rate reflects actual usage patterns in urban freight transport.

The model assumes a linear relationship between the dependent variable and each independent variable, allowing identification of how each independent variable contributes to the variation in the dependent variable when all other variables are considered. The model predicts and interprets the dependent variable based on the given set of predictors by estimating the coefficients of the independent variables. MLR equation considered in this study is given in Equation (1)

$$Y = a_1 * X_1 \dots (Eq. 1)$$

Where, Y = trip rate

X1 = Registered Vehicles

a1 = coefficient of the model parameters.

By using MLR, the model captures the relationship between the number of registered vehicles and the expected trip rates, allowing for data driven

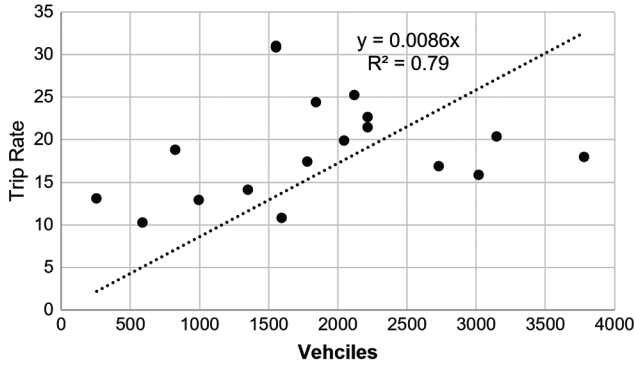


Fig. 3 — Trip rate 3WT.

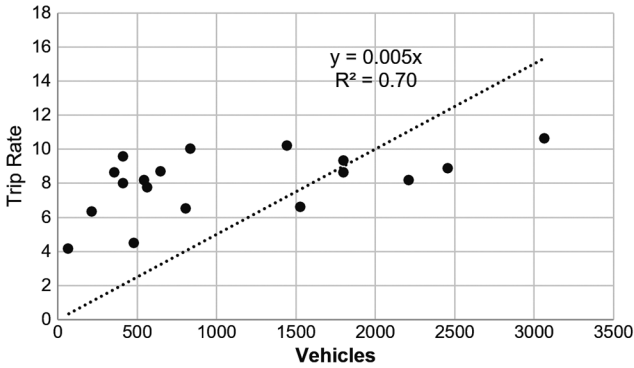


Fig. 4 — Trip rate LGV.

forecasting and planning. This is particularly useful for understanding how shifts in vehicle adoption, such as the growing prevalence of electric 3WTs, may impact future freight activity. The following graphs in Fig 3 illustrate the individual linear relationships between vehicle registrations and trip rates for both 3WTs and LGVs, supporting the forecasting model with observed trends and correlations in the data.

The relationship between the number of three-wheelers (3WTs) and the trip rate across different areas. It reveals a strong positive correlation, indicated by the trend line equation  $y = 0.0086x$  and  $R^2$  value of 0.79. This shows that as the number of 3WTs increases, the trip rate generally rises, with around 79% of the variation in trip rate explained by the number of vehicles. Most data points follow this trend, a few outliers suggest variations in local conditions or usage patterns.

The relationship between the number of light goods vehicle (LGV) and the trip rate across different areas is shown in Fig. 4 It reveals a strong positive correlation, indicated by the trend line equation  $y = 0.005x$  and  $R^2$  value of 0.70. This shows that an increase in LGVs is generally associated with a higher trip rate, and about 70% of the variation in trip rate

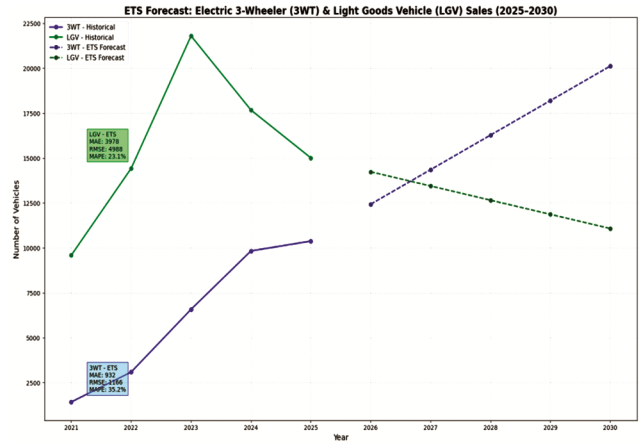


Fig. 5 — Projected sales of electric 3WT and LGV in Delhi 2025-2030.

can be explained by the number of vehicles. The trend is strong but slightly weaker than that of 3WTs, suggesting a less efficient or consistent usage pattern

### 3.5 Electric 3WT growth forecast

The growth of Electric 3-Wheelers (3WTs) was forecast using the Exponential Smoothing (ETS) method with an Additive Trend component. This time series model is well-suited for short-term projections where data exhibits a consistent upward trend but lacks strong seasonality typical of emerging EV markets. The ETS model decomposes historical data (2021–2025) into two key components:

- *Level* ( $\ell_t$ ): The baseline sales value at time  $t$ , updated recursively using a smoothing parameter ( $\alpha$ ).
- *Trend* ( $b_t$ ): The additive rate of growth, smoothed using parameter ( $\beta$ ).

The forecasted sale  $\hat{y}_t$ , for a future point  $t + h$  is calculated as:

$$\hat{y}_{t+h} = \ell_t + h \cdot b_t \dots \text{(Eq. 2)}$$

where  $h$  is the number of years ahead.

This method flexibly captures linear growth trends while ignoring seasonality, making it ideal for early-stage EV adoption patterns. Model performance was evaluated using standard metrics of Mean Average Error (MAE), root Mean Square Error (RMSE), and Mean Average Percentage Error (MAPE). A MAPE of 35.2% reflects the presence of variability in electric 3WT.

The adoption trajectories of electric three-wheelers (3WT) and light goods vehicles (LGV) in Delhi’s urban freight sector, from 2025 to 2030, show contrasting trends, as highlighted in Fig. 5. The 3WT

segment continues its upward momentum, with forecasts showing a steady rise from around 12,500 in 2025 to over 20,000 units by 2030. This growth aligns with policy pushes, last-mile delivery needs, and cost advantages associated with electric 3-wheelers.

In contrast, the LGV segment displays a downward trend post-2025, with vehicle numbers declining from approximately 14,000 in 2025 to nearly 11,000 by 2030. This projected dip likely reflects the substitution effect, where electric 3WTs are increasingly replacing traditional light commercial vehicles due to their lower operating costs, improved range, and regulatory incentives targeting smaller electric freight carriers. Together, the forecast underscores a structural shift in urban freight, with electric 3WTs poised to dominate short-distance deliveries, effectively taking over a significant share of the LGV market by the end of the decade.

#### 4 Conclusion

This study provides empirical evidence of modal shift in Delhi's urban freight transport sector from LGVs to three-wheelers between 2020 and 2025. Analysis of vehicle registration data, traffic volume counts, and district-wise trip rates clearly indicates that electric 3WTs are rapidly replacing LGV for last-mile delivery and intra-city goods movement.

Registration data from Pari Vahan highlights an 634% increase in 3WT registrations and a simultaneous decline in LGV registrations by 15–19% in the past two years, suggesting a clear substitution effect. Traffic counts near key freight corridors such as Anand Vihar further validate this trend, showing a corresponding decrease in LGV traffic and a rise in 3WT usage. The estimated inverse elasticity -0.48 supports the conclusion that for every 1% decrease in LGV traffic, there is a 0.48% increase in 3WT registrations. Additionally, district-level trip rate data shows that electric 3WTs are not only growing in numbers but are also being utilized more intensively averaging a 35% increase in weekly trip rates citywide. Our findings indicate a sharp rise in the future sale and daily utilization of electric 3WTs, accompanied by a relative stagnation in LCV usage.

Key enablers of this transition include the lower total cost of ownership (TCO) of electric vehicles, fewer restrictions on EV entry timings in low-emission zones, and targeted state and central government incentives such as FAME-II subsidies, scrap page benefits, and green registration exemptions. Furthermore, the increasing availability of urban charging infrastructure and the alignment of typical freight trip lengths with the range capabilities of e-3WTs support their growing dominance.

The findings demonstrate that Delhi's EV policies and cost economics of electric 3WTs are driving a change in urban freight logistics. The transition is not limited to specific districts or corridors but is instead the whole city, indicating a scalable and replicable model for other Indian cities. While the benefits in emissions reduction and operational efficiency are evident.

#### References

- 1 Taniguchi E, Sustainable Urban Freight Transport, (Elsevier, 2020).
- 2 Quak H, Lindholm M & Tavasszy L, *Transport Research Procedia*, 12 (2016) 461 - 473.
- 3 Zhang T, Burke PJ & Wang Q, *Resource and Energy Economics*, 76 (2024) 101424.
- 4 NITI Aayog, *EV Adoption in Indian Cities*, NITI Aayog, 2021.
- 5 Swamy H M S, Sinha S, Modi K, Jose D, Sanghvi D, Chippa N & Khurana Y, *Journal of South Asian Logistics and Transport*, 2 (2022) 23–45
- 6 Tarei P K, Chand P & Gupta H, *Journal of Cleaner Production*, 291 (2021) 125847.
- 7 Raghavan S, Vaid S & Sen R, *World Electric Vehicle Journal*, 16 (2025) 554.
- 8 Rao R, Maiti S & Mulukutla P, Assessing the Viability of Using Autorickshaws for Urban Freight Delivery in India, *WRI India*, 2023.
- 9 Census of India, *Provisional Population Totals: Urban Agglomerations and Cities*, Office of the Registrar General & Census Commissioner, 2011.
- 10 Rupesh Kumar Gupta, *The Land Use Pattern of National Capital Region Delhi Using Geo-informatics*, Research Gate, 2021.
- 11 Delhi Development Authority, *Master Plan for Delhi - 2021*, DDA, 2007.
- 12 Delhi State Industrial and Infrastructure Development Corporation, *Status Report on Industrial Areas in Delhi*, DSIIDC, 2021.