Electrification Potential of Urban Freight Vehicles

Delhi LGV Electrification Survey

Final Report

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TRANSPORT DEPARTMENT
Government of NCT of Delhi

TRIP CENTRE

SGA sustainable mobility solutions

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1 Background

Studies conducted in Indian cities show that urban freight is dominated by small goods vehicles with a payload capacity of around 0.5 to 1 ton (Gandhi et al., 2019). These include 3 wheelers and 4 wheelers such as Tata Ace and pickup trucks. They are therefore significant contributors in carbon emissions and local pollution. Such vehicles and their operations contribute 75% of all freight related emissions within the city, which account for about 25% of all vehicular emissions. To make matters worse most of these are single vehicle fleets and remain largely unorganised resulting in less than 20% utilisation of kilometres deployed.

However, because of their low trip length and peak payload requirement, most of the current logistics trips by small freight vehicles can be easily electrified. Current studies show that more than 80% of the daily operations by these ICE freight vehicles is within weight and range limit of (currently) commercially available e freight vehicles (Gandhi et al., 2019). This implies that there is a significant need and potential for electrification of small freight vehicles. However, the rate of electrification of freight vehicles in the country remains very low. Major reasons for low penetration of EV in freight sector is understood as lack of supporting policy, limited charging as well parking infrastructure, and limited access to finances for overcoming the high upfront capital cost (even though the operational costs and TCO remain attractive as compared to ICE vehicles).

To overcome these bottlenecks, the Government of National Capital Territory of Delhi (GNCTD) has put in place significant measures to overcome these bottlenecks. These are embedded in the Delhi EV policy (August 2020) which builds in fiscal and non-fiscal incentives for vehicle owners, in addition to eco-system development measures (through Switch Delhi mission) including massive investment in charging station development throughout the state. Subsequently we have witnessed the penetration of electric vehicles in the freight sector, but this is currently by larger aggregators such e-Del. While it is expected that the bulk of freight operations in Delhi is by single or small fleet operators, their transition to e-freight is little or non-existent. As per Vaahan database, out of 21,885 light good vehicle (LGV) sales in Delhi, only two were electric. This is less than 0.01% of LGV sales.

Clearly the reason for such low adoption of e-freight vehicles notwithstanding a range of fiscal and non-fiscal incentives available, needs to be investigated. To achieve this, GNCTD under a memorandum of understanding (MoU) with Transportation Research and Injury Prevention Centre (TRIP-C) at Indian Institute of Technology Delhi (IITD) has initiated a study to understand the gaps and requirements for electrification of light goods vehicles in Delhi. This report develops a baseline for urban freight, characteristics in Delhi including daily trips, average trip length, average trip weight, model as well age characteristics, current operational characteristics, current TCO, etc. based on primary surveys. The survey will also identify bottlenecks in electrification of this mode. This report includes the details of the survey, survey findings and broad recommendations that may be considered to accelerate adoption of e-freight vehicles in the State.

2 Survey Methodology

To achieve the objectives of this study, a user interview based primary survey format was finalised. The survey form was developed and was administered by survey enumerators to LGV owners with payload capacity ranging from 0.5 ton to 1.5 ton. A pilot questionnaire was first administered and a total sample of 50 was collected. This was analysed, and the survey questionnaire revised based on the findings from the pilot. The final survey was administered by the appointed enumerators in the month of January and February 2023 and a total of 2,000 samples was collected. The overall response rate for the survey was 80%.

The final survey questionnaire was divided into 4. parts and included a total of 40 questions. These parts are:

- Personal & Vehicle Details
- Operational Details
- Revenue and Cost Details
- User (Owner) Perception

The approximate time for filling each form was reported as 15 minutes. The 99% of forms were completely filled. While only 30 forms had missing data. The missing data mostly related to questions on odometer reading, customers served and parking location during working hours Not more than 2 questions or 5% of required responses were missing in any form. Annexure 1 presents the questionnaire used for the survey.

2.1 Survey Location

The survey samples have been collected from the different zones of Delhi. These are mainly concentrated in North and northeast Delhi near whole sale markets. These include locations such as Azadpur, Bawana, Burari, Chandani chowk, Fatehpuri, Gazipur mandi, Old Delhi, Jahangir Puri, Jhilmil, Kashmiri Gate, Mandoli, Naya bazar, Okhla, Samaypur Badli and Shashtri park etc. The survey locations were identified based on density and movement of freight vehicles. The identified survey locations were the mandi, wholesale market and industrial areas such as Azadpur (Asia’s largest vegetable and fruits market), Old Delhi (noted for being the largest wholesale and goods market), Bawana and Okhla (industrial area). The survey locations and photos are presented in Figure 1 and Figure 2.

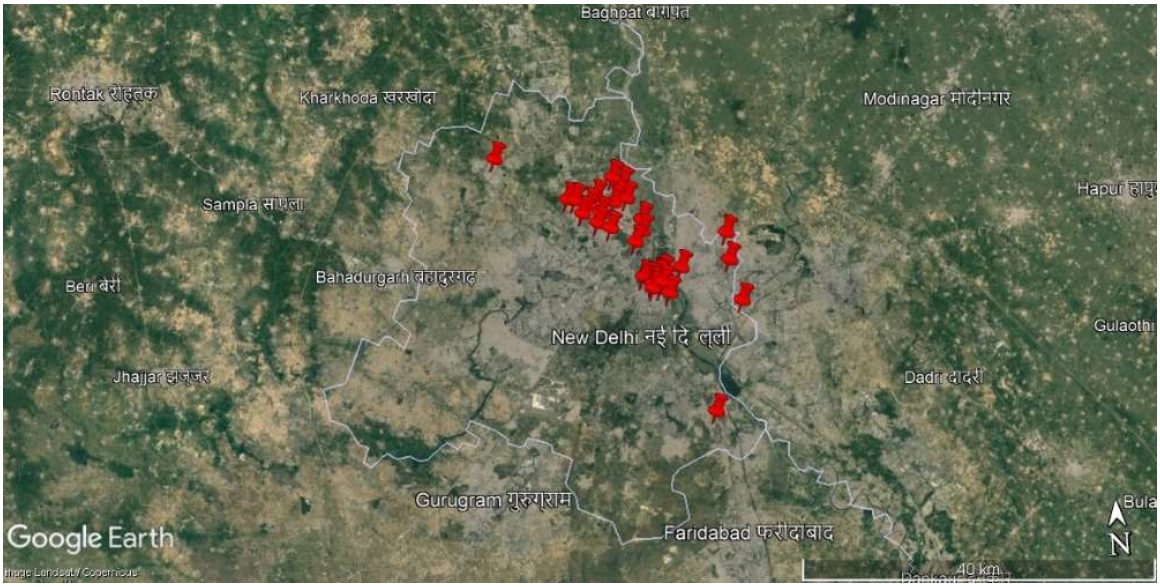

Figure 1: Map of Delhi showing survey locations

Azadpur market (mandi)

Naya bazar (Food grain market)

Khari baoli market (Old Delhi)

Okhla & Jhilmil (Industrial area)

Figure 2: Some photos of survey locations

3 Survey Data and Analysis

The survey form was divided into 4 parts. This section presents the data and findings from each of the parts.

3.1 Part 1 - Personal and vehicle details

A total of 11 questions were presented to the respondents in this part. Out of these, 2 questions focused on personal information of the owner such as Name and contact number. The remaining 9 questions under this section focused on the vehicle details such as year of registration, fuel type, odometer reading, vehicle type (3 or 4 wheeler), vehicle model, etc. The responses received against these 9 questions were used directly as well indirectly used to derive the findings. The answers from questions - vehicle number, year of registration, year of make and odometer reading were used to derive additional data/findings used in the analysis. The range, mean and standard deviation of responses collected for questions in this part have been presented in the Table 1 with respective range response, mean and standard deviation.

Table 1: The range, mean and standard deviation of responses to question on personal and vehicle details

Question	Minimum	Maximum	Mean	Standard Deviation	Number of responses
Fleet Size	1	25	1.22	1.1	1996
Vehicle Type (Three/Four-Wheeler)	772 Three-wheeler	1228 – Four Wheelers	-	-	2000
Fleet Utilisation (%)	20	100	99.53	5.2	2000
Odometer Reading (km)	115	17,00,000	1,24,437.85	1385.9	1984

Based on the responses, the findings derived for each question is presented in the subsequent section

3.1.1 Vehicle Type

For questions related to vehicle type,100% response were received. The analysis revealed that 62% of the vehicles used were four wheelers while rest 38% consisted of three wheelers. This section presents, the capacity, model name, and fuel type of each vehicle type. The current study is limited to LGV. A total of four categories of freight vehicles upto 1500 kg capacity, in LGV category have been covered in this study.

Table 2: Categories of freight vehicles covered in this study

S. No.	Name	Description	Payload Capacity
1	carts	E-carts and some 3-wheeler models	<=500kg
2	3-wheeler	Freight 3-wheeler models, ex. Bajaj, Piaggio	501-699 kg
3	4-wheeler	Freight 4-wheelr models, ex. Tata Ace	700-999 kg
4	Pick-up truck	Pick-up truck models, ex. Mahindra Bolero	1000 – 1500 kg

These four categories have been selected because most three wheelers have a load carrying capacity between 500-700kg, while most four wheeled non-pickup truck vehicles have a capacity between 700-1000 kg, while current pickup trucks have a capacity between 1000-1500kg.

3.1.1.1 Vehicle type by payload capacity

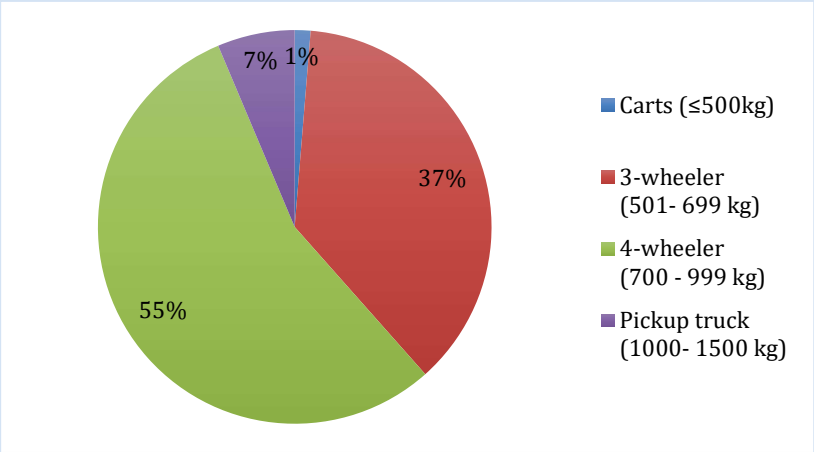

Figure 3: Distribution of vehicle type by payload capacity

3.1.1.2 Vehicle model by type

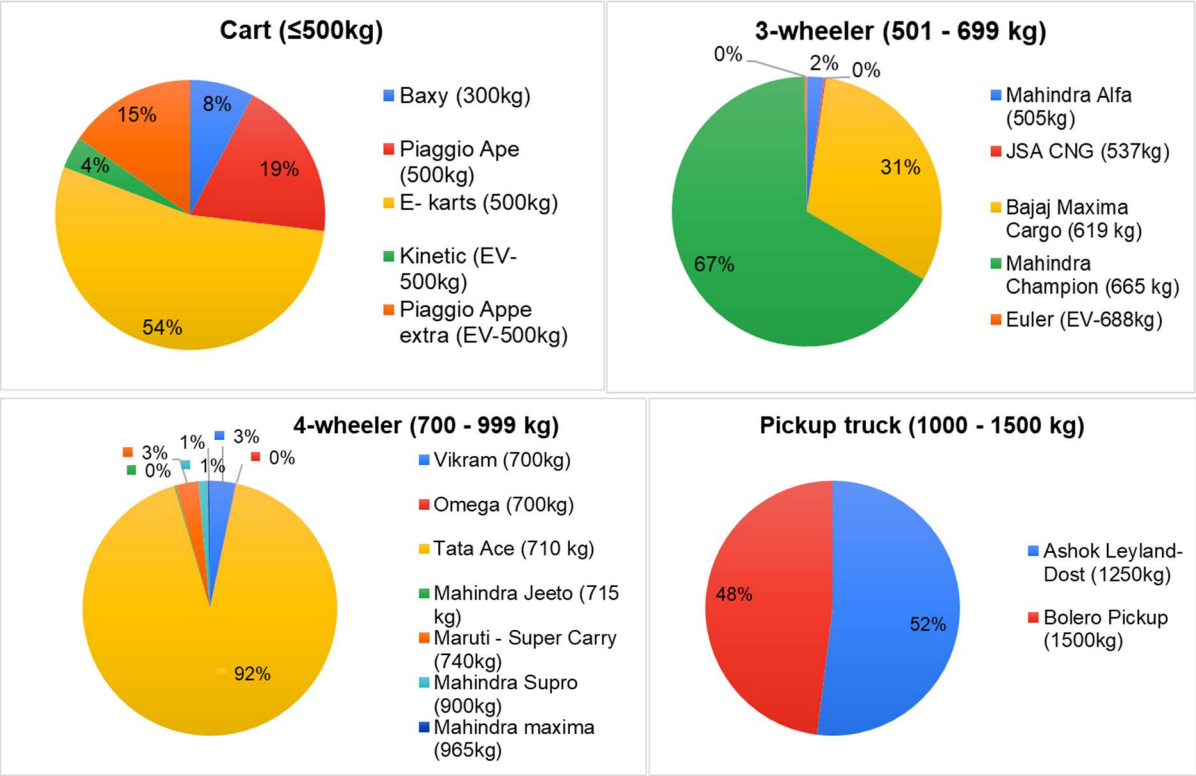

Figure 4: Distribution of vehicle models by capacity

3.1.1.3 Vehicle type by fuel

A 100% response rate was obtained when asked about the type of vehicle used in terms of fuel type. Analysis showed that only 1% of the respondents used electric vehicles, while the remaining 99% using internal combustion engines (ICE) type vehicles, mostly with CNG.

All observed electric freight vehicles, were either three-wheeler or e-carts.

3.1.2 Commodities carried by freight vehicles

99% (1996 responses out of 2000 samples) responded to the question on commodity distribution by freight vehicles. The analysis revealed that majority of commodities carried were food and grains (44%), followed by, mixed[1] (26%) and courier and e-commerce (8%). Capacity wise analysis shows <700kg capacity vehicles (carts and 3-wheelers) carry a relatively higher share of perishable food, FMCG, grocery and food grains, while >=700kg capacity vehicles (4-wheelers and pick-up trucks) carry a higher share of courier & E-commerce, solid waste and mixed commodities. Table 3 and Figure 5 presents the distribution of freight vehicles, by commodity carried. Figure 6 presents the comparative distribution of different freight vehicles by commodity carrie.

Table 3: Commodities carried by freight vehicles

S. No.	Commodity	No. of responses	**% Distribution**
1	Food Grain	870	43.6
2	Perishable Food	32	1.6
3	Liquor	1	0.1
4	FMCG	47	2.4
5	Courier and E-Commerce	164	8.2
6	Cash	2	0.1
7	Pharmacy	13	0.7
8	Hotel & Restaurant	17	0.9
9	Electronics	44	2.2
10	Solid Waste	91	4.6
11	Clothes & Accessories	52	2.6
12	Printing & Publishing	42	2.1
13	Construction & Demolition	34	1.7
14	Oil and Natural Gas	17	0.9
15	Mixed	512	25.7
16	Other	58	2.9
Total		2000	100%

[1] Mixed: carrying more than one commodity during the day in different trips.

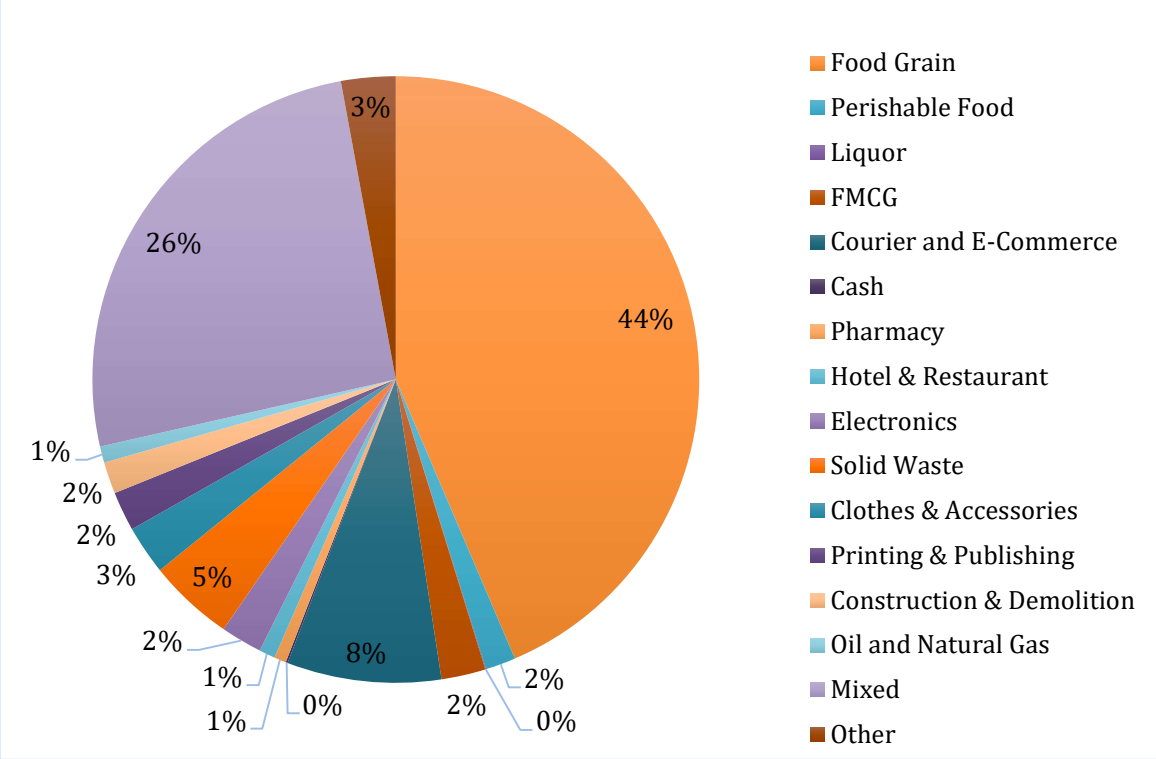

Figure 5: Breakup of different commodities carried by freight vehicles

3.1.2.1 Commodity distribution by vehicle type

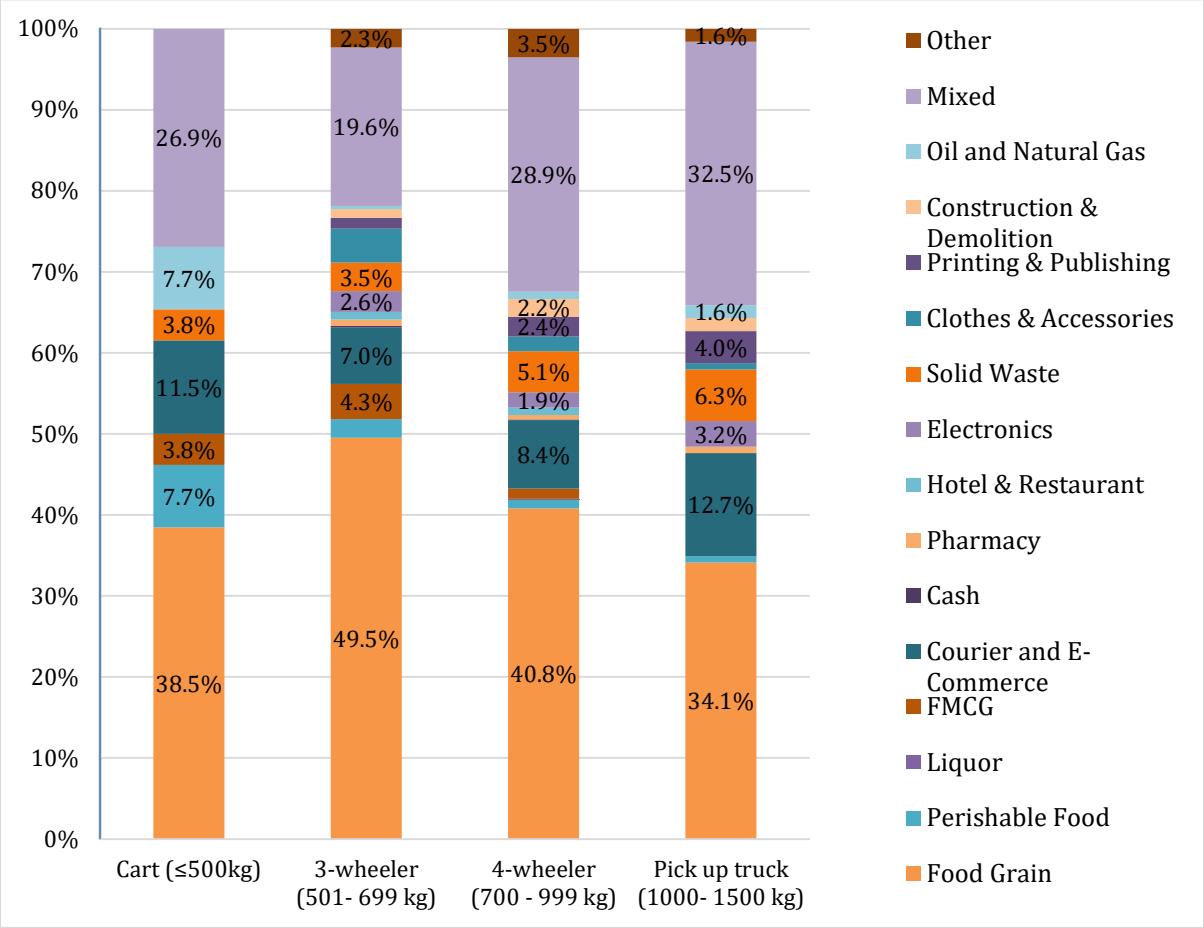

Figure 6: Commodity distribution by vehicle type

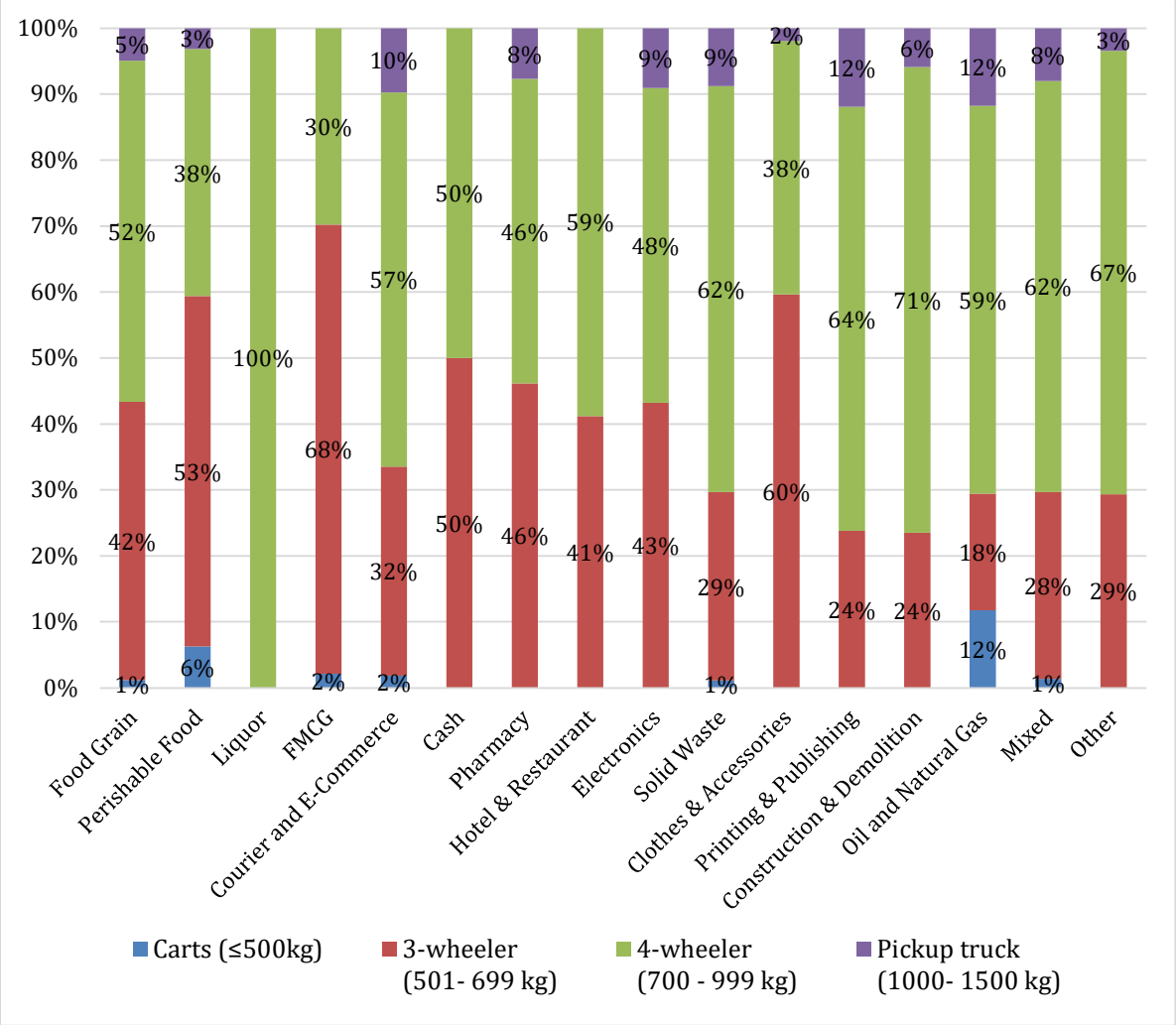

Figure 7: Vehicle type distribution by commodity

3.1.3 Fleet Size and Utilisation

For fleet size and fleet utilization 100% response (2000 samples) was received.
The analysis revealed the following:

1. About 91% (1815 responses) of the users owned single vehicle and achieved an average of 100% fleet utilization.
2. 8% (159 responses) of users owned vehicles with fleet size ranging from 2 to 4 vehicles and achieved an average of fleet utilization of 95%
3. 1.15% (23 responses) users were found to be using a fleet ranging from 5 to 10 vehicles and achieved an average of 98% of fleet utilization.
4. Only 0.45% (3 responses) owned a fleet size comprising of more than 10 vehicles and achieved an average fleet utilization of 90%

When the data is distributed vehicle payload capacity wise the analysis suggests that 4-wheeler and pick-up truck owners have larger fleet size than 3-wheelr and cart owners. The analysis suggests higher per vehicle utilisation for single vehicle owners and lower for multiple vehicle owners. This is because single vehicle owners can't afford to utilise their vehicle on any given day. Figure 8, Figure 9*Figure 8* and Figure 10 presents fleet size breakup and fleet utilization of freight vehicles.

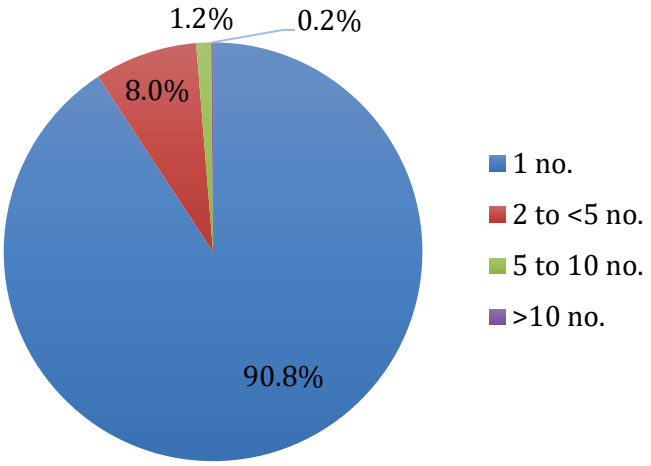

Figure 8: Fleet size distribution

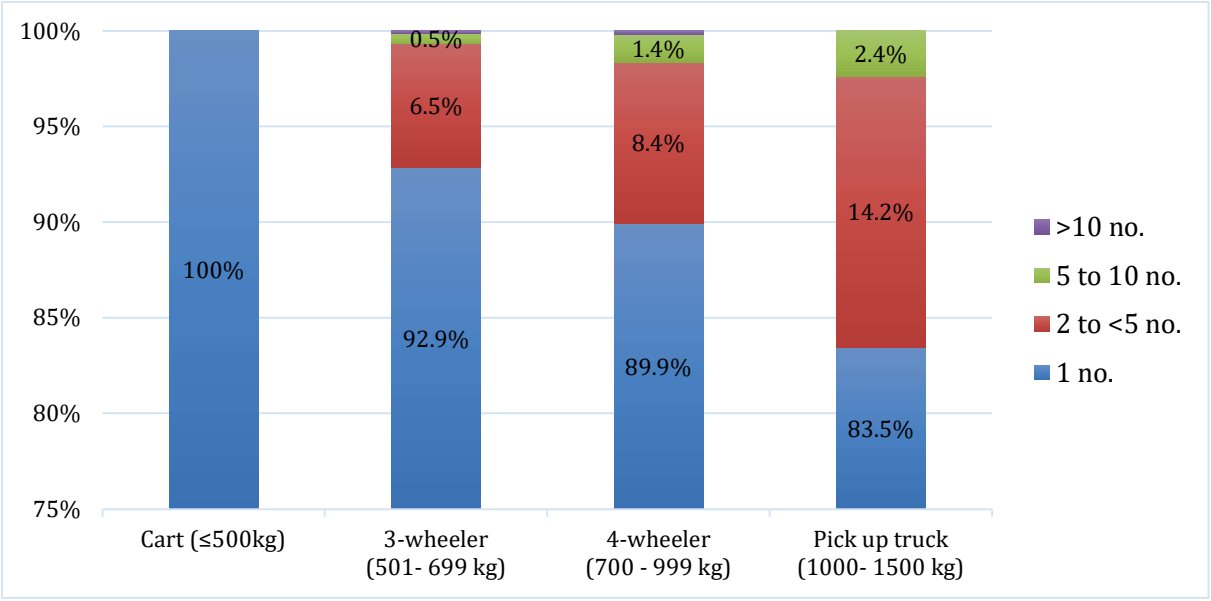

Figure 9: Vehicle type wise fleet size distribution

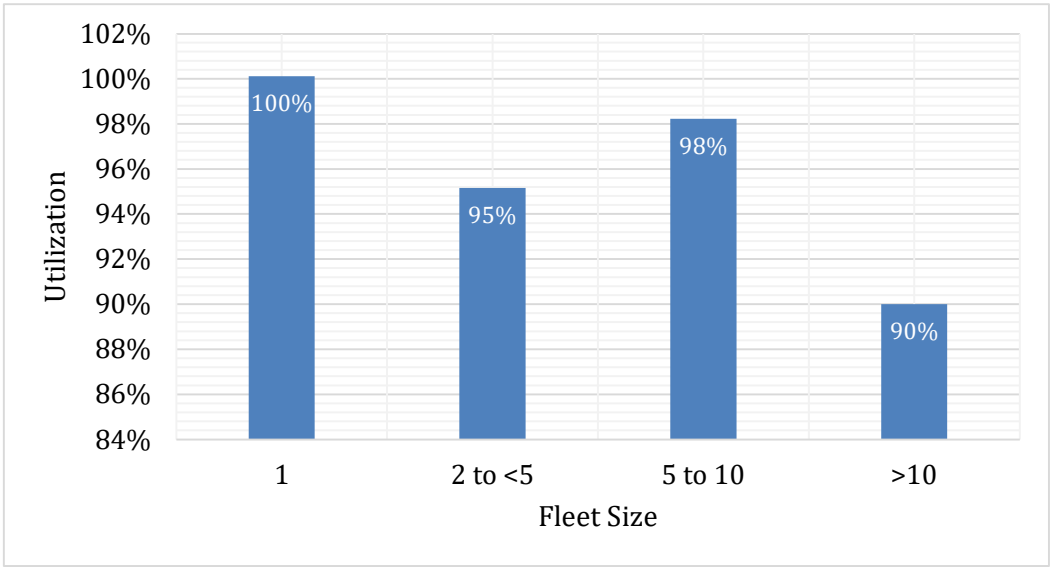

Figure 10:Average vehicle utilization by fleet size

3.1.4 GST Number?

As part of the survey, the users were also enquired about GST registrations. 100% response were received for this question. The responses revealed that only 2% of the owners have a GST registration.

3.1.5 Vehicle Ownership

100% response rate was achieved for questions related to ownership type of fleets. Only 3% of fleets are second hand and 97% are first hand.

3.1.6 Vehicle Age

The fleet owners were asked about the registration year of their vehicles. This was used to derives the vehicle age (Figure 11). The analysis revealed that 42% fleet vehicles were 1 to 5 years old, followed by 33% which were 6 to 10 years old, while 23% were 11 to 15 years old and only 2% fleet vehicles were <1 year old. When the data is distributed vehicle payload capacity wise the analysis suggests that for 4-wheelers and pick-up trucks 58% vehicles are under 5-year-old while less than 15% are more than 10-year-old. While for carts and 3-wheelrs, 37% vehicles are >10-year-old while less about 25% are less than or equal to 5-year-old (Figure 12). The average age carts are 3.9 years, for 3-wheelers is 8.6 years, for 4-wheelers is 5.6 years and for pick-up trucks is 5.4 years. This indicates that 3-wheelers can be electrified sooner.

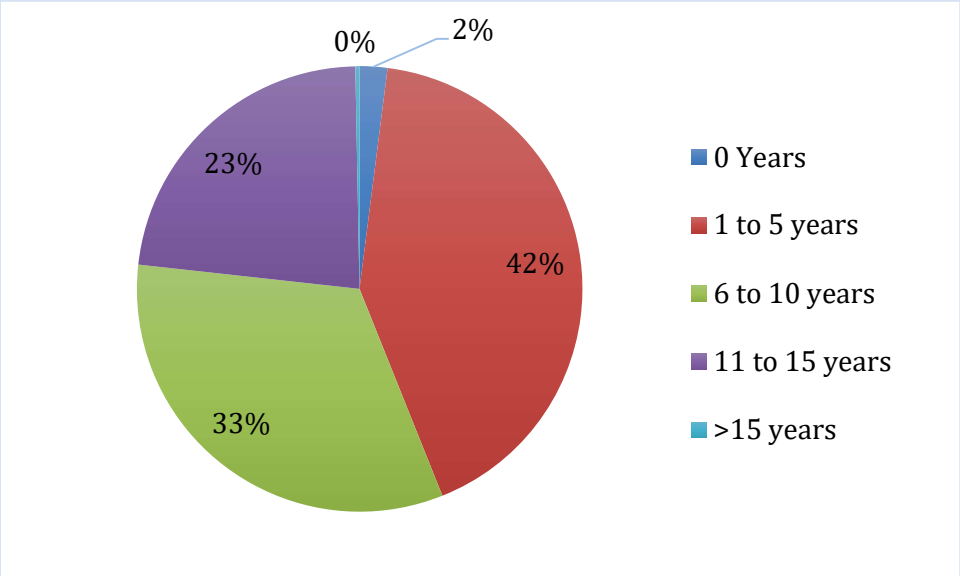

Figure 11: Distribution of vehicle age

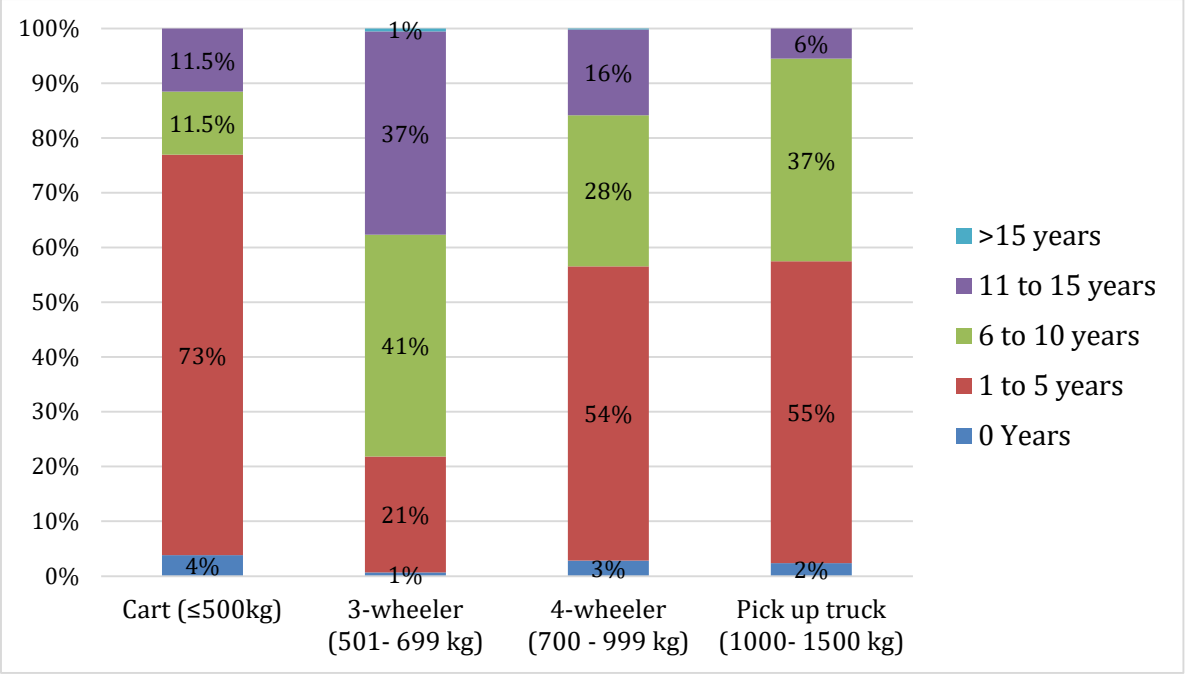

Figure 12: Vehicle type wise vehicle age distribution

3.1.7 Odometer Reading

For odometer reading 99% (1984 samples) response were received. The average km driven (by vehicle payload capacity) has been determined. The average total km operated for carts is 76,502 km, for 3-wheelers is 1,47,567 km, for 4-wheelers is 1,10,118 km and for pick-up trucks is 1,22,787km.

3.2 Part 2 Operational Details

A total of 13 questions were asked in this part. Out of these 8 questions were used to directly derive the findings, while 5 answers from Questions were used with other responses to derive additional data/findings. The range, mean and standard deviation of responses collected for questions in this part have been presented in Table 4, while the findings from each question are presented subsequently.

Table 4: The range, mean and standard deviation of responses to question on operational details

Question	Minimum	Maximum	Mean	Standard Deviation	Number of responses
No. of Trips per day	1	8	1.83	1.2	1999
Average no. of stops per trip per day (excluding origin/destination)	0	20	0.96	1.6	2000
Average no. of different customers served on a typical trip	1	30	2.08	1.8	1966
Average weight per trip (kg)	80	4000	1236.9	519.9	1999

Question	Minimum	Maximum	Mean	Standard Deviation	Number of responses
Total km covered per day	10 km	600[2] km	102.51	71.9	1998
No. of working days in a month	10	30	26.7	3.2	2000
No. of accidents/crashes in a month	0	9	1.13	0.4	2000
Km of operations per crash (in km)	200	14400	2431.1	1547	2000
Average time per trip (in minutes)	30	720	170.6	127	2000
Total working hours per day (in hours)	3	20	8.9	2.6	2000

3.2.1 Type of Movement

As a part of this question, fleet owners were asked about their trip characteristics. Overall, 100% (2000 samples) of respondents responded to these questions. Only 18% have fixed routes while 82% of the fleet have flexible routes. When the data is analysed with vehicle payload capacity, it did not reveal significant differences (Figure 13).

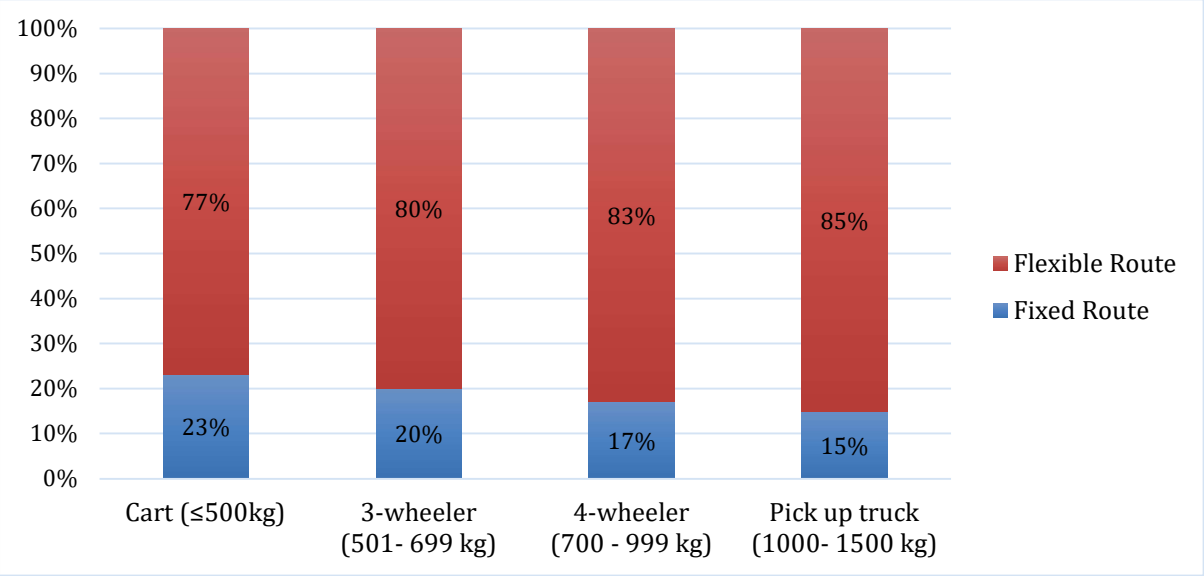

Figure 13: Type of movement by vehicle capacity

3.2.2 Delivery type

The fleet owners were questioned about the type of delivery in this inquiry, and response rate achieved for this question was 100% (2000 responses). As per the data, 57% of deliveries are point-to-point and 43% are staged deliveries. When the data is distributed based on vehicle payload capacity the analysis revealed that staged deliveries were increased with vehicle payload capacity (Figure 14).

[2] Some of the freight vehicle drivers were observed undertaking trips beuond city boundaries.

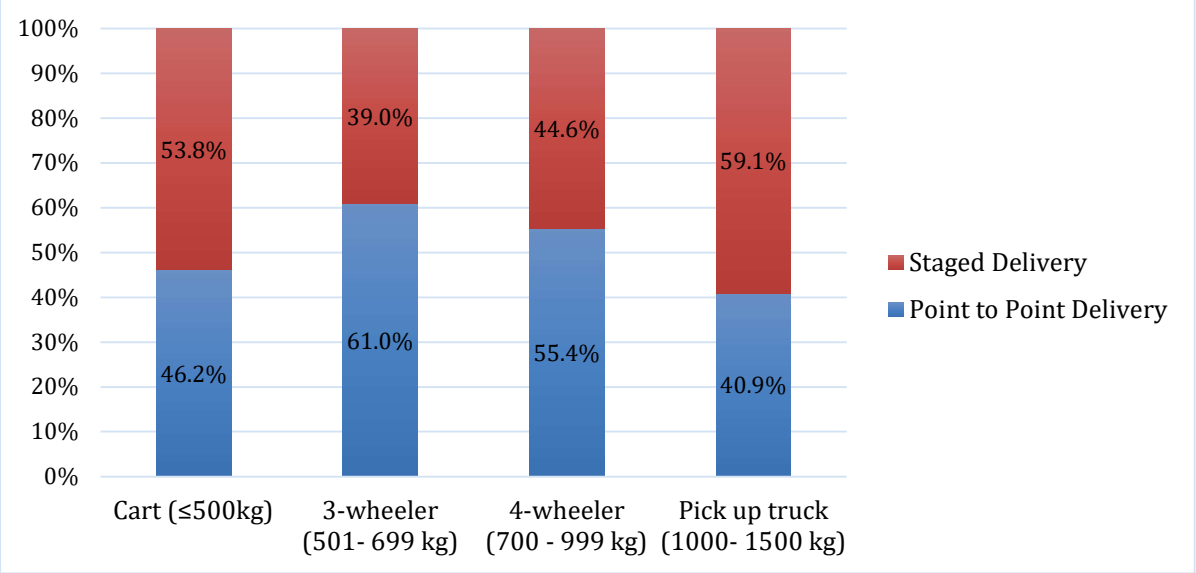

Figure 14: Delivery type by vehicle type

3.2.3 Number of trips per day

The freight vehicle owners were inquired about the total number of trips made each day. Overall response rate was 99.9% (1999 responses). Analysis suggests that 51% of vehicles make 1 trip, 31% make 2 trips and the rest make more than 2 trips in a day. The data and analysis are presented in Table 5 and Figure 15.

Analysis according to the vehicle's capacity (Figure 16) suggests that for all modes, nearly 50% of operators undertake one (return) trip per day. However, share of operators undertaking more than two trips per day are more for smaller capacity vehicles than for larger capacity vehicles. The average no. of return trips per day for carts is 2.5, for 3-wheelers is 1.86, for 4-wheelers is 1.79 and for pick-up trucks is 1.7.

Table 5: Total no. of trips per day

Total No. of Trips per day	1 Trip	2 Trips	3 Trips	4 Trips	5 Trips	>5 Trips
Sample	1021	632	156	117	29	44

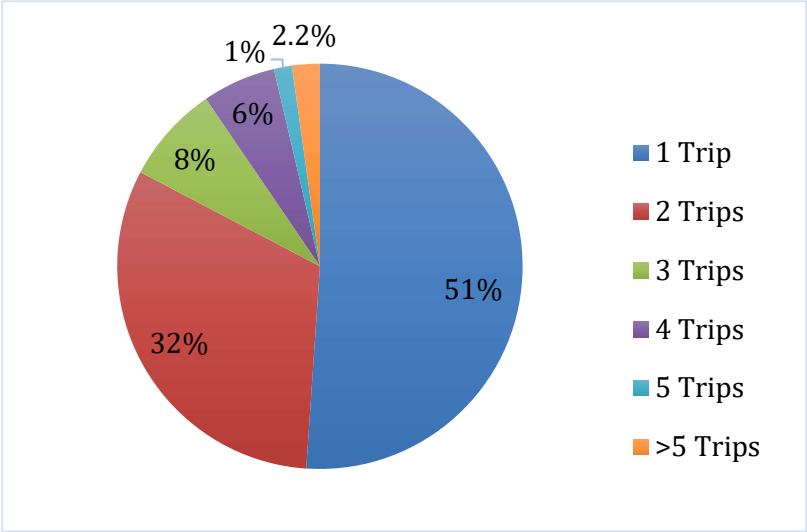

Figure 15: Total no. of trips per day

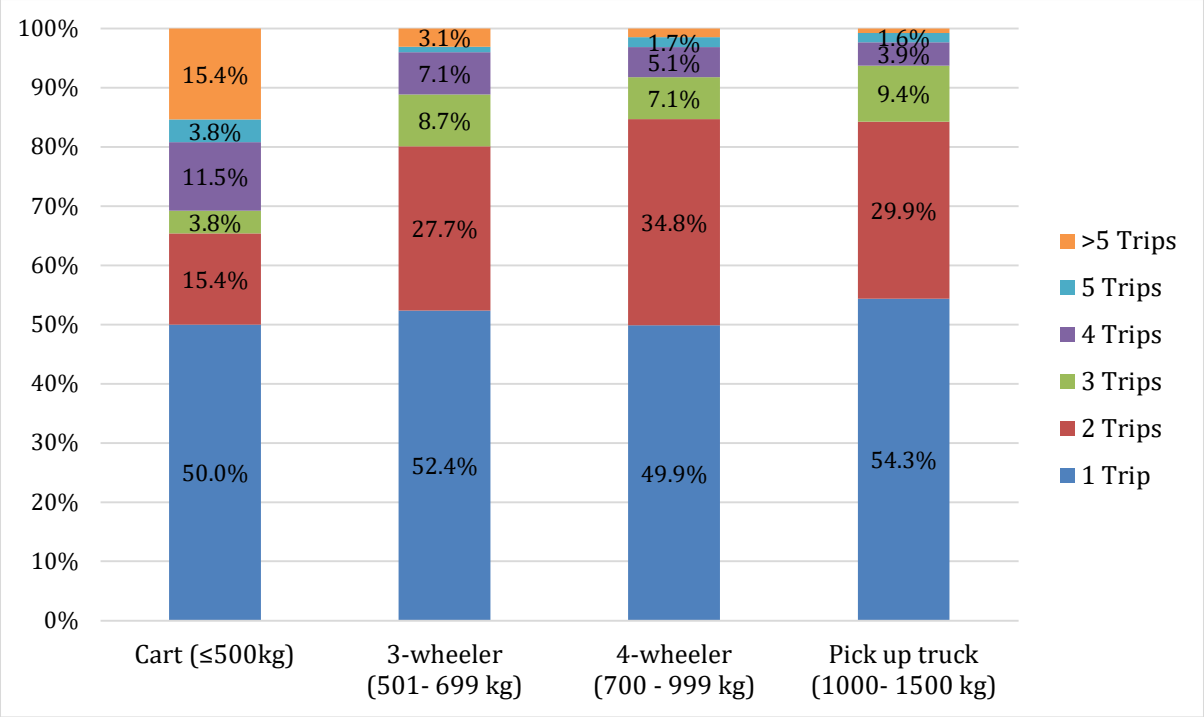

Figure 16: Average no of trips per day by vehicle type

3.2.4 Average number of mid-stops per trip per day

Fleet owners were queried on the average number of stops made between origin and destination per day. This data was used along with stated average daily trips to derive average stops (for loading/unloading) per trip per day from the responses. The response rate was 100%. The analysis suggests that 57% of trips include “zero” mid-stops (between the origin-destination), while 39% undertake 1 to 2 mid-stops. The remaining undertake more than two stops per trip. The data and analysis from the response to this question is presented in Table 6 and Figure 17. Average no of stops per trip per day is also presented by vehicle capacity/type in Figure 18.

Table 6: Total no. of stops per trip per day

Total No. stops per trip per day	**0 Stop**	**1 Stop**	**2 Stops**	**3 Stops**	**4 Stops**	**5 Stops**	**>5 Stops**
Sample	1135	181	600	14	20	9	41

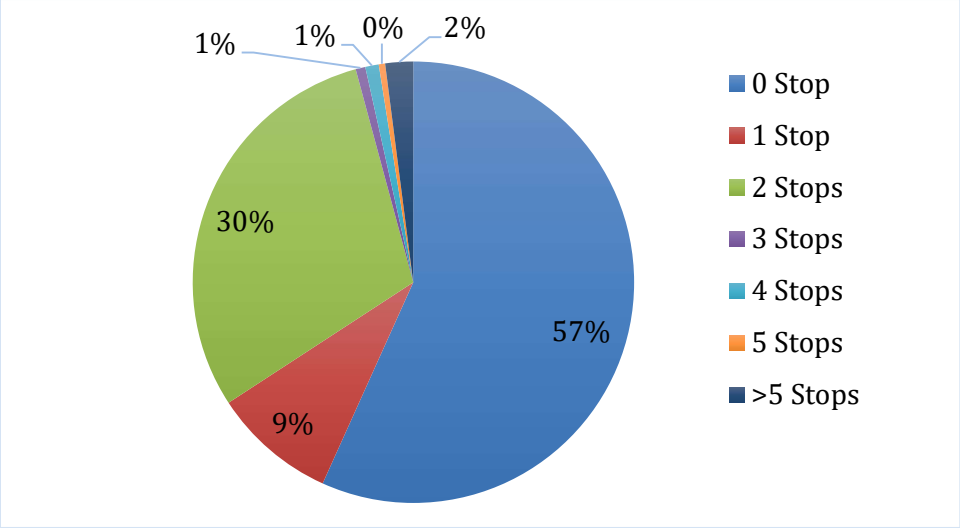

Figure 17: Total no. of stops per trip per day

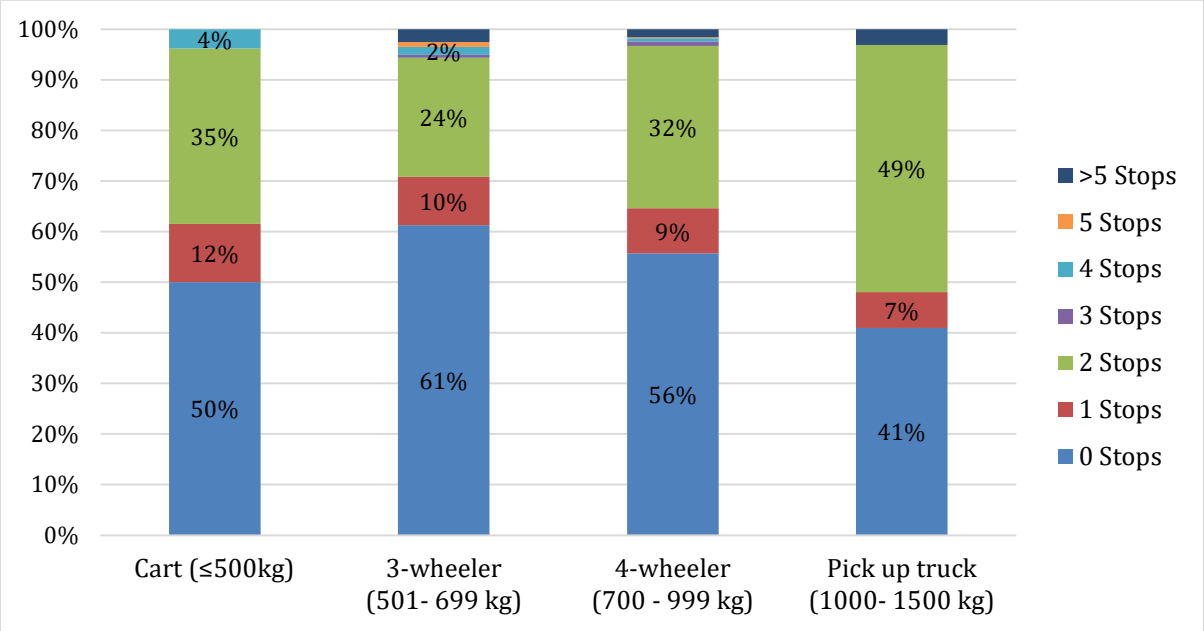

Figure 18: Average no of stops per trip per day by vehicle type

3.2.5 Average number of customers served on a typical trip

99% (1966 response out of 2000) response rate was achieved for this question. The analysis suggests that about 51.7% of trips serve only one customer, 24.4% serve two customers, and the rest of the trips serve more than two customers. *It is important to note that number of stops and number of customers can differ, because for some commodities the vehicle may drop goods at a location where more than one customer receive it.* The data and analysis from the response to this question is presented below in Table 7 and Figure 19.

Table 7: Average customers served in a typical trip

Average customers served in a typical trip	**1 no.**	**2 no.**	**3 no.**	**4 no.**	**5no.**	**>5 no.**
Sample	1016	481	163	157	70	79

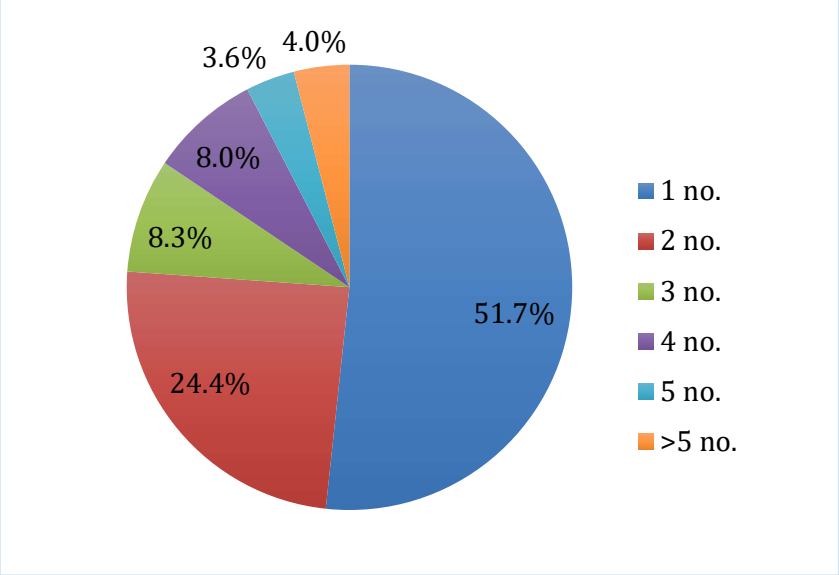

Figure 19: Average customers served in a typical trip

3.2.6 Average weight per trip

99.9% (1999 response out of 2000) response rate was observed for this question. The analysis suggests that about 70% of people carry more than 1000 kg followed by 22% carrying between 700 – 999 kg and only 8% carry less than 700 kg. Vehicle type/payload capacity wise analysis suggests that weight per trip increases with vehicle payload capacity. The analysis from the response to this question is presented in Table 8, Figure 20 and Figure 21.

Table 8: Average weight per trip

Average weight per trip	**≤500kg**	**501-699 kg**	**700-999 kg**	**1000-1500 kg**	**>1500 kg**	**Total**
Sample	109	63	436	982	409	1999

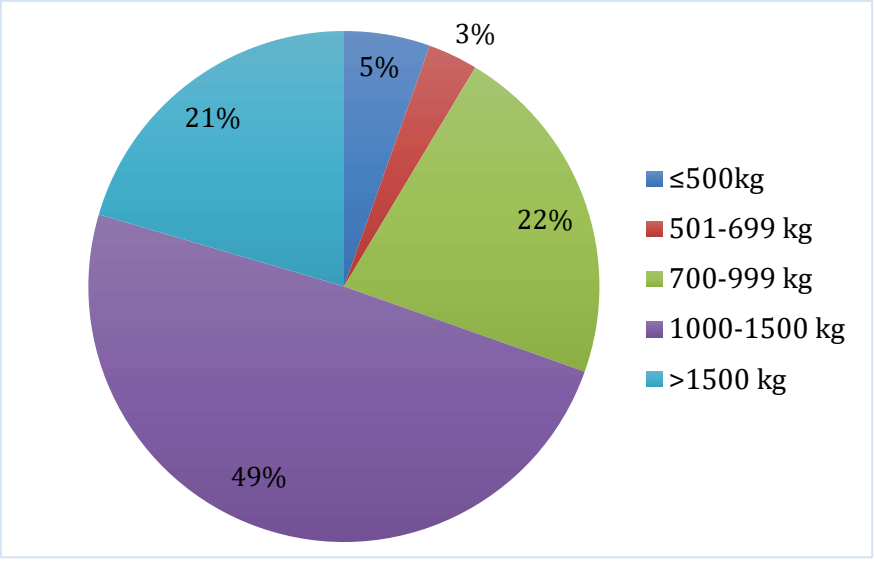

Figure 20: Average weight per trip

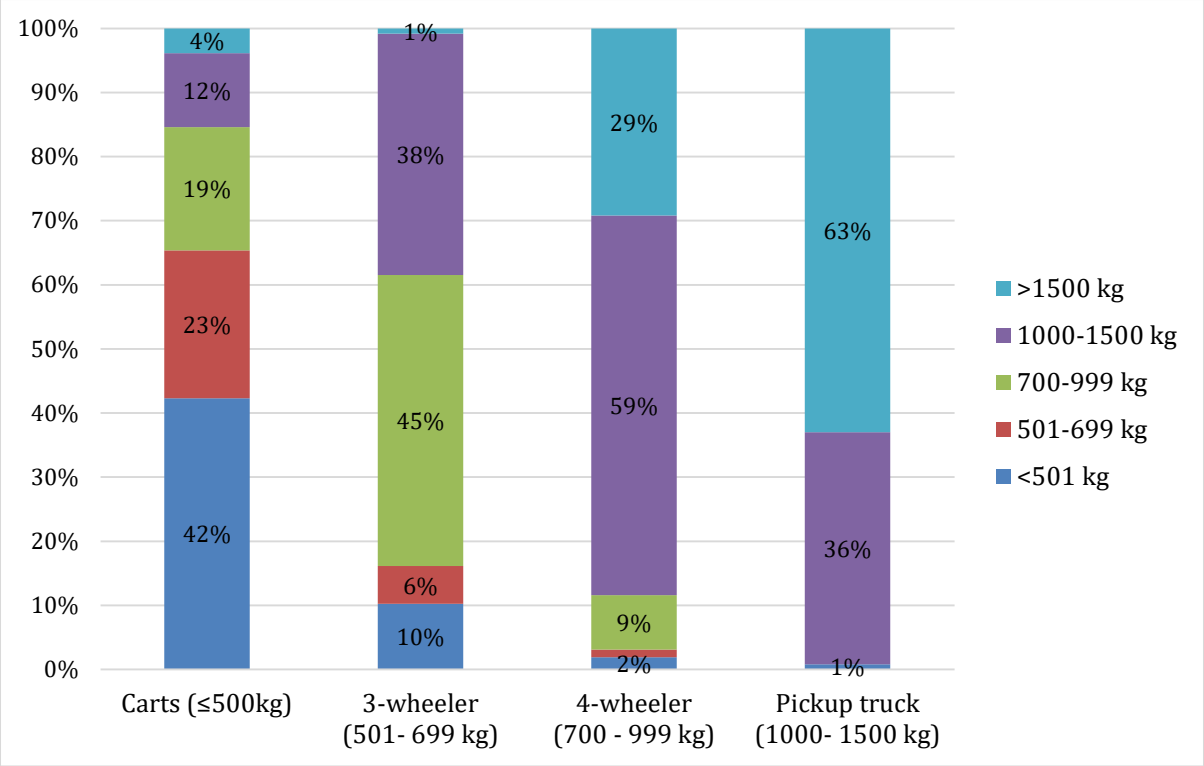

Figure 21: Distribution of average weight per trip by vehicle type

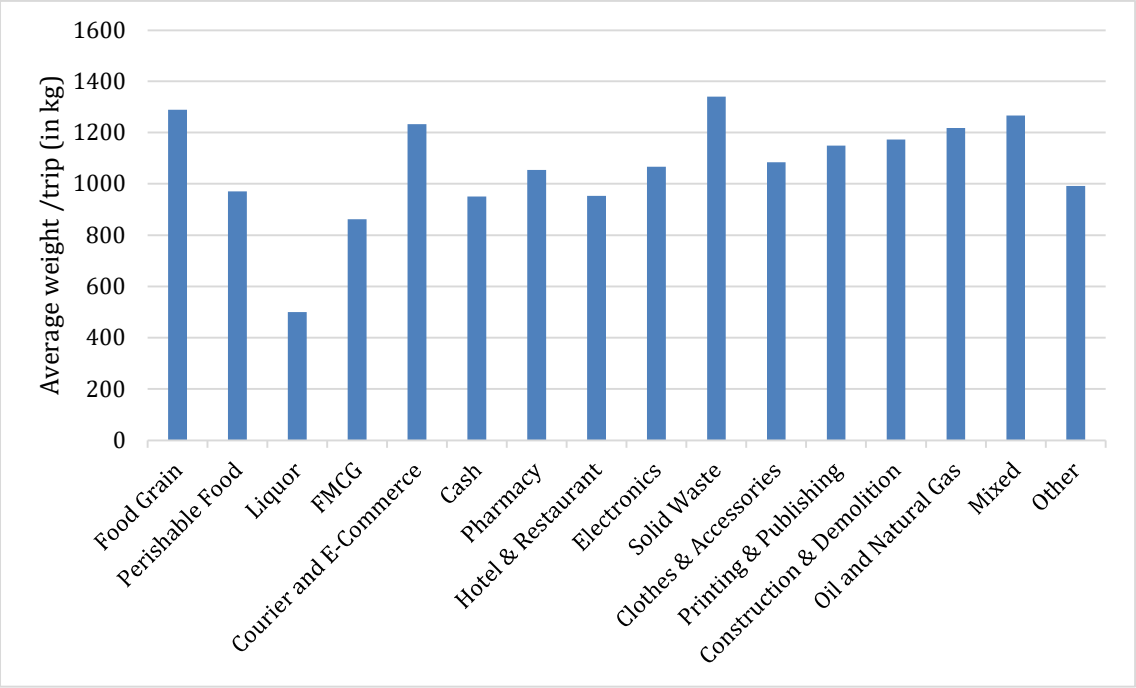

Figure 22: Distribution of average weight per trip by commodity

The ratio of stated commodity weight carried to vehicle payload capacity is presented in Figure 23 below. The stated measure of weight to vehicle capacity ratio suggests a high share of overweight trips. Only 9% of trips were within the payload capacity, while 50% trips were up to 50% higher, while 47% trips were between 50% to 3 times and 3% carried more than 3 times the payload capacity of the vehicle. There is no clear indication that larger share of any vehicle type undertakes overweight trips. 92% of observations are from 3-wheelers and 4-wheelers and between 84 to 88% of samples from this category undertake

overweight trips. While, between 58% to 63% of other vehicle categories (carts and pick-up trucks) undertake overweight trips. The ratio of overweight vehicles to vehicle payload capacity is presented in Figure 24.

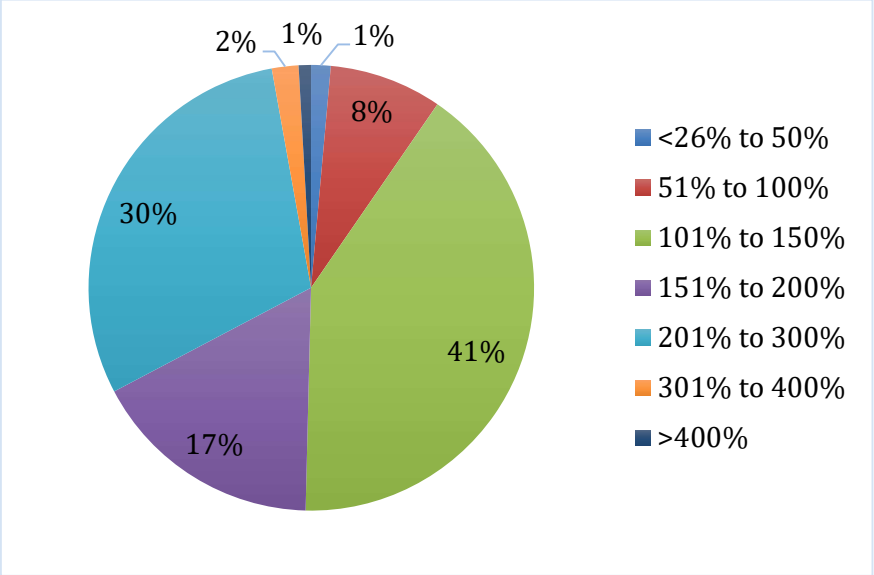

Figure 23: Ratio of observed weight with capacity

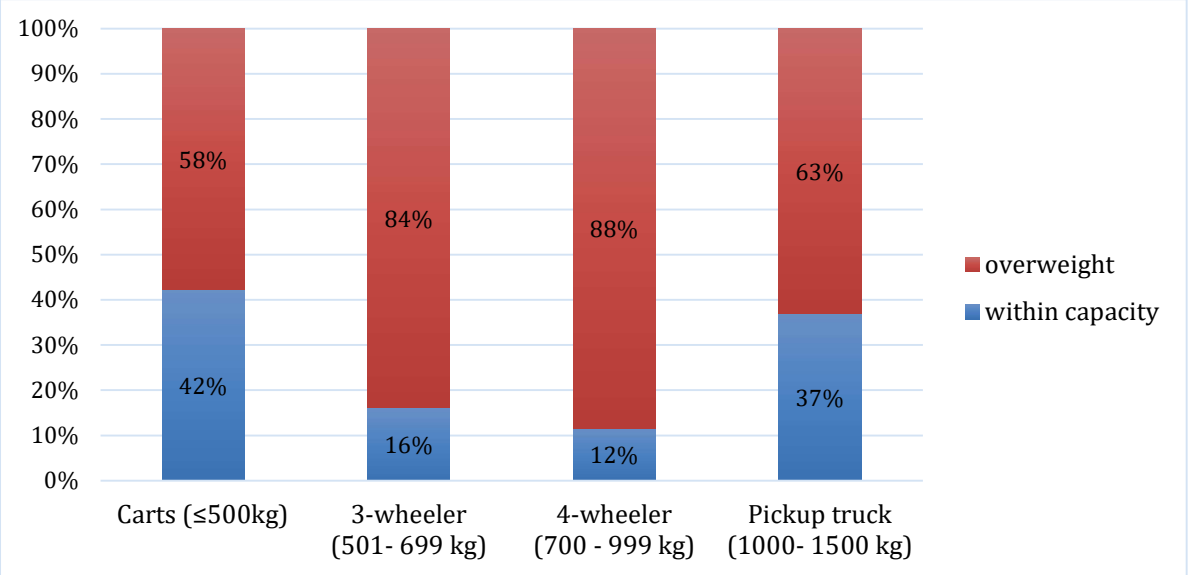

Figure 24: Vehicle type wise distribution of overweight vehicles.

3.2.7 Total Vehicle Utilization per day

100% (2000 responses) response rate received for this question. The survey data and its analysis suggest that 27% of freight vehicles travel less than 51 km in a day, 49% travel 51 to 100 km, and the rest travel more than 100 km. The stated responses to this question are strongly correlated (0.67) to derived data (from other questions in the survey). It is observed that daily vehicle utilisation in terms of km operated per day, increases with vehicle payload capacity. The average km covered per day for carts is 71.53 km, for 3-wheelers is 86.66 km, 4-wheelers is 109.82 km and for pick-up trucks is 138.05 km. The data and its analysis is presented below in Table 9 , Figure 25 and Figure 26.

Table 9: Total vehicle utilization per day

Total Km covered per day	<51 km	51-100km	101-150 km	151-200 km	201-300 km	301-400 km	>400km
Sample	547	980	207	155	75	18	18

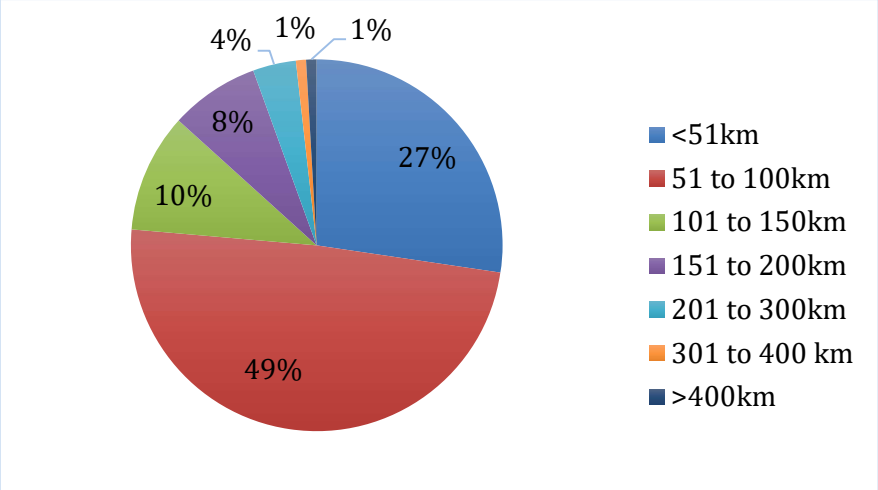

Figure 25: Total vehicle utilization per day

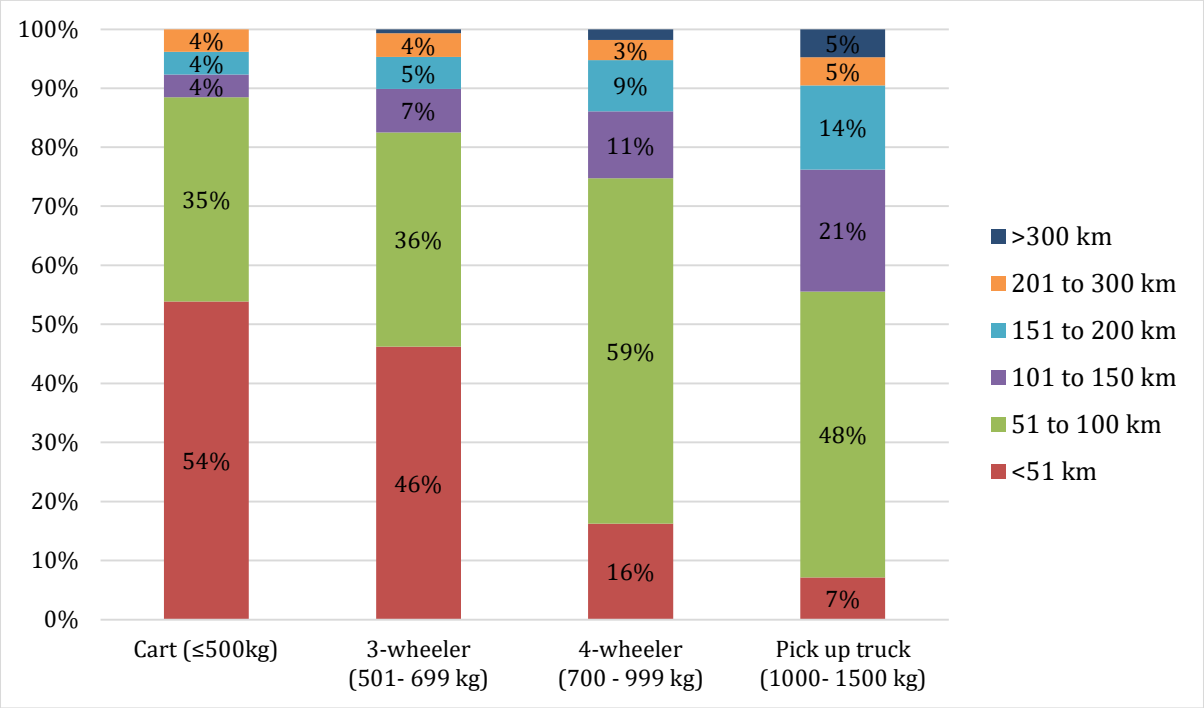

Figure 26: Distribution of total km covered per day by vehicle type

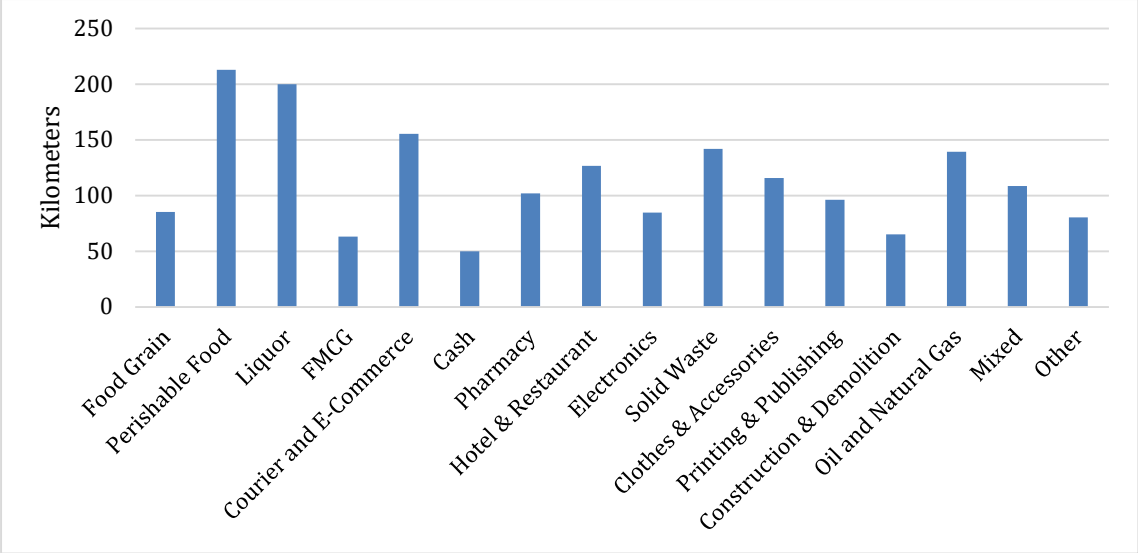

Figure 27: Distribution of total km covered per day by commodities

3.2.8 Average Return Trip Length

Average (return) trip length is derived from the responses on vehicle utilization per day and number of trips per day. The analysis suggests that for 30% responses - average trip length is ≤40 km, for 44% responses - average (return) trip length is between 4 km to 80km and for only 26% responses average (return) trip length is greater than 80 km. For data disaggregated as per vehicle type, the analysis suggests that average (return) trip length is higher for higher payload capacity. The data and analysis are presented in Table 10, Figure 28 and Figure 29.

Table 10: Average trip length

Average trip length	<21 km	21 to 40 km	41 to 60 km	61 to 80 km	81 to 100 km	>100 km	Total
Samples	128	471	646	234	392	129	2000

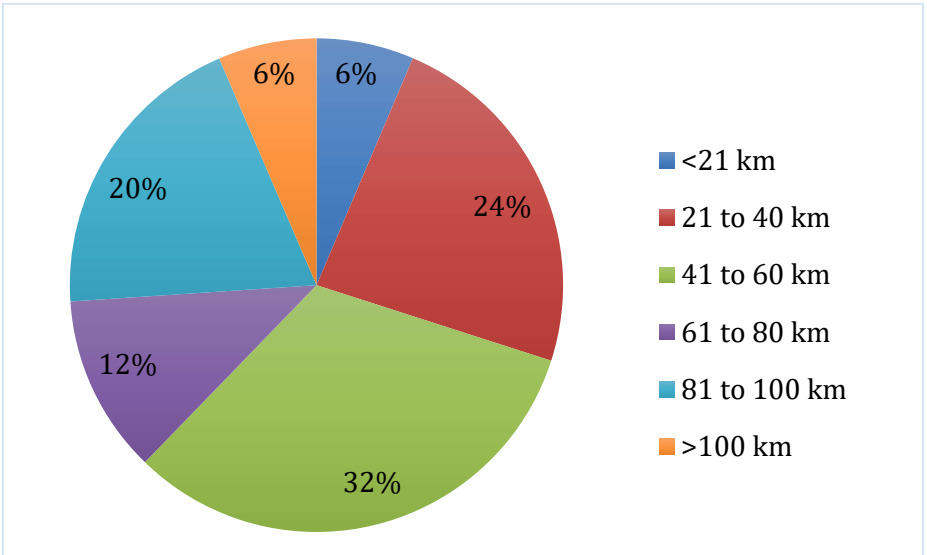

Figure 28: Average trip length (in km)

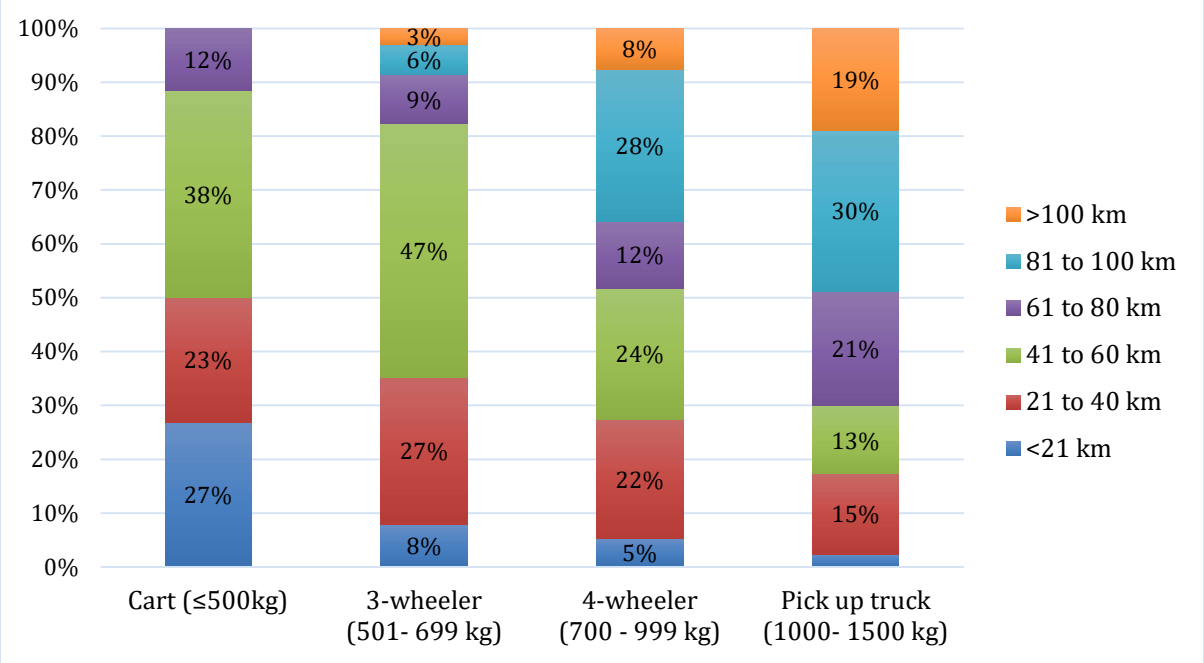

Figure 29: Vehicle type wise distribution of average trip length

3.2.9 Parking Location

This query consisted of two parts enquiring on parking locations at non-working hours and working hours. 100% (2000 responses) response rate was achieved for non-working hours and 50% (1000 response) response rate was achieved for working hours. Figure 30 presents the comparison of parking location of vehicles at working and non-working hours. Data in both situations suggests that most vehicles are parked along the road (away from home), with 90% of vehicles doing so during working hours and 27% doing so during non-working hours. Majority of vehicles are parked within or next to the residence of the operator during non-working hours. The data and analysis from response to this question is presented in Table 11 and Figure 30.

Table 11: Parking Location

Parking Location	**Roadside (away from home)**	**Private parking/ in the shop**	**Commercial Parking**	**Home (or near/ next to home)**	**Total**
During non-working hours	536	134	96	1234	2000
During working hours	896	68	2	34	1000

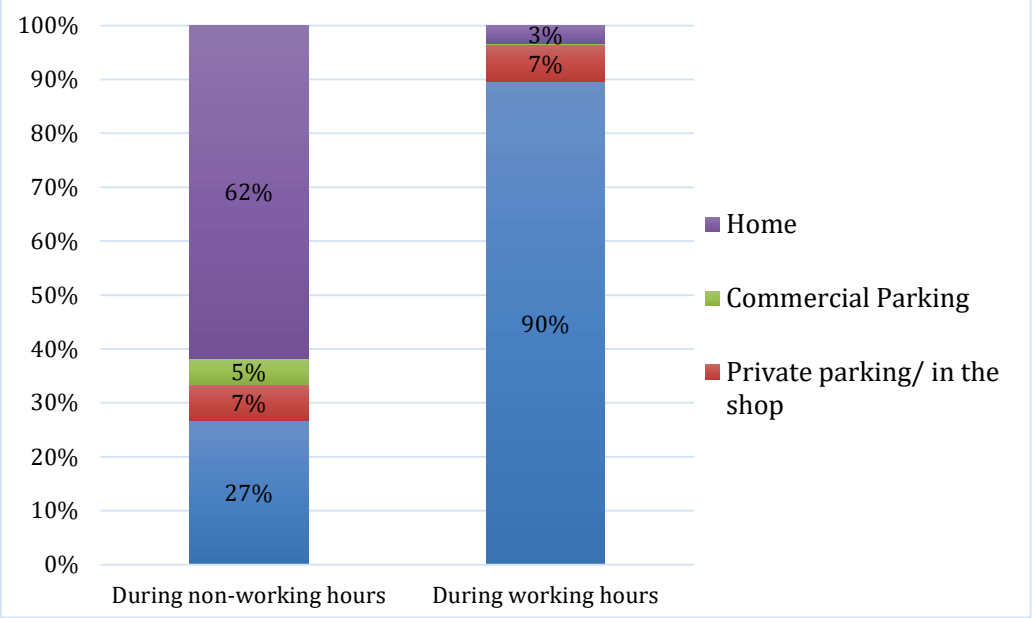

Figure 30: Comparison of parking location during working and non-working hours

Analysis of parking behaviour during working and non-working hours, by vehicle type, suggests no significant difference for majority of the vehicles surveyed. 60% to 70% of 3-wheelers and 4-wheelers park at or next to the operator's residence during non-working hours. However, only 31% of pick -up trucks park at or near the operator's residence. Majority of pick-up trucks (53%) park along the street (away from the residence) during non-working hours (Figure 30). There is insignificant difference in terms of parking during working hours between different vehicle types and majority of fleet owners park at roadside, away from their residence, during working hours (Figure 32).

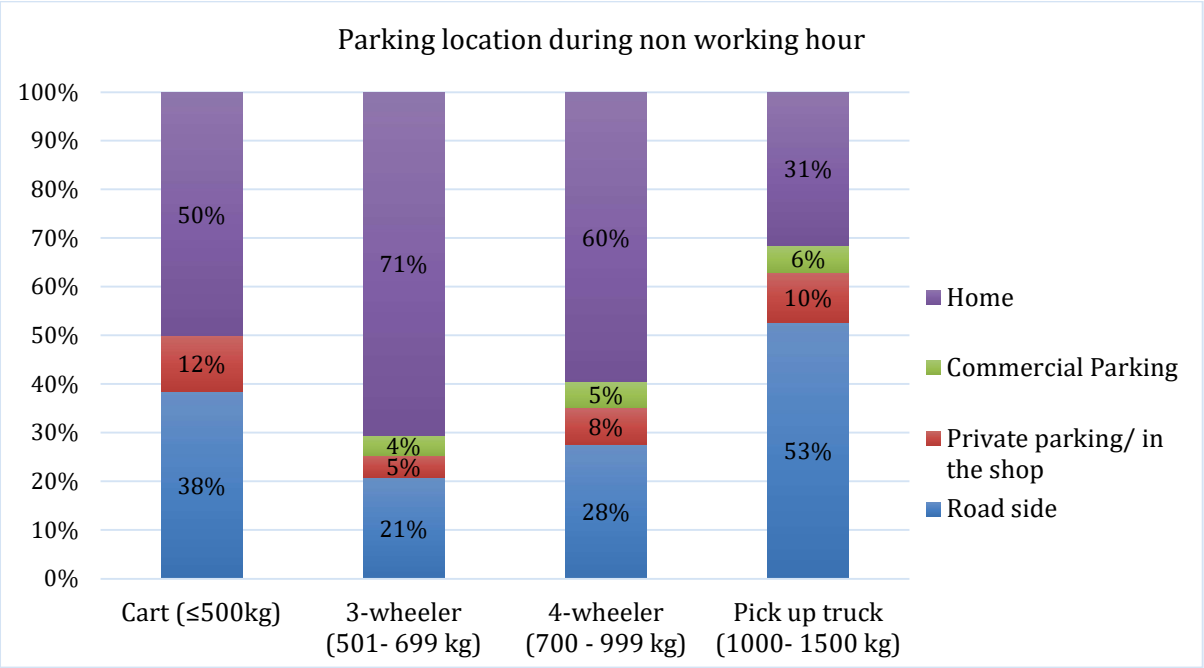

Figure 31: Distribution of parking location during non-working hours, by vehicle type

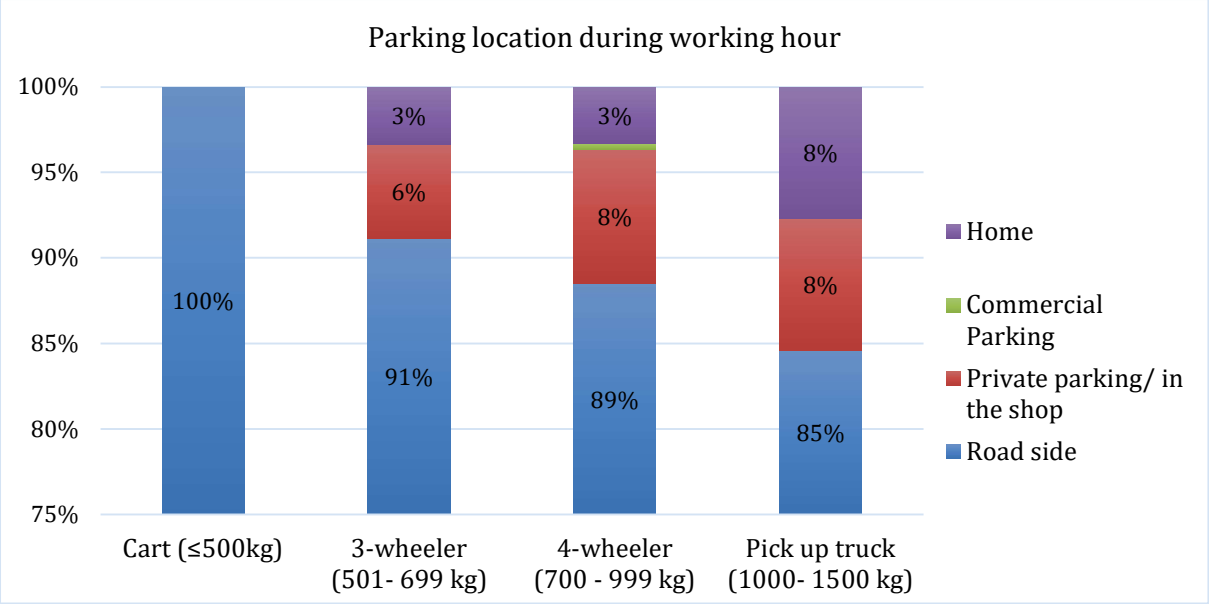

Figure 32: Distribution of parking location during working hours, by vehicle type

3.2.10 Number of Working days in a month

100% (2000 responses) response rate was achieved for this question. The analysis suggests that about 77% of people work more than 25 days in a month, while 15% work between 21 and 25 days, and the remaining 10% work fewer than 20 days. The data and analysis from the response to this question is presented below in Figure 33.

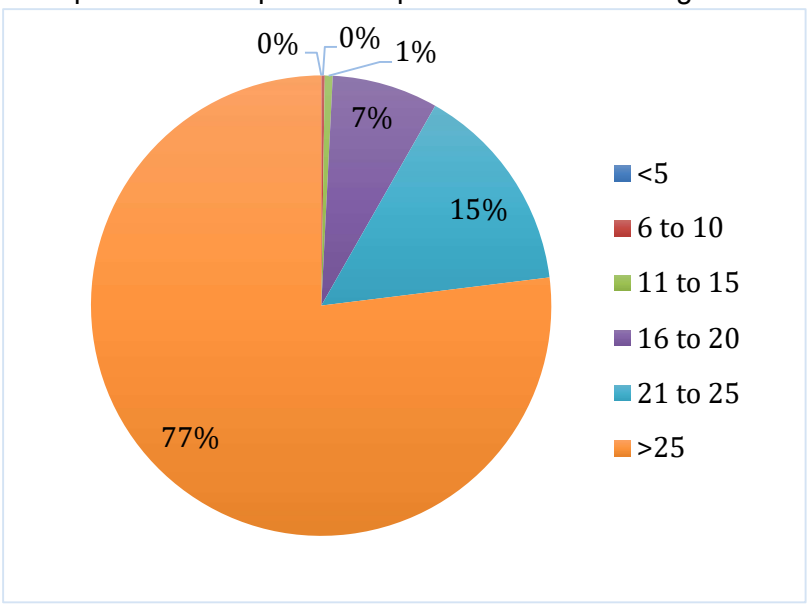

Figure 33: No. of working days in a month

3.2.11 Average time per return trip

100% response (2000 samples) rate was achieved for questions on average return trip duration. The analysis suggests the following:

1. About 21% (428 responses) of the respondents take an average of less than 1 hour per return trip
2. 29% (587 responses) of the respondents take 1 to <2 hours.
3. 33% (651 responses) of the respondents take 2 to <3 hours.

4. 5% (96 responses) of the respondents take 3 to <4 hours.
5. Only 2% (36 responses) of the respondents take 4 to <5 hours.
6. 10% (202 responses) of the respondents take more than 5 hours per return trip.

Figure 34 presents the breakup of average time per trip.

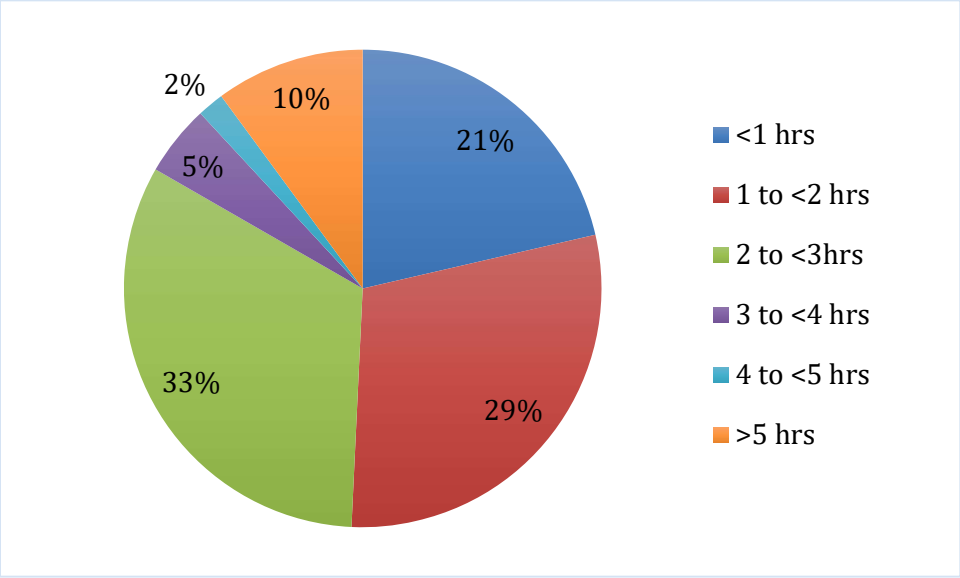

Figure 34: Average time per trip

Figure 35 presents the vehicle type wise distribution of average time per trip in terms of percentage of responses. The data suggests that share of vehicles with longer trip duration is higher for larger payload capacity vehicles.

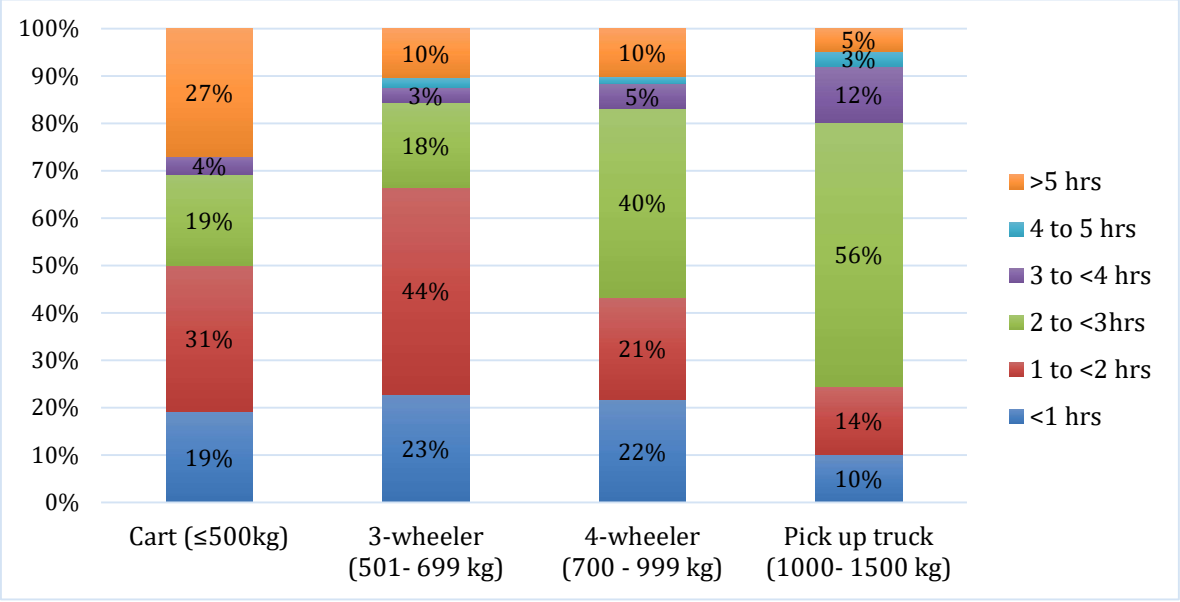

Figure 35: Vehicle type wise average time per trip (% of responses)

3.2.12 Total working hours per day

In this question, fleet owners/operators were enquired about their total working hours per day. 100% response rate was achieved. The analysis revealed the following:
Derived from breakup of daily working hours.

- Only 2% fleet owners work less than 4 hours per day.

- 46% (929 response) fleet owners work between 5 to 8 hours per day.
- 43% (855 response) fleet owners work between 9 to 12 hours per day.
- 9% fleet owners work more than 12 hours per day.

This question has been divided into three parts. These include queries on loading-unloading time, idle/rest time (between the start and end of a work day) and driving time. The sum of these three provide us the total working hours in a day. Vehicle type wise analysis is also presented for each part. The data and analysis from responses to this question is presented in Table 12, Figure 36 and Figure 37. The analysis suggests that with increasing payload capacity, the idle time reduces for operators and driving as well loading/unloading time increases.

Table 12: Total daily work hours

Total Daily work hours	**1 to 4 hrs**	**5 to 8 hrs**	**9 to 12 hrs**	**13 to >18 hrs**	**Total**
Derived from breakup of stated daily working hours	35	929	855	181	2000

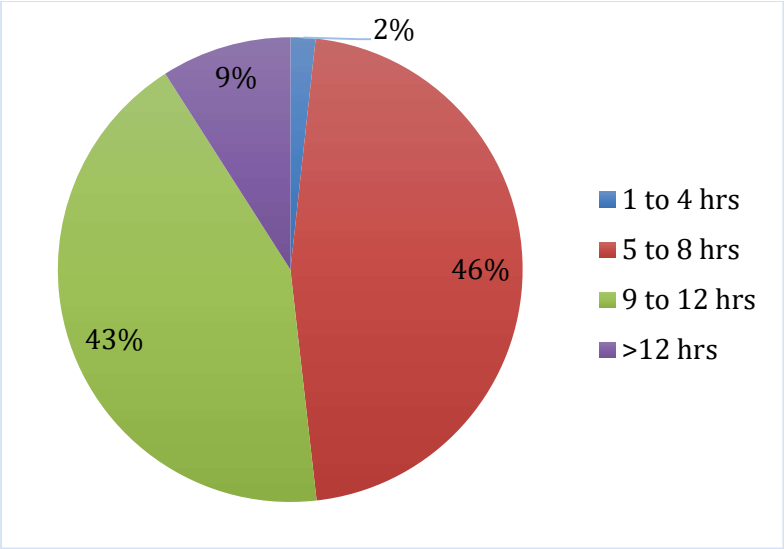

Figure 36: Total daily work hours

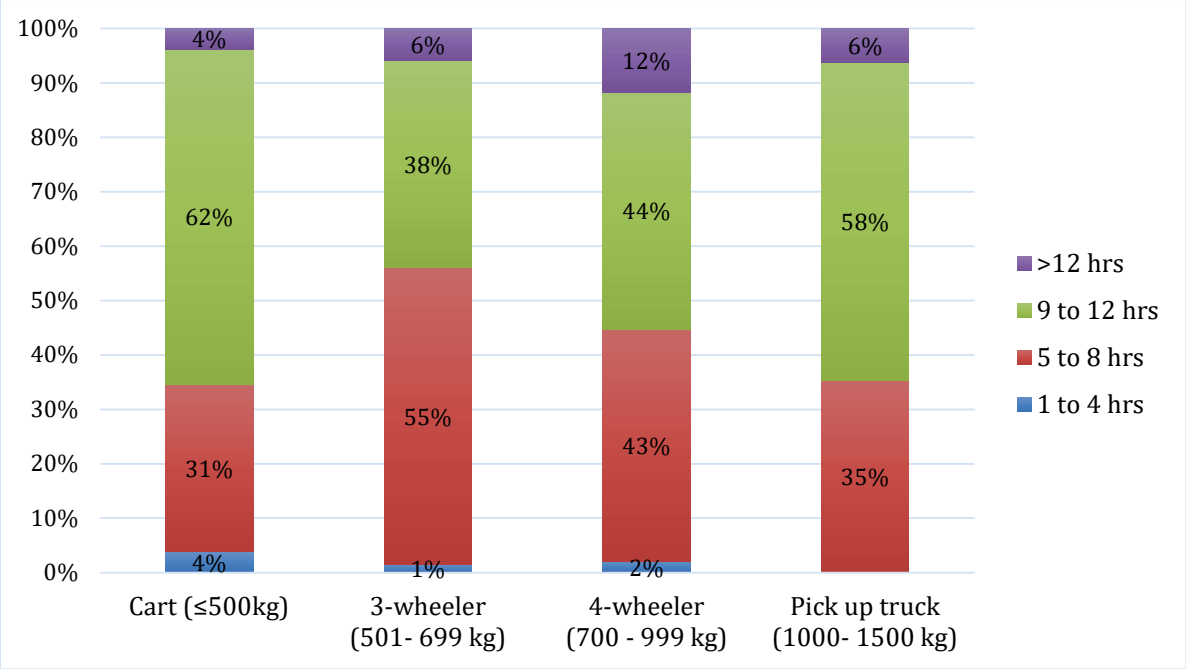

Figure 37: Vehicle type wise total daily work hours

3.2.12.1Loading/Unloading Time

Distribution of loading and unloading time from the responses is presented in Figure 38. The data suggests that 2% of respondents spend less than 0.5 hour, 14% spend between 0.5 hours to <1 hours, 45% spend between 1 hours to <1.5 hours, and the remaining spend longer than 1.5 hours, to load/unload during the working period, per day.

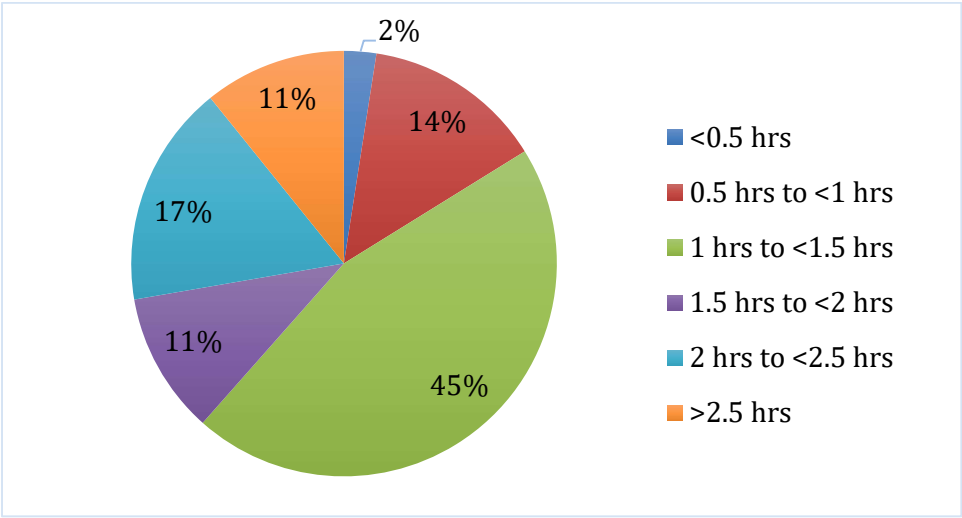

Figure 38: Loading/Unloading time (in hours)

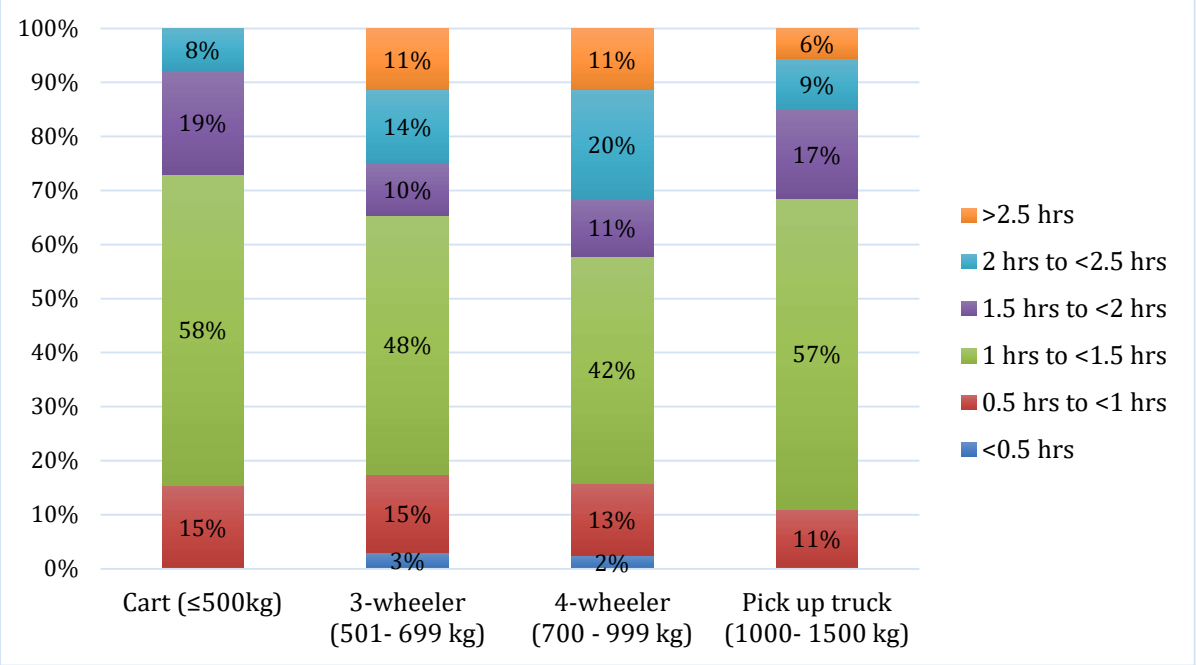

Figure 39: Vehicle type wise loading/unloading time (in hours)

3.2.12.2 Idle/Rest Time

Idle/rest time distribution from responses is presented in Figure 40. 15% of respondents suggest they take less than 1 hour of break in a workday. 54% take a break of between 1 and <2 hours, 31% take a break of between 2 and <3 hours, while the remaining take a total break lasting longer than 3 hours.

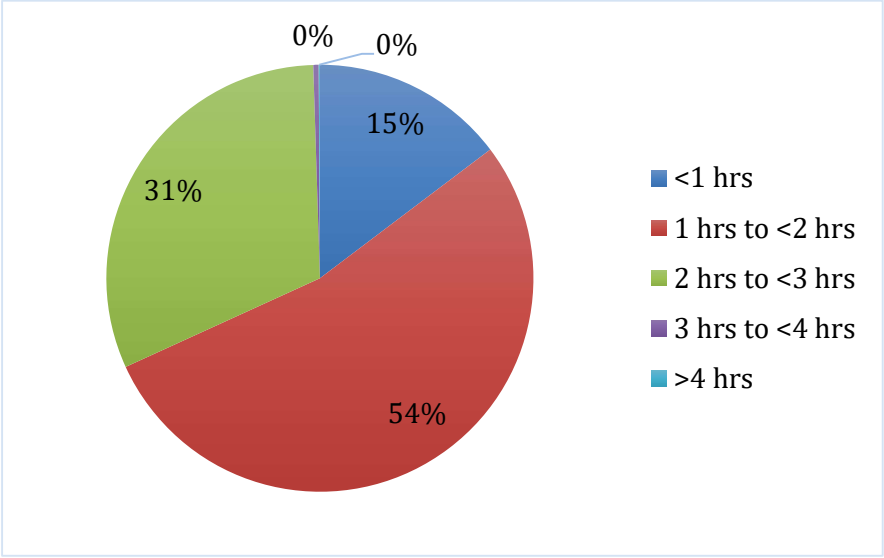

Figure 40: Idle/Rest time (in hours)

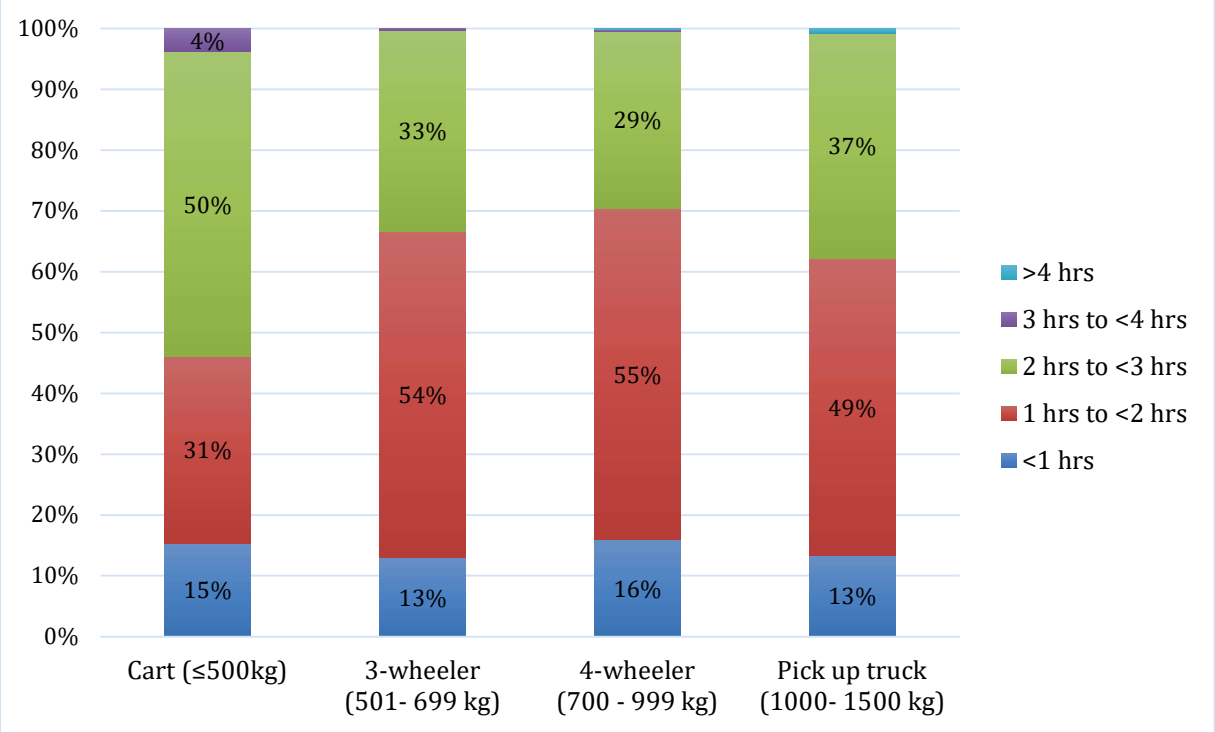

Figure 41: Vehicle type wise idle/rest time (in hours)

3.2.12.3 Driving Time

The distribution of driving time from different responses is presented in Figure 42. Almost 0% (only 1 response) of fleet vehicles drive for less than <2 hours, 13% drive for between 2 and <4 hours, 27% drive for between 4 and <6 hours and the remaining drive for more than 6 hours.

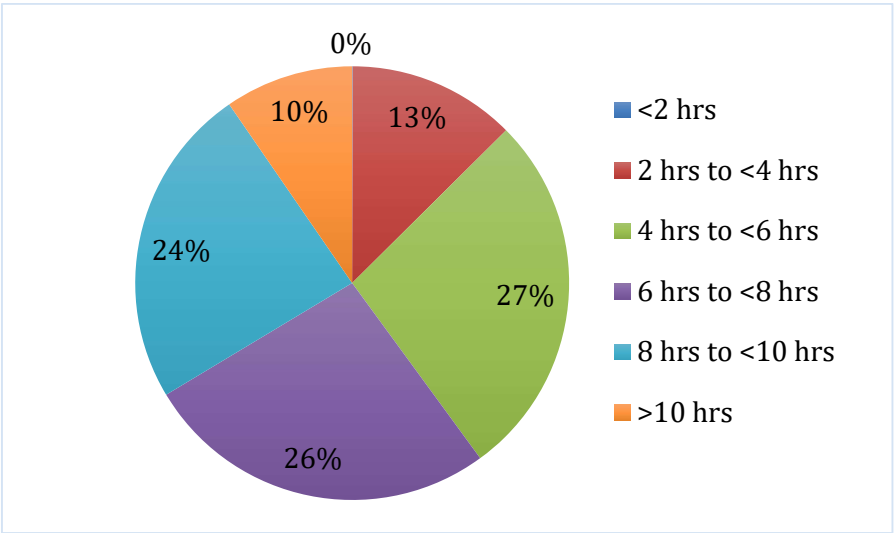

Figure 42: Driving time (in hours)

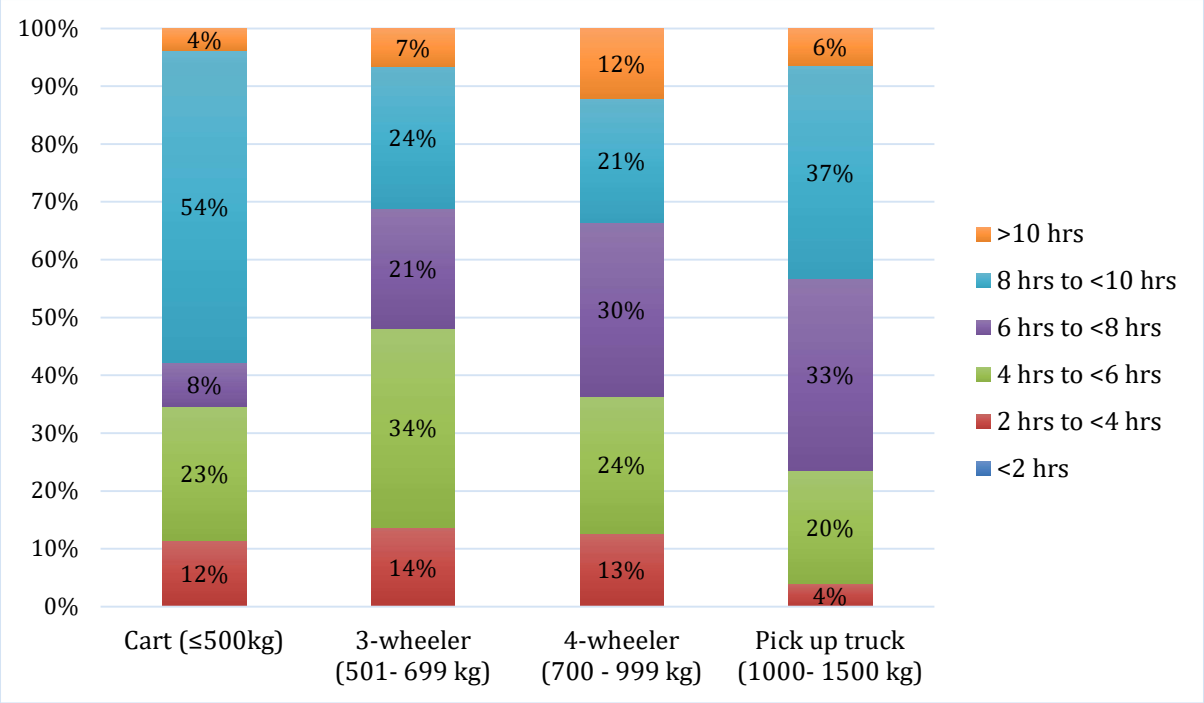

Figure 43: Vehicle type wise driving time

3.3 Part 3 Revenue and Cost Details

A total of three questions were presented to the respondents in this part. One of the questions is further divided into five sub-parts. All responses were used directly in the analysis. The range, mean and standard deviation of responses collected for questions in this part have been presented in Table 13, while the findings from each of these questions is presented subsequently.

Table 13: The range, mean and standard deviation of responses to questions on revenue and cost

Question	Minimum	Maximum	Mean	Standard Deviation	Number of responses
Total earning per month (INR)	7,000	1,00,000	37,781.5	11,211.2	2000
Total profit per month (INR)	0	60,000	17,248.5	6061.3	2000
Monthly/Annual Cost of Operation (INR)	3317	1,35,750	20,818	9086	1999

3.3.1 Total Earning per Month

This question includes enquiries on monthly earning, including profit and expenses, of the freight vehicle owners. 100% response rate was achieved for these questions. This analysis is undertaken in two parts, one for single fleet vehicle owners and the other for multiple vehicle owners. The analysis suggests that on an average multiple vehicle owners earn more than single vehicle owners. The details are as following:

1. Only 1.4% single and 0.5% multiple fleet vehicle owner's earning per month is less than ₹ 20,000.

2. 60% single and 44% of multiple fleet vehicle owners earn between ₹20000 to ₹40,000 per month.
3. 34% single and 44% multiple fleet vehicle owners earn between ₹40,000 to ₹60,000 per month.
4. 4.4% single and 11.3% multiple fleet vehicle owners earn more than ₹60,000 per month.

The data is analysed for different vehicle types. This suggests that payload capacity does not influence earning per km (EPK). The average EPK for carts is ₹16.4 per km, for 3-wheeers is ₹18.2 per km, for 4-wheeler is ₹18.2 per km, and for pick-up trucks is ₹16.8 per km. The data and analysis from response to this question is presented in Table 14, Figure 44, Figure 45, Figure 46 and Figure 47.

Table 14: Total earning per month

Monthly Stated Earning	**1 to <20k**	**20k to <40k**	**40k to <60k**	**60k to <80k**	**>80k**	**Total**
Single Fleet Vehicle Owner	26	1092	617	66	14	1815
Multiple Fleet Vehicle Owner	1	82	81	18	3	185

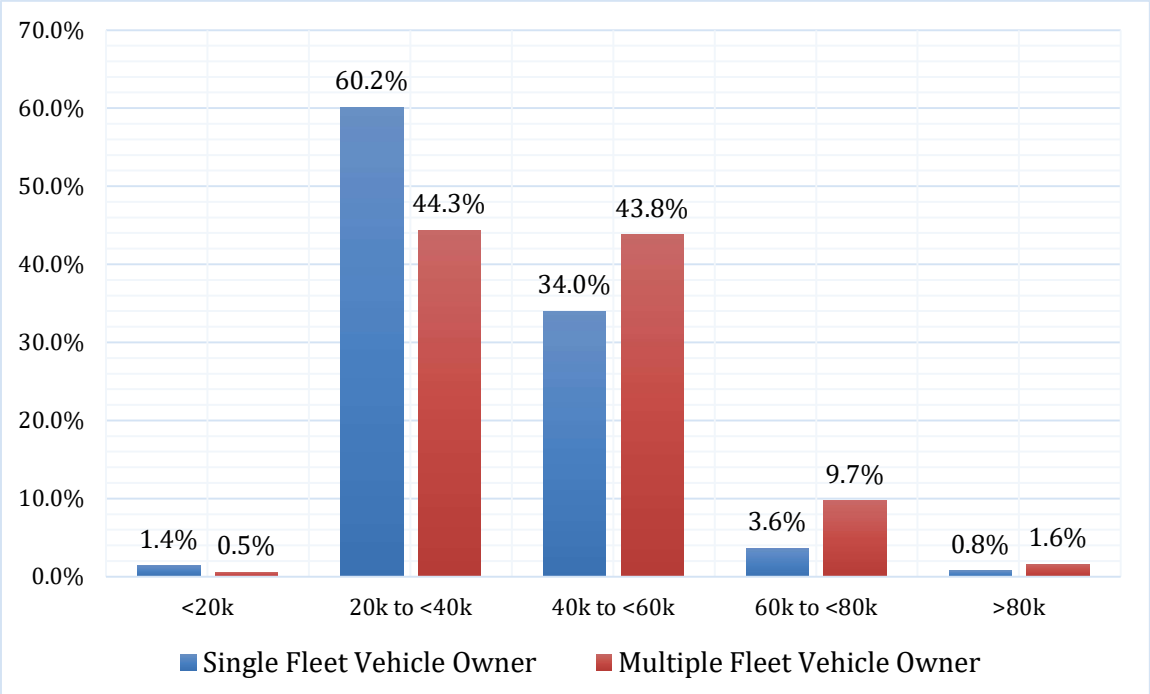

Figure 44: Distribution of monthly stated earning of single and multiple fleet vehicle owners

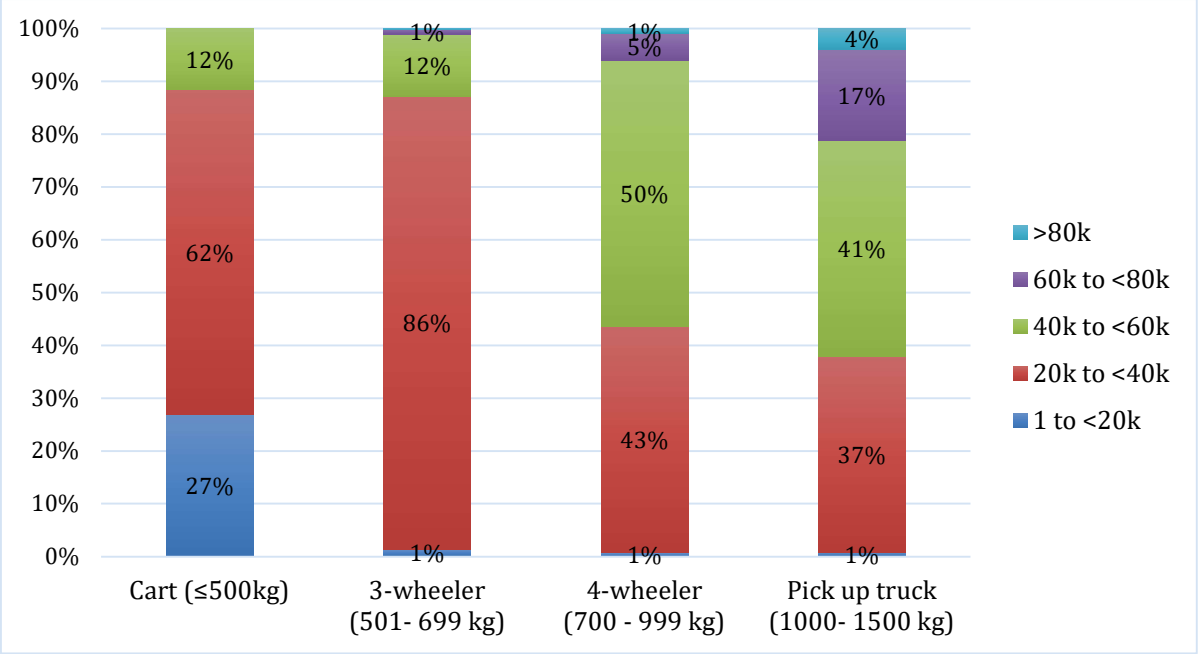

Figure 45: Vehicle type wise distribution of monthly earning

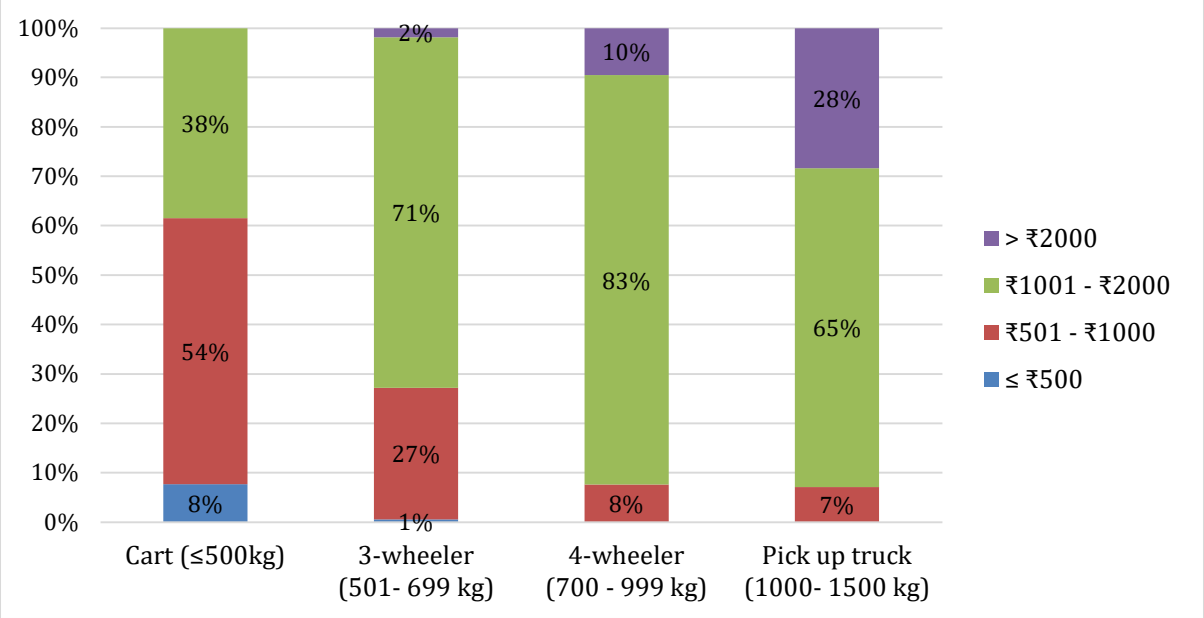

Figure 46: Vehicle type wise distribution of daily earning

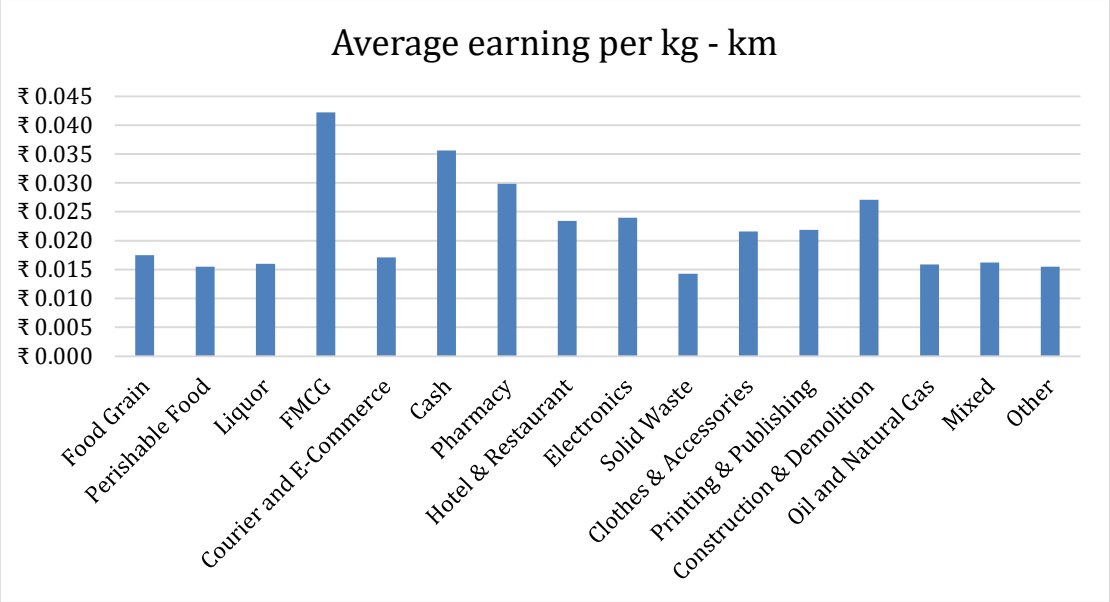

Figure 47: Average earning per kg - km (commodity wise)

3.3.2 Total Profit per Month

As a part of this question the respondents were enquired about the total profit per month excluding all expenses. 100% response rate was achieved for this question. The analysis is presented in two parts, one for single vehicle fleet and the other for multiple vehicle fleet. The analysis suggests the following:

1. Only 0.3% single vehicle fleet operators are in loss.
2. 4.4% single and 6.4% multiple vehicle fleet operators' profit is less than ₹10,000 per month.
3. 59% single and 52% multiple vehicle fleet operators' profit between ₹10,000 to ₹20,000 per month
4. 33% single and 34% multiple vehicle fleet operators' profit between ₹20,000 to ₹30,000 per month
5. 3.9% single and 7.6% multiple vehicle fleet operators' profit is more than ₹30,000 per month.

Data analysis in terms of vehicle type suggests that profit per month/day increases with vehicle payload capacity. However, profit per km reduces with increasing payload capacity (because is lower utilization for low payload capacity vehicles). The average profit per kilometre for carts is ₹9.5, for 3-wheelers the profit per kilometre is ₹9.4, for 4-wheelers the profit per kilometre is ₹8.2 and the profit per kilometre for pick-up trucks is ₹6.6. The data and analysis from responses to this question is presented in Table 15, Figure 48, Figure 49 and Figure 50.

Table 15: Total profit per month

Monthly Stated Profit	**<=0**	**<10k**	**<20k**	**<30k**	**<40k**	**>40k**	**Total**
Single Fleet Vehicle Owner	5	79	1068	593	49	21	1815
Multiple Fleet Vehicle Owner	0	13	96	62	12	2	185

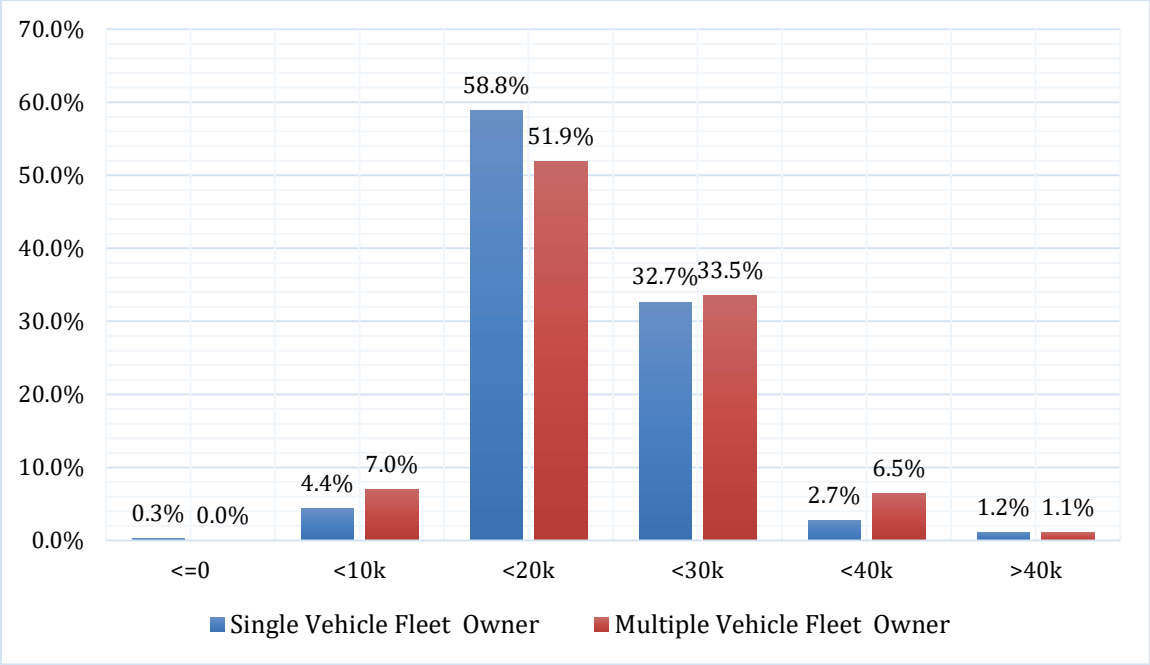

Figure 48: Distribution of monthly stated profit of single and multiple vehicle fleet owners

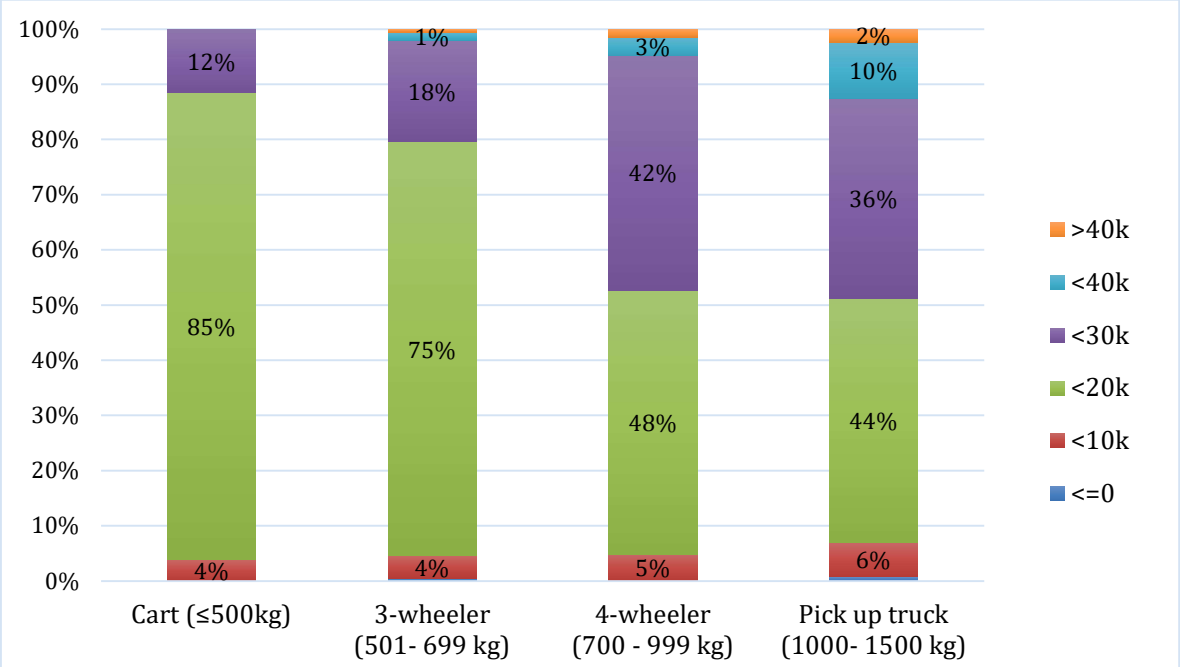

Figure 49: Vehicle type wise monthly profit

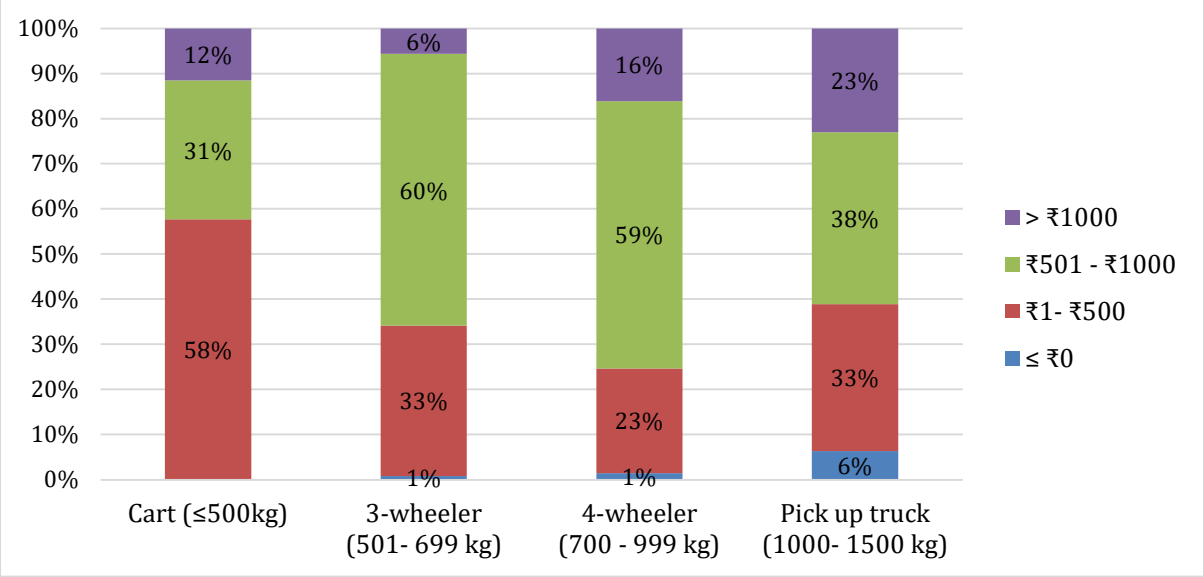

Figure 50: Vehicle type wise daily profit

3.3.3 Cost of Operation

In this question the respondents were enquired about the monthly/annual cost of operation for their vehicles. The following 5 categories were used to break down the queries on cost - monthly rent/EMI, cost of fuel/charging per month, monthly maintenance cost, monthly parking/other charges (permit, licence, road tax etc.) and annual insurance charge. The cost per kilometre (CPK) were determined by analysing these details. The analysis of data suggests that the CPK for freight vehicles increases with payload capacity. The details are as following:

1. The CPK for 68% of single and 61% of multiple vehicle fleet owners ranges from ₹1 to ₹10
2. For 27% of owners of a single vehicle fleet and 34% of owners of multiple vehicle fleets, the CPK ranges from ₹11 to ₹20.
3. For 4% of owners of a single vehicle fleet and 5% of owners of multiple vehicle fleets, the operation cost per kilometre ranges from ₹21 to ₹30.
4. Only 1.4% single vehicle fleet owners and 1.1% multiple fleet vehicle owner's CPK is more than ₹30.

The average CPK for carts ₹5.8, for 3-wheelers is ₹9, for 4-wheelers is ₹10 and pick-up trucks is ₹10.6 (Figure 54). The data and analysis from response to this question is presented in Table 16, Figure 51, Figure 52, Figure 53 and Figure 54.

Table 16: Cost of operation per kilometre

CPK	1 to 10 ₹	11 to 20 ₹	21 to 30 ₹	31 to 40 ₹	41 to 50 ₹	>50 ₹
Single vehicle fleet owners from stated values	1231	481	77	16	4	6
Multiple vehicle fleet owners from stated values	112	62	9	2	0	0

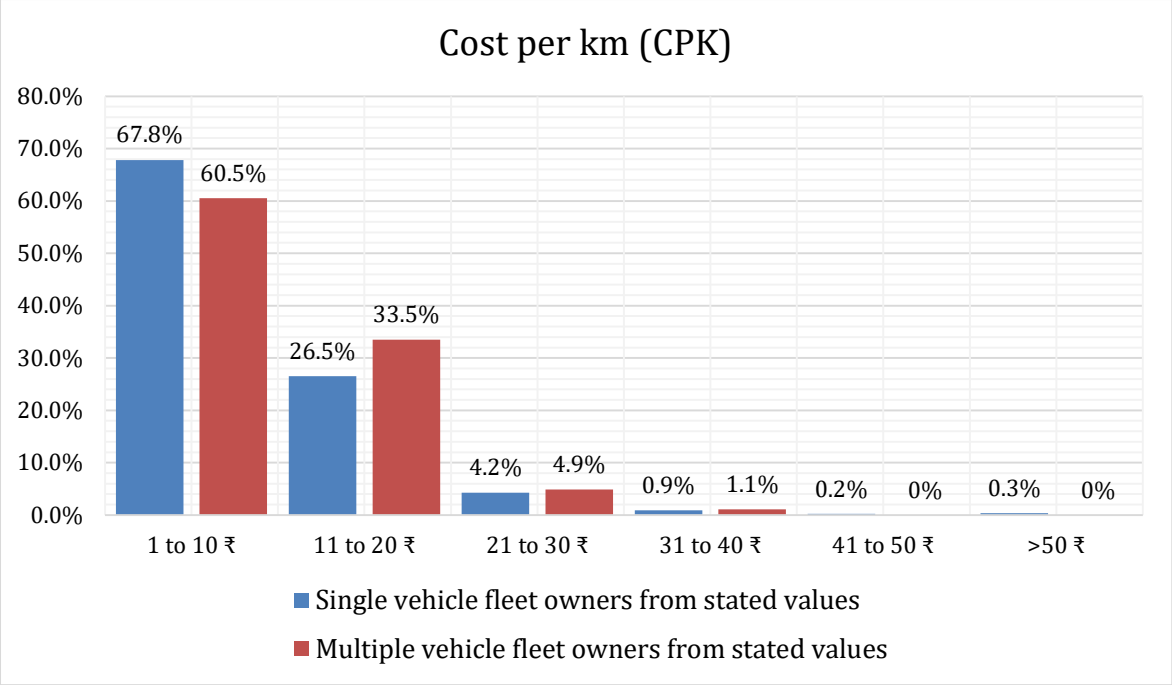

Figure 51: Distribution of cost per km. (CPK) of single and multiple fleet vehicle owners

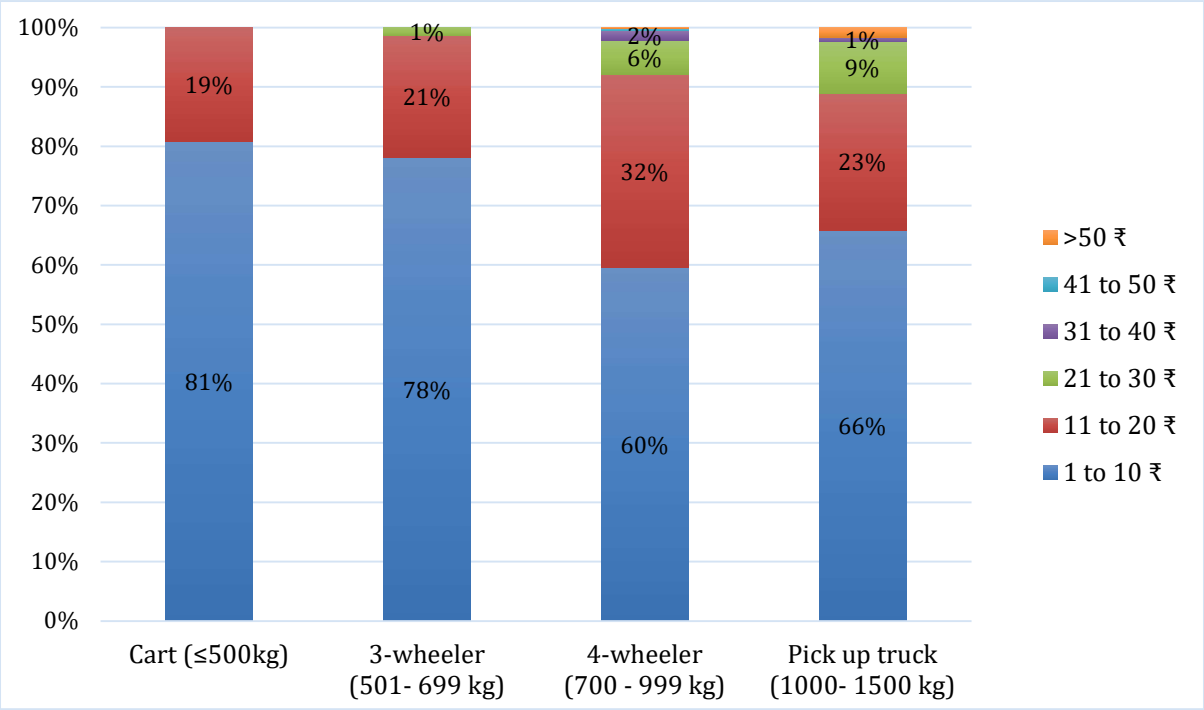

Figure 52: Vehicle type wise distribution of cost per km (in INR)

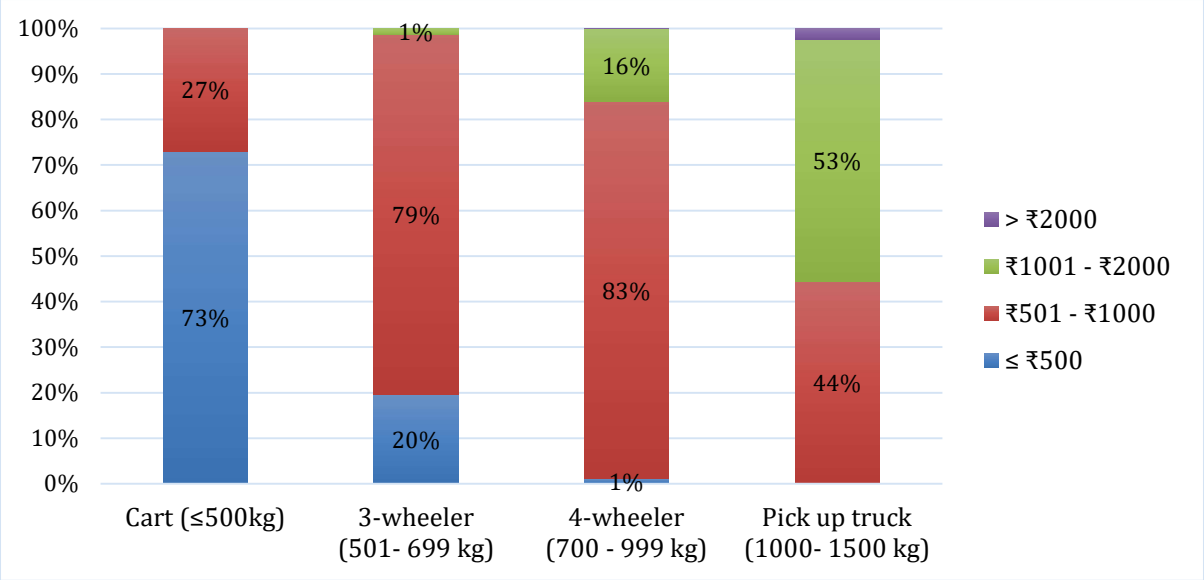

Figure 53: Vehicle type wise distribution of daily cost of operation

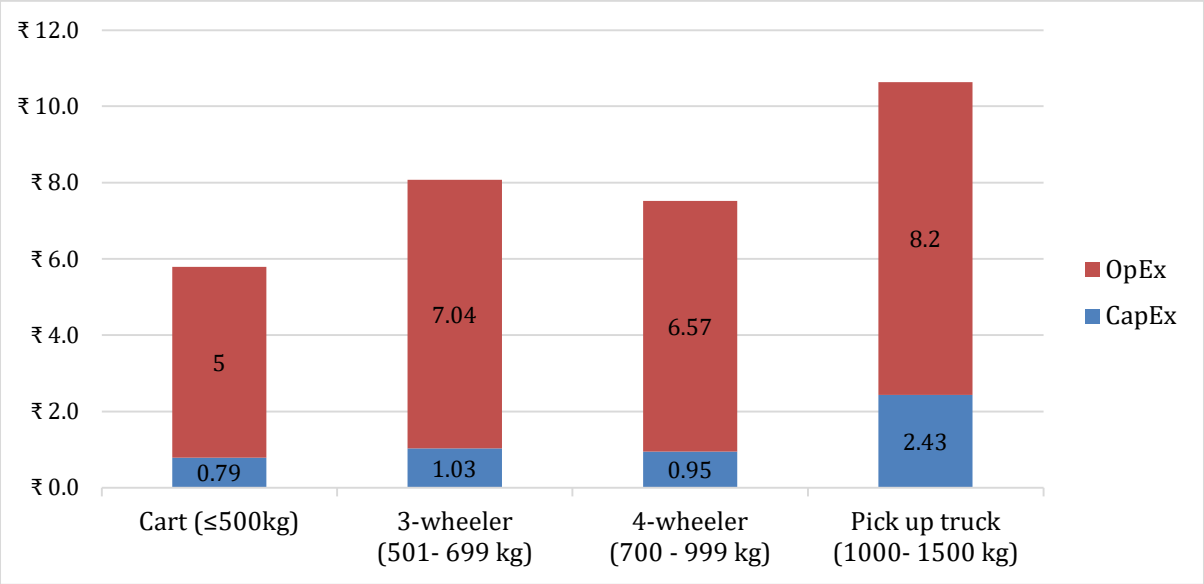

Figure 54: Vehicle type wise distribution of average cost operation per km (in INR)

3.4 Part 4 User (Owner) Perception

A total of 9 questions were put forth to the respondents in this part. All questions were used to directly derive the findings. The questions and responses are as following:

3.4.1 When do you plan to replace the current vehicle or add a new vehicle in your fleet?

The response rate for this question was 100%. Figure 55 presents the analysis of data from this question. The analysis suggests that almost 3/4th of all existing vehicle owners will buy a new vehicle within the next five years. Following are the findings of the analysis from this data analysis:

1. About 5.7% (114 responses) replied that they will replace/add new vehicles after 10 years.
2. 14.5% (289 responses) said they will replace/add new vehicles between 6 to 10 years.
3. 36% (720 responses) responded that they will replace/add vehicles between 4 to 5 years.
4. 37.5% (755 responses) of respondents said that they will replace or add vehicles between 1 and 3 years.
5. Only 6.1% (122 responses) of respondents plan to replace or add vehicles within the next year.

Vehicle type wise analysis suggests that more fleet owners with larger payload capacity vehicles do not plan to replace or buy a new vehicle before three years. 53% of existing operators of 3-wheelers will by a new vehicle in less than three years, while 37% of existing operators of 4-wheelers will buy a new vehicle in less than three years (Figure 56).

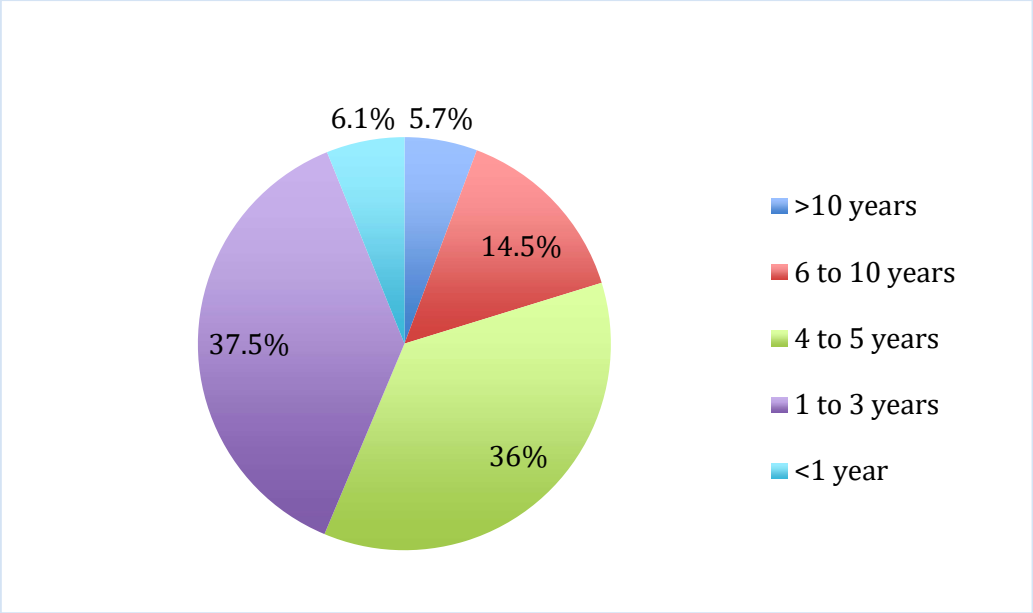

Figure 55: Responses for plan to replace the current vehicle or add a new vehicle in fleet

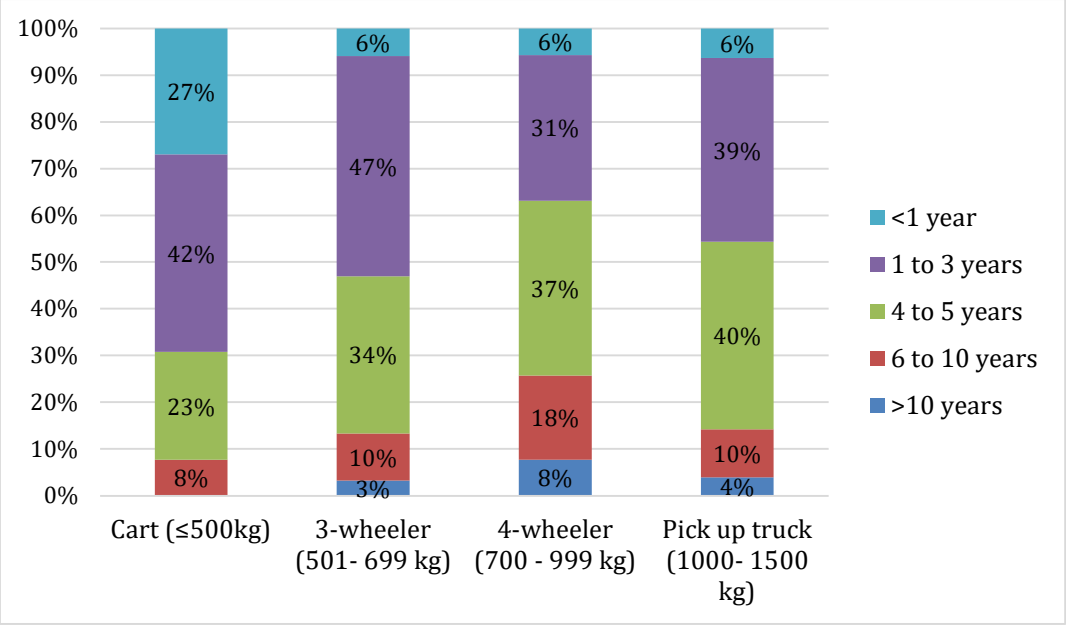

Figure 56: Vehicle type wise responses for plan to replace the current vehicle or add a new vehicle in fleet

3.4.2 In the current circumstances and available subsidy levels, how likely is it that your next purchase will be an electric Light Goods Vehicle?

This question had a response rate of 100%. About 2/3rd freight vehicle owners indicated that it is unlikely that an EV will be their next purchase. Just 1% of respondents were sure that there next purchase would be an EV (Table 17 and Figure 57). When data is analysed by vehicle types, it suggests that smaller payload capacity vehicle operators are slightly more confident that their next purchase will be EV than larger payload capacity vehicle operators. However, the difference is not significant (Figure 58).

Table 17: Responses for how likely is it that your next purchase will be an electric Light Goods Vehicle

	Very unlikely	**Somewhat unlikely**	**May or may not be (moderate)**	**Somewhat likely**	**Very likely**	**Total**
Sample	261	1066	346	302	25	2000

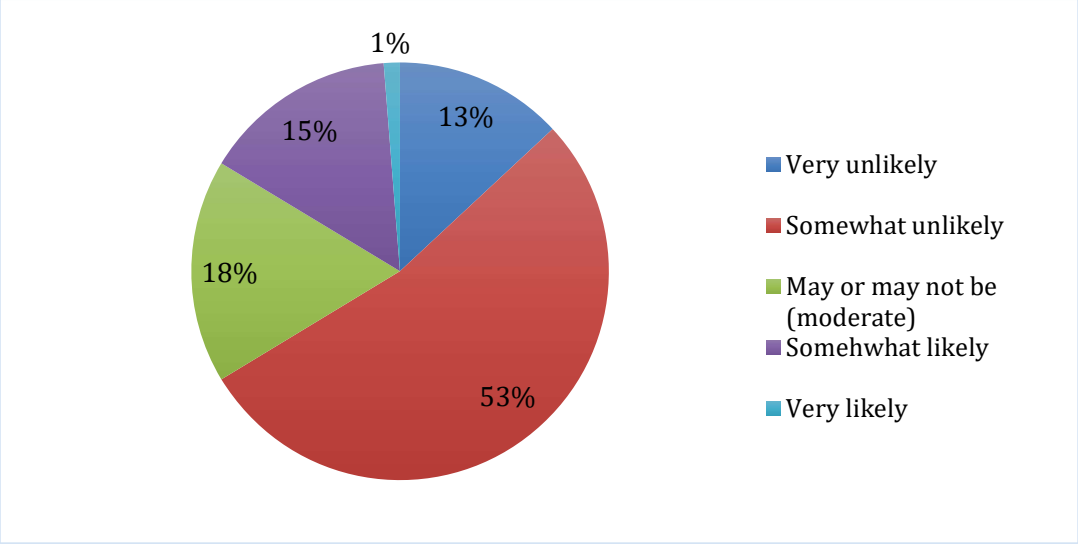

Figure 57: User perception distribution regarding how likely is it that your next purchase will be an electric light goods vehicle

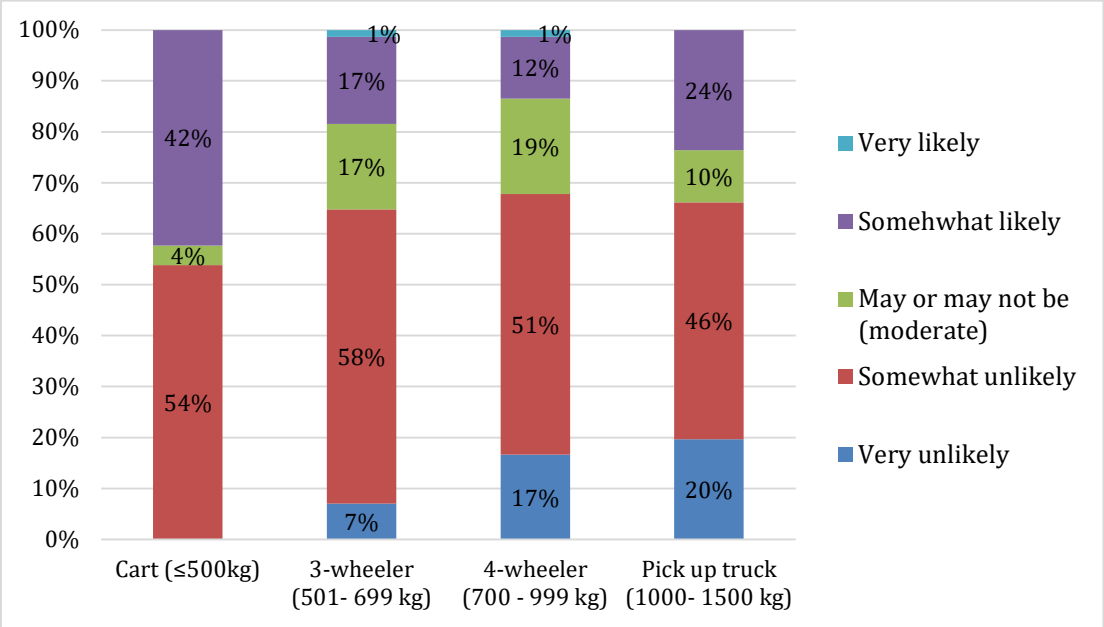

Figure 58: Vehicle type wise user perception distribution regarding how likely is it that your next purchase will be an electric light goods vehicle

3.4.3 Do you have knowledge of subsidies and benefits offered by the central and state government on buying and operating electric goods vehicles in Delhi?

100% respondents answered this question. The survey's analysis reveals that just 31% (627 responses) of fleet owners are aware of the subsidies and advantages, while 69% (1373 responses) are unaware of the government's incentives for purchasing and operating electric goods vehicles in Delhi.

When the data is evaluated in terms of vehicle type, it is observed that operators of carts and 3-wheelers have better knowledge about the subsidies as compared to operators of 4-wheelers and pick-up trucks (Figure 59).

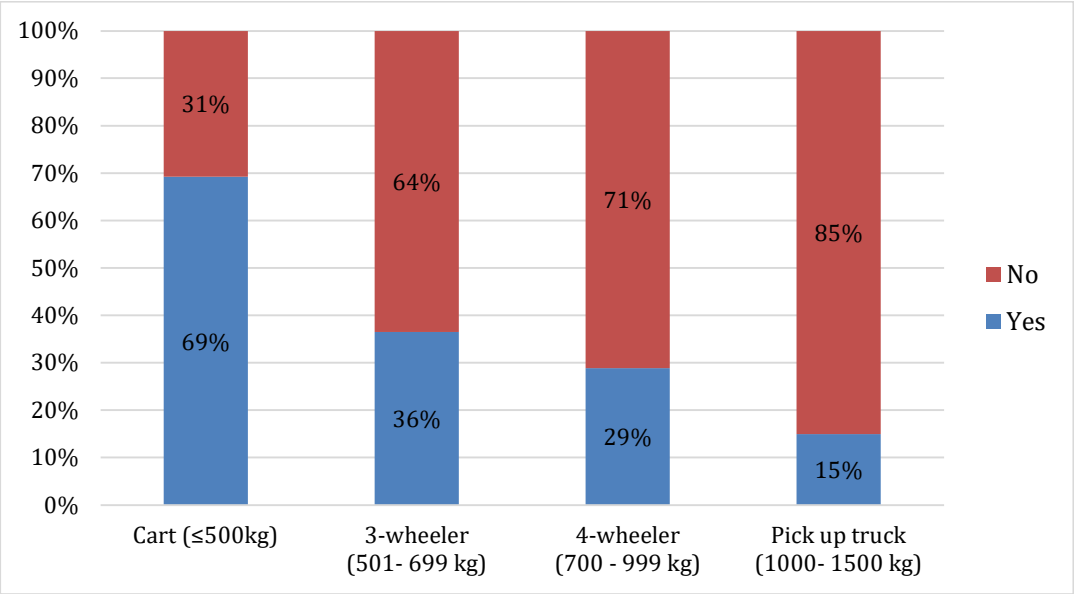

Figure 59: Vehicle type wise distribution of responses for the knowledge of the subsidies and benefits for electric vehicle

3.4.4 In your opinion (with current subsidies/benefits) how expensive or cheap is it to buy or own (vehicle cost, insurance, tax, etc.), similar electric vehicle model when compared to your current petrol/diesel/CNG vehicle?

This question achieved a response rate of 100%. Almost 92% of the respondents acknowledge that electric vehicles are comparable in price to a similar model of ICE freight vehicle. Approximately 35% (696 responses) of respondents indicated that it is somewhat expensive to buy a similar electric vehicle model when compared to their current petrol/diesel/CNG vehicle, while 33% of respondents indicated almost equal cost to buy a similar electric vehicle, while 24% respondents perceive the electric vehicle cost to be somewhat cheaper than comparable CNG vehicle cost. Just 1% of respondents said that it is very cheap to own a similar electric vehicle (Table 18 and Figure 60). Analysis of responses by vehicle type suggests that relatively more operators of smaller payload capacity vehicles (as compared to lower capacity vehicles) perceive electric versions to be relatively cheaper to own (Figure 61).

Table 18: Responses for how expensive or cheap is to buy or own (vehicle cost, insurance, tax, etc.), similar electric vehicle model when compared to your current petrol/diesel/CNG vehicle

	Very expensive	**Somewhat expensive**	**Almost equal**	**Somewhat cheaper**	**Very cheap**	**Total**
Sample	135	696	670	488	11	2000

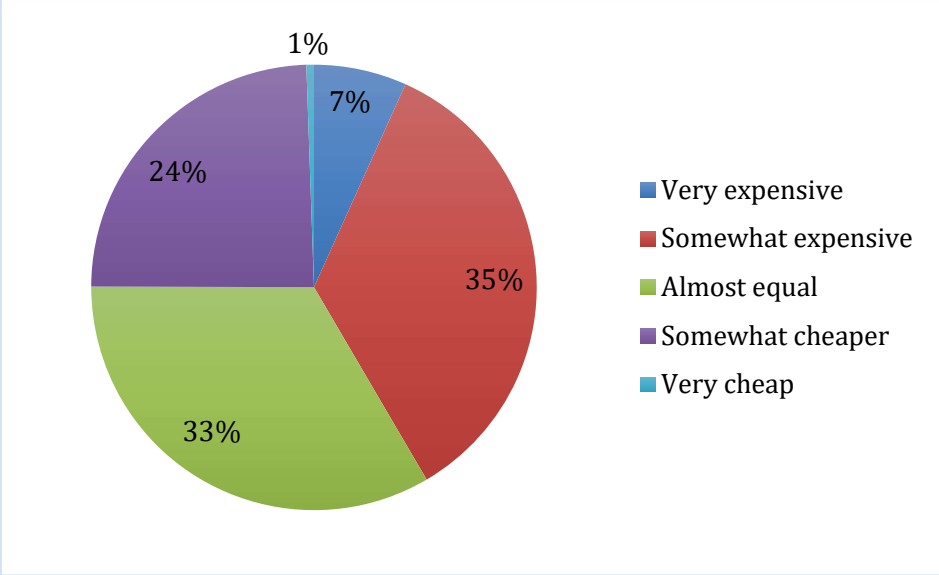

Figure 60:User Perception distribution regarding how expensive or cheap is to buy electric vehicle model compared to current petrol/diesel/CNG vehicle.

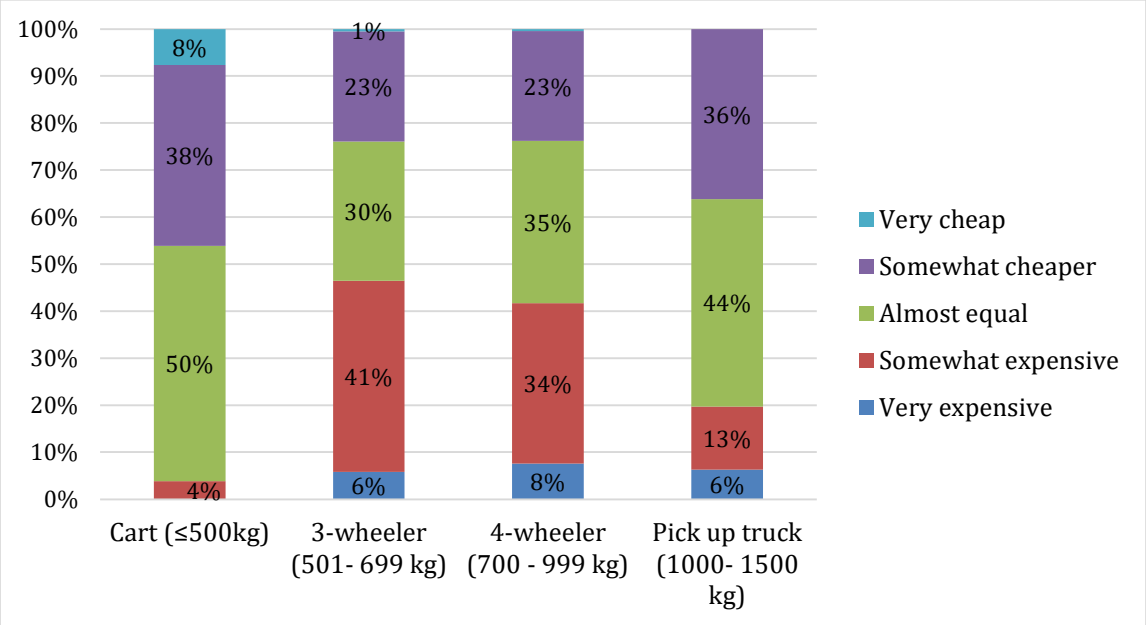

Figure 61: Vehicle type wise user Perception distribution regarding how expensive or cheap is to buy electric vehicle model compared to current petrol/diesel/CNG vehicle.

3.4.5 In your opinion (with current subsidies/benefits) how much more or less is the daily operational (fuel and daily maintenance) cost of a similar model of electric vehicle when compared to your current petrol/diesel/CNG vehicle?

This question had a response rate of 99.9% (1999 samples). Approximately 47% (940 responses) respondents indicated that daily operational cost of a similar model of electric vehicle when compared to their current petrol/diesel/CNG somewhat cheaper, while 39% of respondents indicated almost equal daily operational cost a similar electric vehicle. Just 1% of respondents said that the daily operational cost is very cheap for a similar electric vehicle (Table 19 and Figure 62). Analysis of

responses by vehicle type suggests that relatively more owners of larger payload capacity vehicles (as compared to lower payload capacity vehicles) perceive electric versions to be cheaper to operate than their current CNG vehicles (Figure 63).

Table 19: Responses for how much more or less the daily operational (fuel and daily maintenance) cost of a similar model of electric vehicle is when compared to your current petrol/diesel/CNG.

	Very expensive	Somewhat expensive	Almost equal	Somewhat cheaper	Very cheap	Total
Sample	33	220	782	940	24	1999

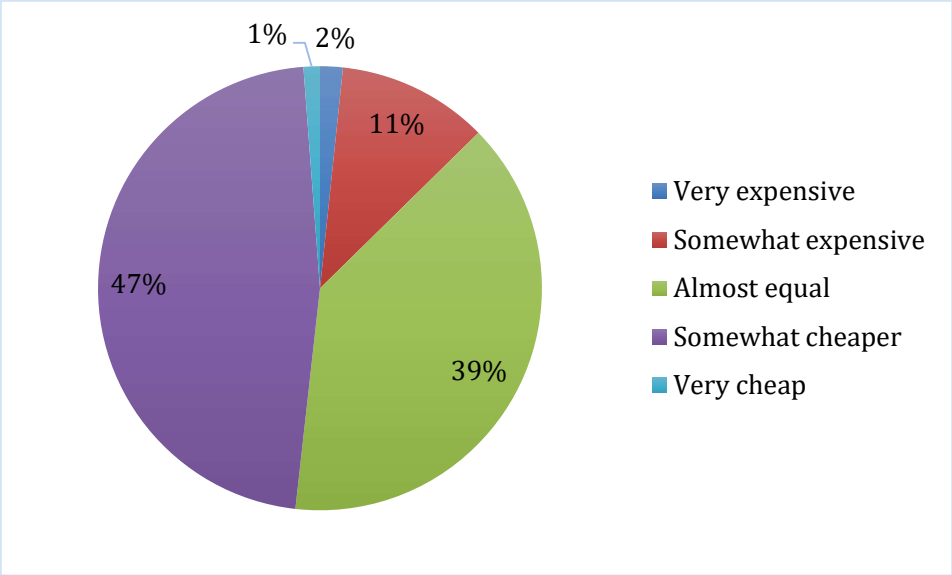

Figure 62: User Perception distribution regarding daily operational cost of electric vehicle compared to current petrol/diesel/CNG vehicle.

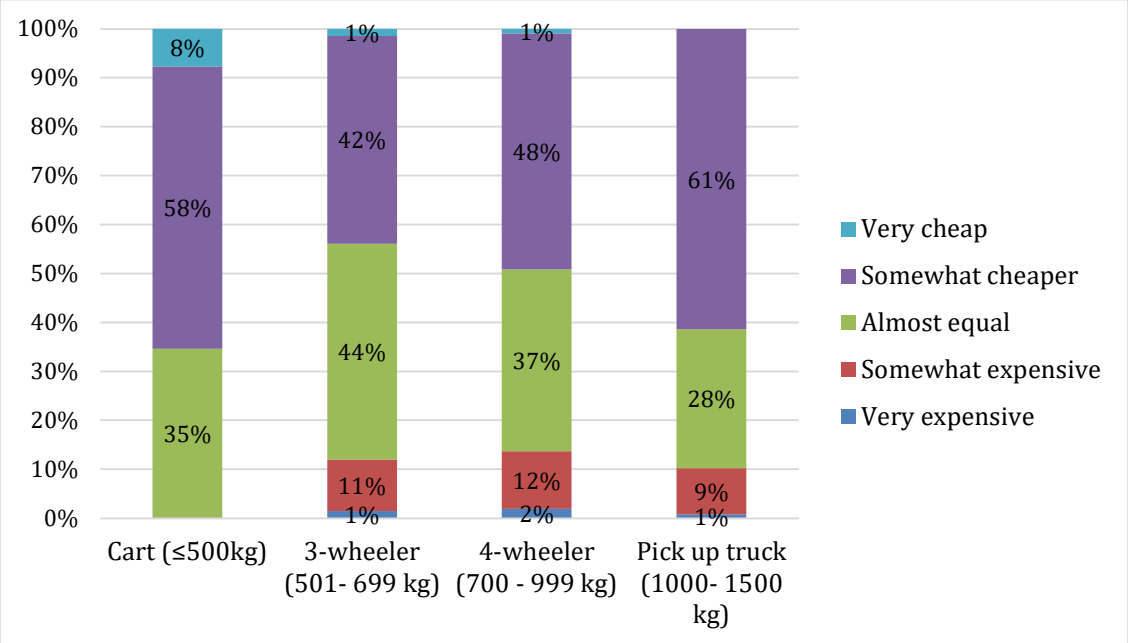

Figure 63: Vehicle type wise user perception distribution regarding daily operational cost of electric vehicle compared to current petrol/diesel/CNG vehicle.

3.4.6 Do you know of any people who have purchased electric vehicles?

100% of respondents answered this question. Approximately 53% (1057 responses) responded that they know very few people who have purchased electric vehicles Almost 0% (5 responses) responded that everyone they know have purchased electric vehicles (Table *20*, Figure 64). When the data is analysed vehicle type wise, it is observed that ownership of larger capacity electric vehicles is less common than that of lower capacity electric freight vehicles. This is also confirmed by Vaahan database (Figure 65).

Table 20: Responses for do you know of any people who have purchased electric vehicles

	None	Very few	Half of people I know	Most of them have	Everyone I know has	Total
Sample	674	1057	202	62	5	2000

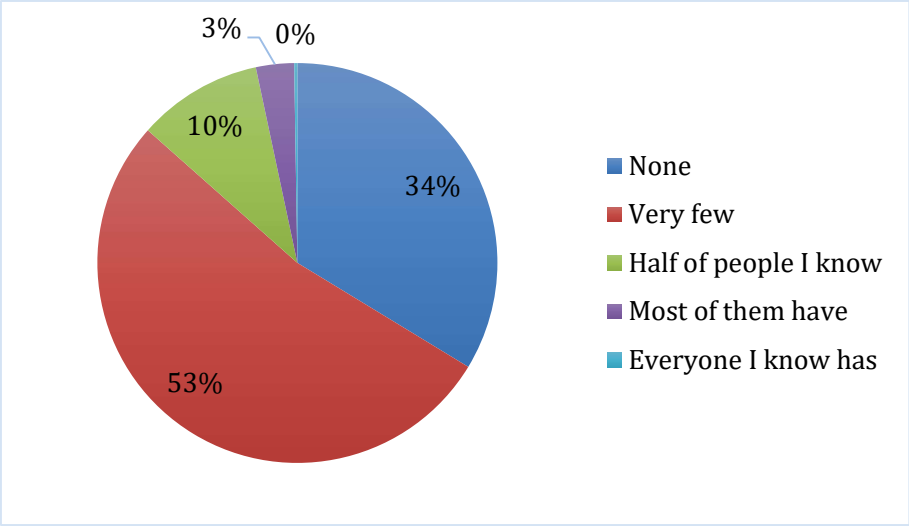

Figure 64: User Perception distribution regarding current electric vehicle ownership

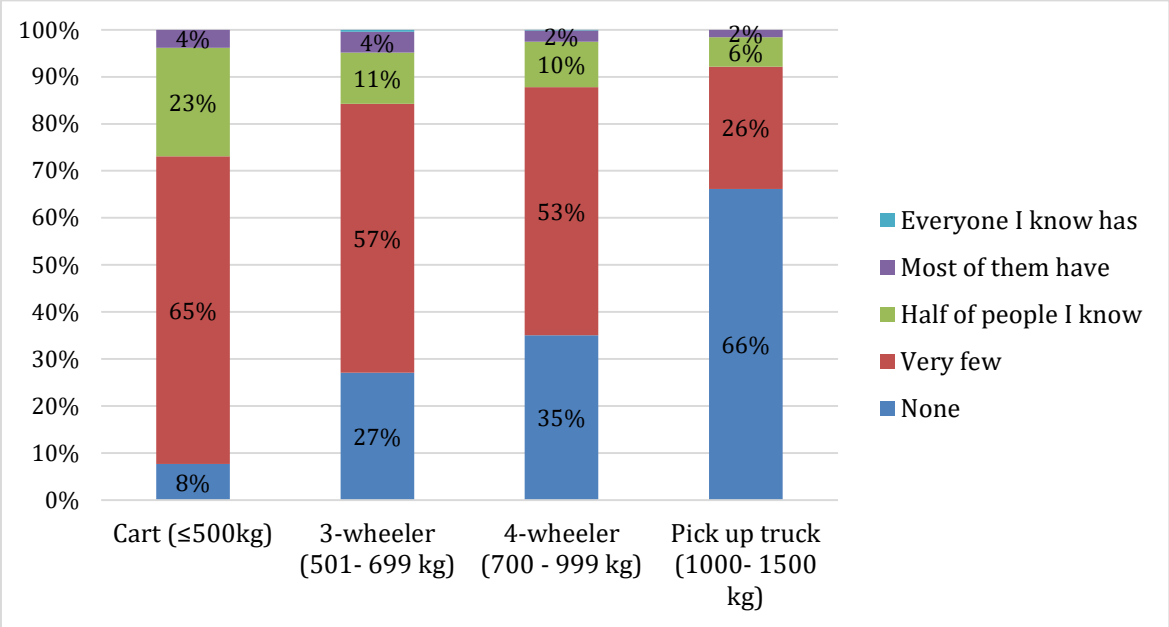

Figure 65: Vehicle type wise user perception distribution regarding current electric vehicle ownership

3.4.7 Are you aware of any owners who have availed of any electric vehicle-related government benefits/schemes?

This question had a response rate of 100%. Approximately 40% (789 responses) responded that they know very few people who have availed of any electric vehicle-related government benefits/schemes. Almost 0% (2 responses) responded that everyone they know availed of any electric vehicle-related government benefits/schemes (Table 21 and Figure 66). When the data is analysed vehicle capacity wise, it is perceived that larger capacity vehicles are less likely to avail subsidy benefits (Figure 67).

Table 21: Responses for: are you aware of any owners who have availed of any electric vehicle-related government benefits/schemes

	None got it	Very few got it	About half of people who bought got	Most of them got it	All got it	Total
Sample	645	789	462	102	2	2000

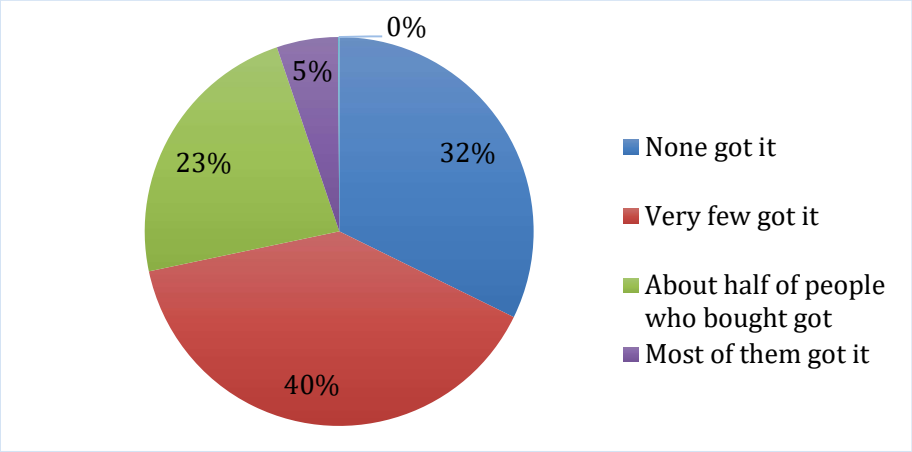

Figure 66: User Perception distribution regarding electric vehicle benefit awareness

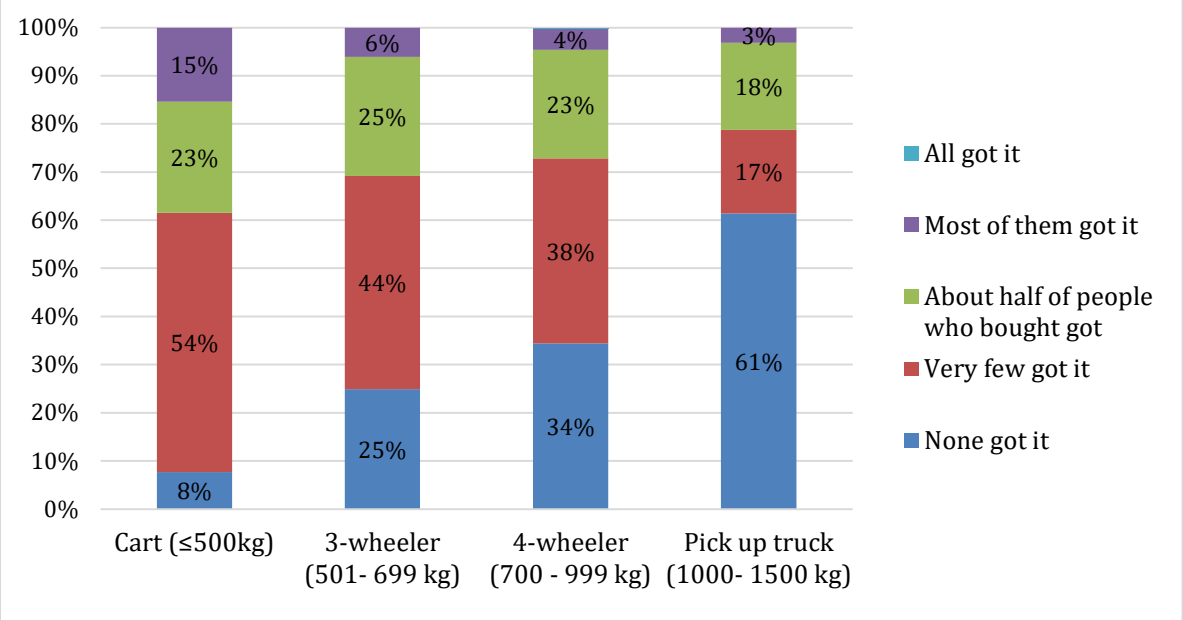

Figure 67: Vehicle type wise user perception distribution regarding electric vehicle benefit awareness

3.4.8 How easy or difficult do you think it will be to avail these benefits/subsidies for purchasing an electric light goods vehicle?

This question had a response rate of 100%. Approximately 58% (1162 responses) respondents indicated that it will be Moderate - neither difficult not easy to avail these benefits/subsidies for purchasing an electric light goods vehicle. Almost 1% (10 responses) of respondents indicated that it will be extremely easy to avail these benefits/subsidies for purchasing an electric light goods vehicle (Table 22 and Figure 68). When the data is analysed vehicle type wise, no clear relationship emerges between vehicle capacity and perception of ease of availing subsidy on EV (Figure 69).

Table 22: Responses for how easy or difficult do you think it will be to avail these benefits/subsidies for purchasing an electric light goods vehicle

	Almost impossible	very difficult	Moderate - neither difficult not easy	Very easy	Extremely easy	Total
Sample	43	476	1162	309	10	2000

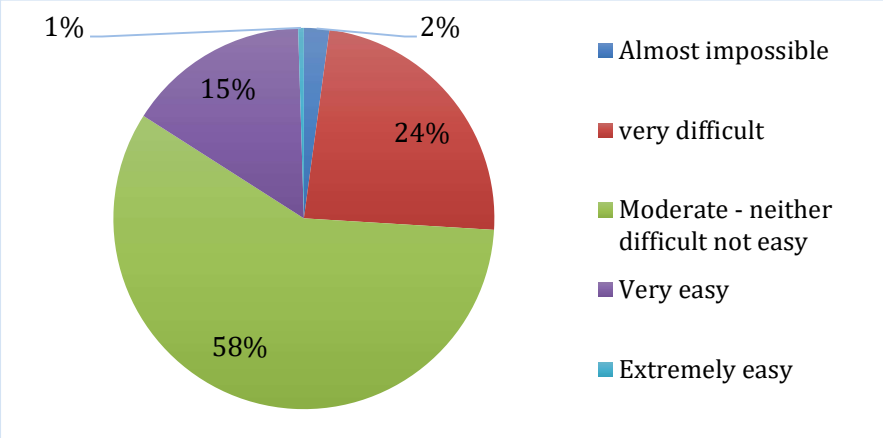

Figure 68: User Perception distribution regarding the difficulty level in availing electric vehicle benefits by users

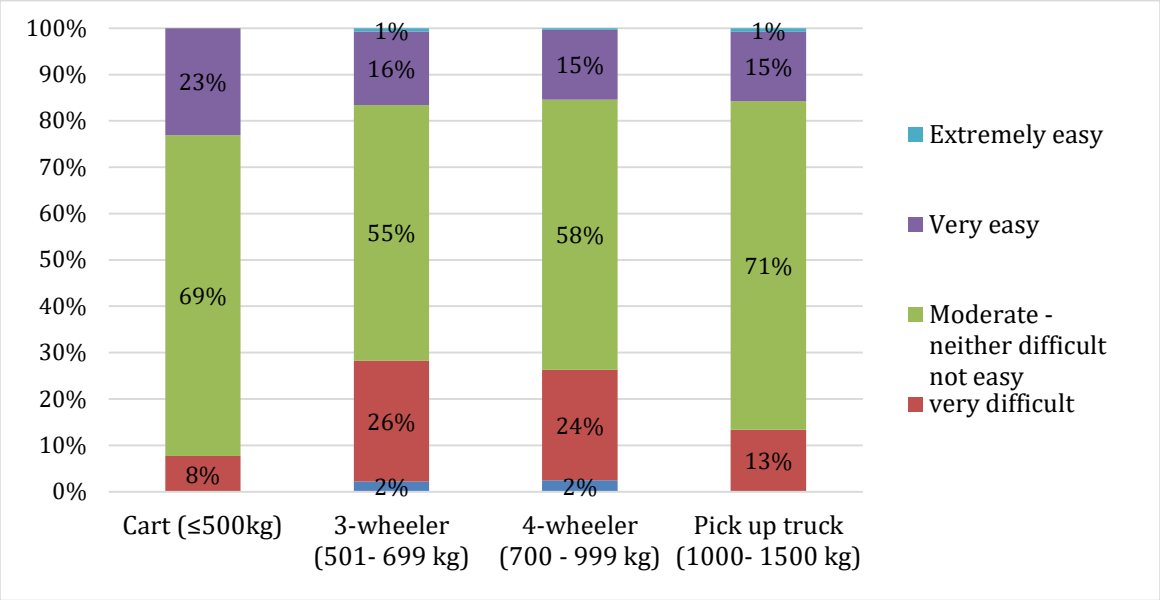

Figure 69: Vehicle type wise user perception distribution regarding the difficulty level in availing electric vehicle benefits by users

3.4.9 Which one of these facilities/services will positively contribute to meet your operational requirements towards electrification? Please rank in the order of preference (1 to 5)

This question had a response rate of 100%. The responses are the following:

3.4.9.1 Lower Financing – Interest rate

Analysis of the responses suggests that 35% have ranked this this facilty number 2, 29% ranked it number one 1, 13% rank it number 3 & rank 4 each and 10% ranked it number 5 (Figure 70). When the data is analysed in the term of vehicle type wise, the analysis suggests that majority of pick-up truck operators rank this facility as number 1 and while majority of all other vehicle owners rank it as number 2 (Figure 71).

3.4.9.2 Cheaper electricity charges - lower than Rs 5/KW/h

Analysis of the responses suggests that 33% have ranked this facility as number 1, 31% have ranked it as number 2, 15% have ranked it as number 3, 12% have ranked it as number 4 and 9% have ranked it as number 5 (Figure 70). When the data is analysed in the terms of vehicle type, the analysis suggests that majority of pick-up truck operators have ranked this facility as number 2 while majority of other vehicle owners have ranked it as number 1 (Figure 72).

3.4.9.3 Availability of more options of vehicle models

Analysis of the responses suggests that 37% have ranked this condition as number 5, 21% have ranked it as number 4, 16% have ranked it as number 2, 15% have ranked it as number 3 while 12% have ranked it as number 1 (Figure 70). When the data is analysed in the term of vehicle type, the analysis suggests that majority of all operators of different vehicle type have ranked this condition as the least important or number 5 (Figure 73).

3.4.9.4 Parking & charging infrastructure

Analysis of the response suggests that 42% have ranked this facility as number 3, 18% have ranked it as number 4, 14% have ranked it as number 2 and 5 each, while 12% have ranked it number 1 (Figure 70). When the data is analysed in term of vehicle type, the analysis suggests majority of operators for all vehicle types have ranked this facility as number 3 (Figure 74).

3.4.9.5 Maintenance / Service facility

Analysis of the responses suggest that 37% rank this facility as number 4, followed 30% rank it at number 5, 15% rank it at number 3, 14% rank it at number 1 and 5% rank it at number 2 (Figure 70). When the data is analysed in the term of vehicle type, the analysis suggests that majority operators of all vehicle type rank this facility as number 4 (Figure 75).

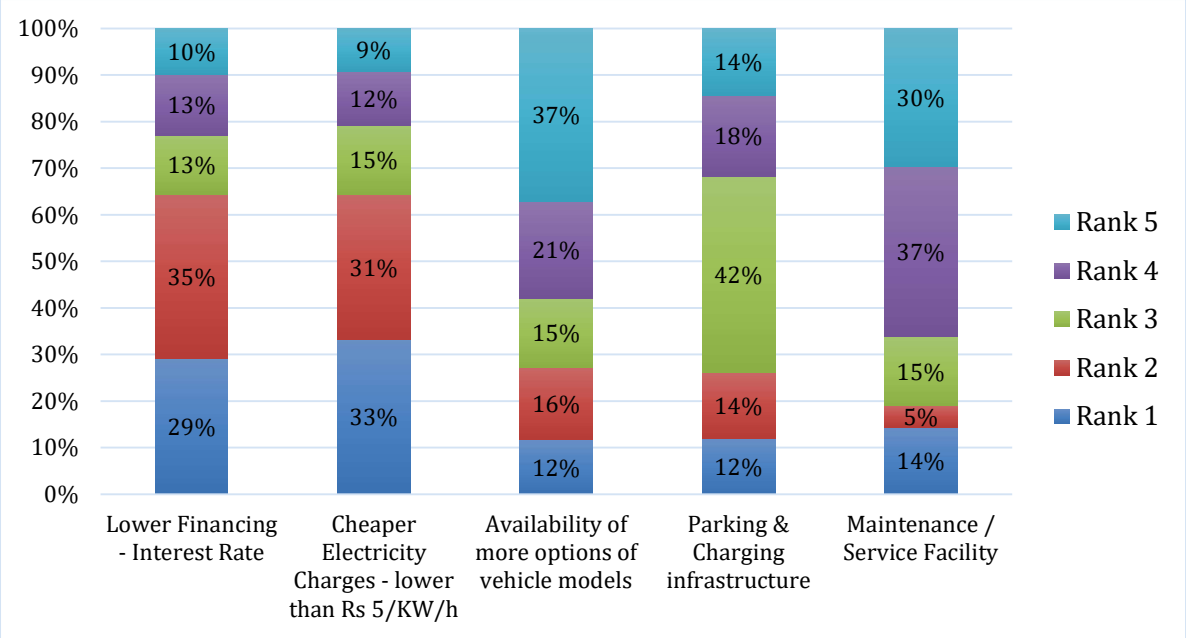

Figure 70: Distribution of rank preferences of facilities/services

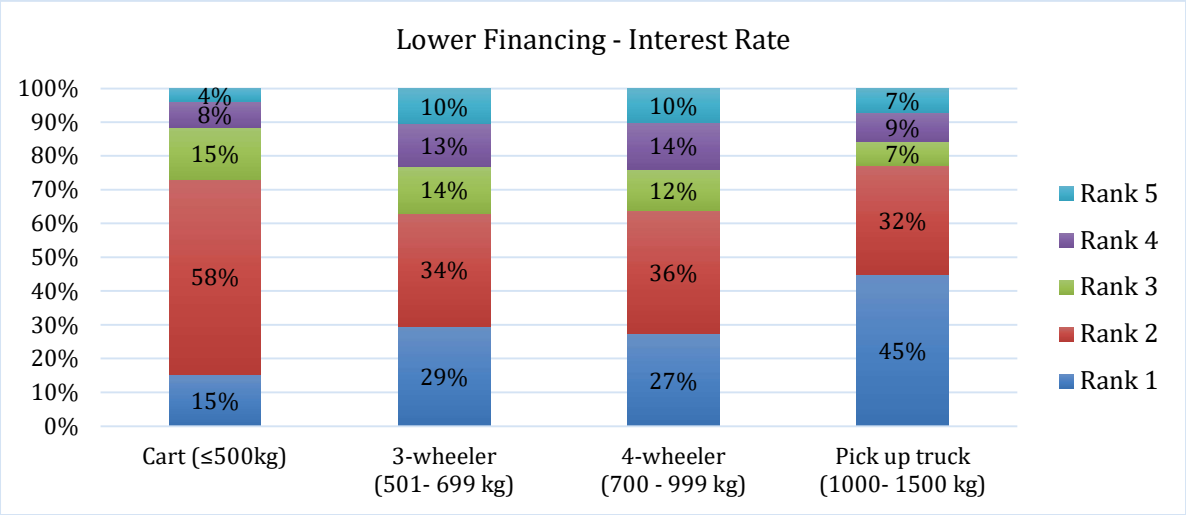

Figure 71: Vehicle type wise rank preference for lower financing - Interest rate

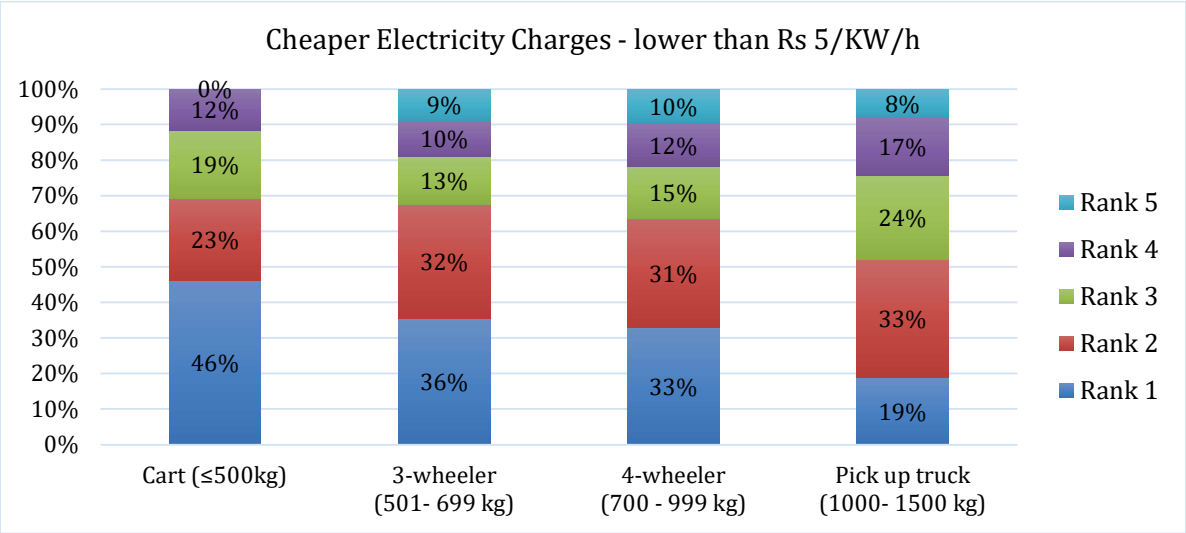

Figure 72: Vehicle type wise rank preference for cheaper electricity charges - lower than Rs 5/KW/h

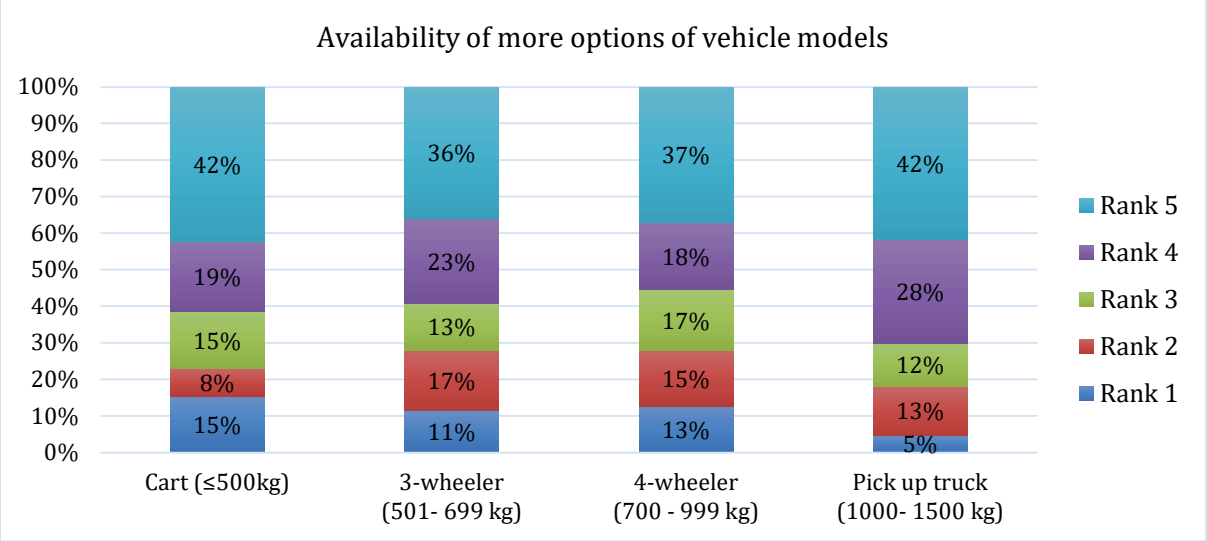

Figure 73: Vehicle type wise rank preference for availability of more options of vehicle models

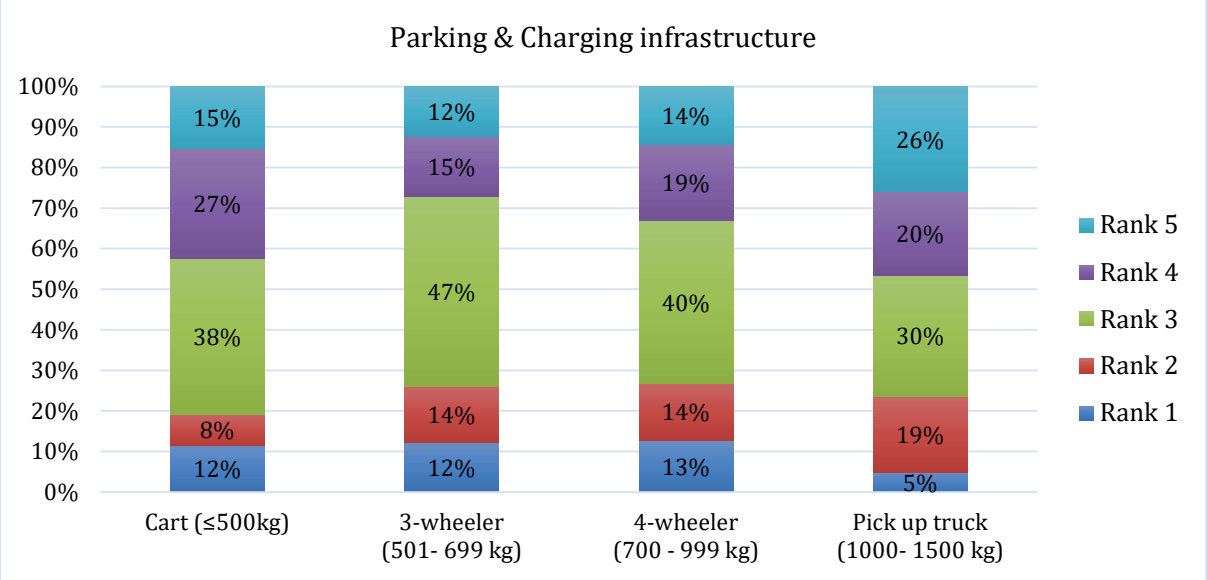

Figure 74: Vehicle type wise rank preference for parking & charging infrastructure

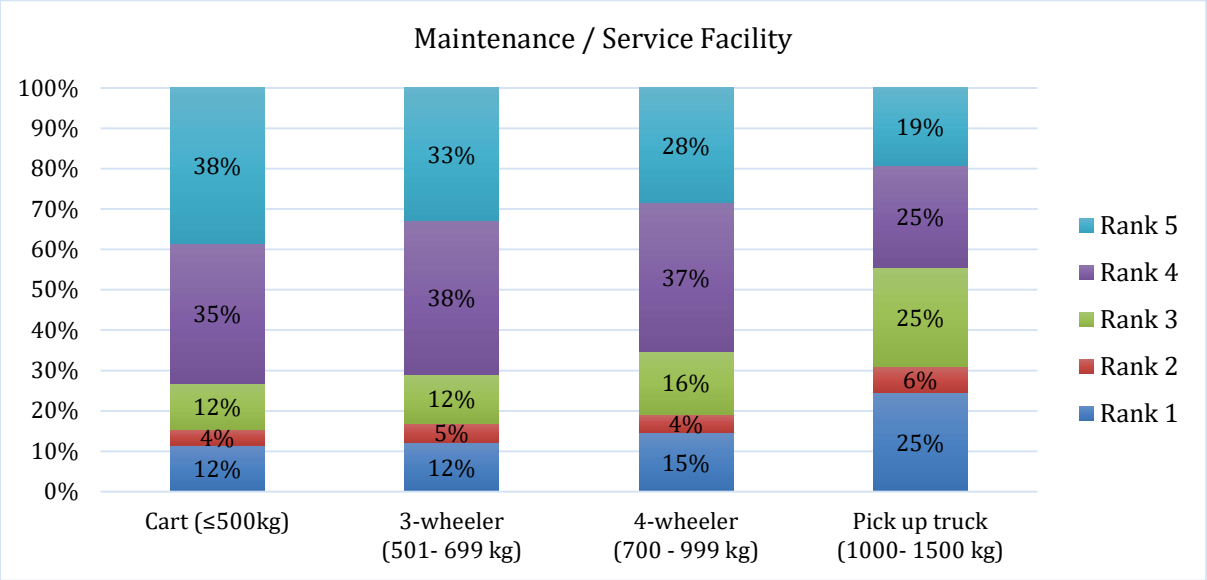

Figure 75: Vehicle type wise rank preference for maintenance / service facility

4 Survey Findings and Recommendations

This section presents the findings and recommendations from the survey based on the data collected and its analysis.

4.1 Findings

This section presents the findings from the survey. The findings have been presented in two parts – 1) findings on LCV based urban freight vehicle and trip characteristics in Delhi, and 2) findings on barriers in electrification of these vehicles.

4.1.1 Vehicle and Trip Characteristics

- Less than 1% of total responses is from operators of carts, hence this is excluded from most findings.
- Only 7% of all responses is from pick-up truck operators, while 92% of samples almost uniformly divided in two categories of vehicles, i.e., 3-wheelers and 4-wheelers.
- Smaller payload vehicles undertake shorter but greater number trips as compared to larger payload vehicles which undertake relatively longer but lesser number of trips per day.
- Due to shorter trips, the per trip duration is less for shorter payload vehicles than for larger payload vehicles and the overall daily working hours is also less (<8 hours for most operators) than that for larger payload vehicles (>8 hours for most operators).
- Total daily utilization (total km of operations per day) increases with payload capacity.
- The idle time per day is similar for all vehicle categories (likely because of government enforced non-working hours for commercial vehicles). This is also the reason why loading/unloading time does not differ between vehicle categories (as it coincides with non-working hours for most operators). Thus, the overall driving time is observed to be increasing with payload capacity.
- The idle time for operators is not constant and reduces with increase in working/driving/loading-unloading hours. However, working/driving hours tend to be constant and working day increases with increase in idle time. This suggests an employment profile like daily wage, i.e., minimum daily earning must be achieved by committing minimum working hours even if overall working day length increases.
- Though most freight trips are overweight, the average percentage overweight for smaller payload vehicles is less than that for larger payload vehicles.
- 91% trips are overloaded with 32% trips being overloaded more than twice the capacity.
- Only 16% of 3-wheelers and 11% of 4-wheelers are carrying within their limits. This will be a barrier for electrification of these vehicles – excess weight will reduce range apart from other incremental damages to the vehicle and the environment.

- 76% of freight vehicles travel less than 100km per day. This is promising for adoption of electric freight vehicle, as the need for opportunity charging is eliminated.
- Most operators have flexible routes because they don't have regular customers.

4.1.2 Commodities

- 3- wheelers are more popular than other freight modes for three commodities – perishable food, FMCG and clothes & accessories. For all other commodities 4-wheelers and pick-up trucks are more popular.
- Other commodities where goods three wheelers contribute to significant share of trips (but not as much as four wheelers) are food grain and pharmacy.
- Per trip load varies significantly with commodity. Amongst the lowest is for liquor at less than 500kg per trip and amongst the highest is for solid waste with close to 1500 kg per trip. Other commodities with lower 1000kg) weight per trip are FMCG, perishable food, cash, and hotel & restaurant supplies (catering, etc.).
- Commodities with higher potential for earning (earning > Rs. 0.025 per kg-km) are FMCG, cash, pharmacy, and construction & demolition. Commodities with medium earning potential of between 0.02 to 0.025 per kg km include – hotel and restaurant, electronics, clothes & accessories, and printing & publishing. Solid waste is one commodity which has the lowest earning potential or less than Rs. 0.015 per kg-km.

4.1.3 Potential and Barriers in Electrification of LCV freight vehicles

- Only 1% of survey respondents currently own an electric vehicle while 31% operators have the knowledge of subsidies and benefits offered by the central and state government on buying and operating electric goods vehicles.
- Approximately 44% of goods vehicle owners intend to replace or add vehicles to their fleet in the next three years, while 3/4th will do it within the next five years. This may be an opportunity to influence their decision in favour of an electric goods vehicle.
- To enable the purchase and operation of electric goods vehicles, most fleet owners seek cheaper electricity charges and lower the financing and interest rates.
- Pick-up truck operators have given rank 1 to lower financing – interest rates while other vehicle operators have given rank 1 to cheaper electricity charges.
- Majority of 3-wheelers operators are aware of electric vehicle related incentives and are more inclined to purchase the next electric freight vehicle, when compared to other vehicle type operators.
- 4-wheeler operators are not aware of available subsidies on purchase and operations of electric vehicles They are not much interested in electric vehicles because of the less availability of 4-wheeled electric freight vehicle models and their initial high purchase cost (as compared to that of electric -wheelers).
- 3 and 4-wheeled freight vehicles have comparable market share in ICE/CNG vehicle category. In 2023 the number of registered freight 3 wheelers is over

15,000, whereas the number of freight 4-wheelers and pick-up truck combined is around 9,500.

- However, the sale of electric version of good 3-wheelers (Table 23) is far greater than that of electric version of goods 4-wheeler (Table 23), even when similar subsidies are applicable on both these vehicle types.
- After subsidy schemes were introduced on electric freight 3 and 4-wheelers in August 2021, the total share of electric three wheeled freight vehicles in the share of total freight vehicles sold (in 2023) is risen to 73%. The share of electric freight vehicles (of total freight vehicles sold) with similar models as those of ICE vehicles in 4-wheeler category during the same period is only 1.5%.
- The average age of current CNG three wheeled freight vehicles is 8.6 years, while that of four wheeled freight vehicles is 5.6 years. About 37% of CNG 3-wheeled freight vehicles are more than 10-year-old, while only about 16% of 4-wheeled freight vehicles are more than 10 years old.
- This can be another reason for overall lower number of registrations of electric 4-wheeled freight vehicles as compared that of electric 3-wheeled freight vehicles. This is why significantly less 4-wheeled freight vehicle operators are looking to replace their vehicle as compared to current 3-wheeled freight vehicle operators (Figure 56).
- There is significant availability of opportunity charging infrastructure in Delhi. This is also true for areas where freight vehicles have been found to collect during their idle time. However, the charging tariff is not conducive for commercial vehicles especially e-freight vehicles in LCV category.
- However, the public charging stations need better layout designs. The current designs require vehicles to either park on the footpath, or on the (high speed) carriageway (with cable stretching across the footpath), creating unsafe conditions for both the pedestrians and the vehicles (Figure 76).
- For example, at Barar Square on Ring Road in Delhi, poorly planned charging stations are within 700m of locations that allow a well-planned and safe charging station location. This highlights the need for greater oversight and better planning efforts while locating and planning charging infrastructure in Delhi.
- Significant number of freight vehicle operators in LCV category do not have possibility of charging at their residence. This is because of lack of access to the residence or lack of parking at the residence. This implies high dependence on public charging infrastructure especially for 4-wheeled freight vehicles.
- Lower battery size in e-freight vehicles in LCV category coupled with lack of DC chargers, results in limits to utilization of these vehicles. E-freight vehicles are exempt from the limits on operational hours and can operate at any time of the day. This can mean higher utilization and thus higher profitability for the owners/operators and can also help overcome the need to overload. This should have been one of the key factors in accelerating adoption of e-freight LCV. However, this could not be capitalised to accelerate freight vehicle electrification, higher operational range requirements, or faster, cheaper and more accessible opportunity charging. Both are not available.

Figure 76: Current placement of charger at Barar Square on ring road in Delhi

4.1.4 Cost and Revenue

- Data from stated responses suggests that the current (with ICE vehicles) average earning per km (EPK) is INR 18.3, average cost per km (CPK) is INR 10 and average profit per km is INR 8.3.
- The respondents have provided an overall perception of cost, combining CapEx and OpEx. Respondents believe that electric vehicle TCO is cheaper or comparable to current CNG vehicles.
- Estimated total cost of ownership (TCO) per km (average for 15 years service life of the vehicle) of electric freight 3-wheelers is ₹ 4.31 per km and for electric freight 4-wheelers is ₹ 5.4 per km[3]. In comparison the TCO for ICE/CNG versions of vehicles in these categories is Rs. 8.07 Per km and Rs. 7.52 Per km respectively. The comparative breakup of CapEx and OpEx for ICE and electric 3 and 4-wheelers is presented in Figure 77**Error! Reference source not found.**.
- TCO of electric 3-wheeler during the loan tenure (first five years) is estimated at Rs. 7.92 per km while that electric 4-wheeler is Rs. 9.83 per km. In comparison, the average estimated TCO of current CNG freight vehicles during the loan tenure is Rs. 10.17 per km, are Rs. 9.44 per km respectively for 3 and 4-wheeler vehicles.
- Electric 4-wheelers offer similar or lesser range than currently available electric 3-wheeler models, while their daily utilization requirement is higher. This means

[3] This is based on estimates with total energy cost at Rs. 9.0 per kWh.

that more operators for electric 4-wheelers will be dependent on public charging infrastructure, than those of electric 3-wheelers.

Table 23: Details of currently available models of electric freight vehicle

Sr. No.	Vehicle Model	Battery Capacity (in KWh)	Payload Capacity (in Kg)	Purchase Cost (in Lakh)	Operational Cost (per km)	Range (in Km)
1.	Tata Ace EV (4-W)[4]	17.2	600	9.5	0.9 – 2 Rs	154
2.	Mahindra Treo Zor (3-W)[5]	7.37	578	3.48	0.5 – 1 Rs	80
3.	Piaggio Ape E-xtra (3-W)[6]	8	506	3.12	0.5 – 1 Rs	90
4.	Omega Seiki Rage+ (3-W)[7]	10.8	500	3.61	0.5 – 1.25 Rs	120
5.	Euler Hi-Load (3-W)[8]	13	688	3.78	0.5 – 1.2 Rs	120
6.	Kinetic Safar Jumbo (3-W)[9]	8.2	500	3.45	0.5 – 1 Rs	120

- This relatively slow uptake of four wheeled electric freight vehicles in less than 1 ton category in comparison to electric three wheelers need to be investigated.

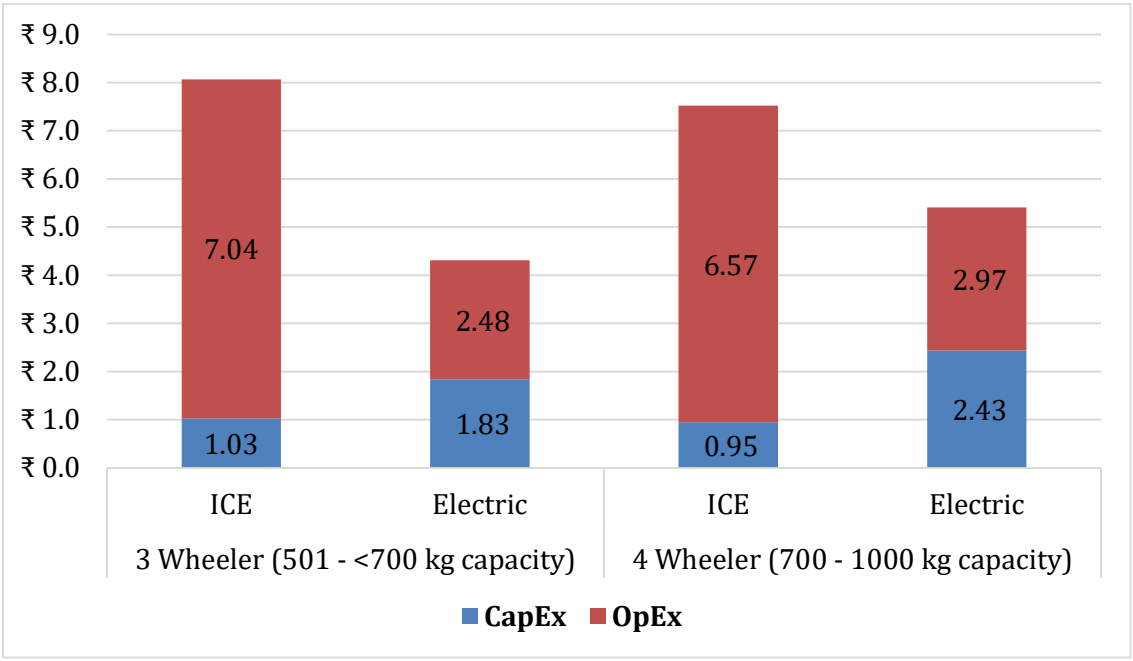

Figure 77: CapEx & OpEx of ICE and electric freight vehicles

[4] *Data source – www.aceev.tatamotors.com/*
[5] *Data source – www.mahindralastmilemobility.com/treo-zor-pickup*
[6] *Data source – www.piaggio-cv.co.in/ape-e-cargo/*
[7] *Data source – www.omegaseikimobility.com/rage-plus/*
[8] *Data source - www.eulermotors.com/hiload*
[9] *Data source - www.kineticgreenvehicles.com/electric-three-wheelers/cargo/safar-jumbo/*

- Since the operators are mostly single fleet owners operating at low profit margins, they are very sensitive to cost of operations and TCO. Hence even if the average TCO during the service life of the electric vehicle maybe less than the CNG version, what matters is the cost during the loan tenure. Hence a lower TCO for electric vehicles, during the loan tenure, than that of similar CNG version is critical to generate the desire for transitions especially for first time buyers of commercial EV.
- While electric 3-wheelers are more profitable than their CNG models even during the loan tenure (estimated with electricity rate of Rs. 9 per kWh) the TCO for electric 4-wheeler, during the loan tenure, is slightly higher than that of similar CNG model. If we account for overloading for both vehicles, the cost of operations is expected to go up by up to Rs. 0.4 per km for electric three wheelers and Rs. 0.7 per km for electric 4 wheelers[10].
- Based on this it can be estimates that for four wheeled e-freight vehicles the cost of electricity needs to be less than Rs. 6 per kWh to ensure that the TCO during the loan tenure is the same as that similar CNG model. For electric freight three wheelers however, the cost of electricity as high as Rs. 22 per kWh (if additional energy requirement due to overloading is accounted for) to Rs. 34 per kWh (if additional energy due to overloading is not accounted for) will keep them more profitable than similar CNG models.
- There is significant variation in current per unit public charging tariff in Delhi. We have documented charging tariff on June 22, 2023, at three locations used by freight vehicles in LCV category in Delhi (based on the survey locations), i.e. Azadpur, Okhla and Old Delhi. We find at these locations the public charging rates for AC fast/slow charging varies between Rs. 10 to Rs. 100 per kWh[11]. The average charging tariff at these locations vary between Rs. 24 to Rs. 45 per kWh. These rates are clearly not attractive for freight vehicle operators and will adversely affect their profitability. This is especially true for 4-wheeler e-freight vehicles, which have a higher dependence on public chargers.
- This is also likely influencing the perception of cheaper electricity charges as a number one motivator for transition to electric, for light freight vehicle operators.

4.2 Recommendations

4.2.1 Public Charging Eco-system

- Charging tariff at public chargers should not be more than Rs. 6-10 per kWh (both for AC fast and AC slow charging).
- Utilization per public charger is expected to increase with reduced tariff, thereby making it viable return of investment even at reduced rates. To further drive down the cost while attracting investment in charging infrastructure GNCTD may consider telescopic minimum demand guarantee models spread over a ten-year period (the estimated life of a charger).

[10] Based on an assumption of 50% higher energy use for three wheelers and 70% higher energy usage for four wheelers.
[11] www.ev.delhi.gov.in

- Also, because freight vehicles with less than 1 ton payload capacity, rely on slow AC charging, there is a need for public depots with charging facilities to enable night parking cum charging for such vehicles. GNCTD should facilitate the development of such depots on a pay and use basis.
- It is recommended that the charging infrastructure/station layout be corrected both for existing and proposed chargers, so as safe environment for both the pedestrians and vehicles can be created and charging vehicles do not lead to any conflicts. For example, chargers can be placed near breakdown bays, with ample space for pedestrian movement behind the chargers (Figure 78). GNCTD may develop a charging infrastructure design and development guideline to achieve the same.

Figure 78: Planned layover bays near Barar Square on the Ring Road

4.2.2 More Models and Better Specifications for E-Freight Vehicles

- It is recommended that OEMs introduce freight vehicle models with lower capital cost in the range of 6-8 lakh per unit and higher payload capacity (>900 kg) as well better range (100-120km). GNCTD may plan demand aggregation approach to scale up the demand in an effort to drive down the price and improve specifications for this category of e-freight vehicles.
- OEMs should add DC charging capability for e-freight vehicles (especially 4-wheelers and pick-up trucks).
- GNCTD should setup DC charging stations combined with planned freight vehicle stands in commercial areas (areas of operations of these vehicles). If such infrastructure and vehicle specs combined can ensure upto 80% charging in less

than 30 minutes, without any additional premium on the tariff, this will greatly contribute to the attractive ness of e-freight vehicles for the operators.

4.2.3 Outreach and Communication

- It is recommended that GNCTD, in collaboration with OEMs, may run awareness campaigns to clarify misconceptions regarding range, cost, and charging eco-system. Additional engagements with freight owners/operators' association may also be helpful.

5 Annexure 1 - Survey Questionnaire

दिल्ली सरकार
आप की सरकार

Transport Department, Government of NCT of Delhi (GNCTD)

Surveyor Name_____ **Date**_____**Time**_____**Location of Survey** _____

Freight Goods Vehicle – Owner Survey Form

Commodities	Please fill commodity in rank wise
1. Food Grain **2.** Perishable Food **3.** Liquor **4.** FMCG **5.** Courier & e-commerce **6.** Cash **7.** Pharmacy **8.** Hotel & Restaurant **9.** Electronics **10.** Solid Waste **11.** Clothes & Accessories **12.** Printing / Publishing **13.** Construction & Demolition **14.** Oil & Natural Gas **15.** Mixed **16.** Other	1. .....(Highest) 2. ..... 3. ..... 4. ..... 5. .....(Lowest)

Three-Wheeler Light Goods Vehicles (having weight of 0.5 ton to 1.5 ton) Please fill the no of vehicles owned in the box

1. Bajaj Maxima Cargo- (619kgs)	2. Piaggio Ape – (500kgs)	3. E- karts (500kgs)	4. Mahindra Alfa - (505kgs)	5. Mahindra Champion (665kgs)
				

Four-Wheeler - Light Goods Vehicles (0.5 to 1.5 ton)

6. Tata Ace- (710kgs)	7. Mahindra Jeeto (715kgs)	8. Maruti Suzuki Super Carry- (740kgs)	9. Ashok Leyland Dost lite – (1250kgs)	10. Mahindra Supro Mini- (900kgs)
				

11. Other Model & no. of vehicles -

Personal Details		**Vehicle Details**						
Owner's Name	**Phone Number**	**Vehicle/s Number**	**Fleet Utilization** (How many % vehicles are in use)	**Do you have GST no?** 1.Yes 2. No	**Fuel type** 1. CNG 2. Diesel 3. Petrol 4. Electric	**Year of registration** Ex 2012	**Year of Make** Ex 2012	**Odometer Reading** Ex. 124579 (in Km)

Type of Movement 1. Fixed Route 2. Flexible Route	**Type of Delivery** 1. Point-to-Point Delivery 2. Staged Delivery *(Multi-stop)*	**No. of Trips** Per Day	**Average no. of Stops per Trip** Per Day	**Average No. of Customers served on a typical trip.**	**Average Weight per trip** In Kg (Ex. 150-200kg)	**Total Km Covered** Per Day	**Parking location** *1. Roadside 2. Private Parking / in the shop 3.Comm. Parking 4. Home* At night/non-working hours (From 1 to 4 above)	During working hours - idle parking (From 1 to 4 above)	**No. of working days in a month** Total Working Days	**No. of accidents happened in a month**

Avg. Travel Time per Trip	**Total Working Hours per day**		
	Loading + Unloading-	Idle/rest-	Driving-

Revenue and Costs

Total Earning per month Per Month *(In Rs.)*	**Total Profit per month** (After deducting expenses) Per Month *(In Rs.)*	**Monthly / Annual Cost of Operation** Monthly Rent /EMI *(In Rs.)*	Cost of Fuel /Charging per Month *(In Rs.)*	Monthly Maintenance Cost *(In Rs.)*	Monthly Parking / Other charges (permit, license, road tax etc.) *(In Rs.)*	Annual Insurance *(In Rs.)*

1

Q.1 When do you plan to replace the current vehicle or add a new vehicle in your fleet?

1	2	3	4	5
Not at all soon > 10 years	6 to 10 years	4 to 5 years	1 to 3 years	<1 year

Q.2 In the current circumstances and available subsidy levels, how likely is it that your next purchase will be an electric Light Goods Vehicle?

1	2	3	4	5
Very unlikely	Somewhat unlikely	May or may not be (Moderate)	Somewhat Likely	Very Likely

E- model	Tata Ace EV (4-wheeler)	Mahindra Treo Zor	Piaggio Ape Extra	Omega Seiki Rage+	Euler Hi-Load	Kinetic Safar Jumbo
						
Purchase Cost	6.6 Lakh	3.48 Lakh	3.12 Lakh	3.61 Lakh	3.55 Lakh	3.45 Lakh
Operational cost per km	0.9 Rs – 2 Rs	0.5 Rs – 1 Rs	0.5 Rs – 1 Rs	0.5 Rs – 1.25 Rs	0.5 Rs – 1.2 Rs	0.50 Rs – 1 Rs

Q.3 Do you have knowledge of subsidies and benefits offered by central and state government on buying and operating electric goods vehicles in Delhi. ○ Yes ○ No

Q.4 In your opinion (with current subsidies/benefits) how expensive or cheap is to buy or own (vehicle cost, insurance, tax, etc.), similar electric vehicle model when compared to your current petrol/diesel/CNG vehicle?

1	2	3	4	5
Very expensive	Somewhat expensive	Almost Equal	Somewhat cheaper	Very cheap

Q.5 In your opinion (with current subsidies/benefits) how much more or less is the daily operational (fuel and daily maintenance) cost of similar model of electric vehicle when compared to your current petrol/diesel/CNG vehicle?

1	2	3	4	5
Very expensive	Somewhat expensive	Almost Equal	Somewhat cheaper	Very cheap

Q.6 Do you know of any people who have purchased electric Vehicle?

1	2	3	4	5
None	Very few	Half of people I know	Most of them have	Everyone I know has

Q.7 Are you aware of any owners who have availed any electric vehicle related government benefits / schemes?

1	2	3	4	5
None got it	Very few got it	About half of people who bought got it	Most of them got it	All got it

Please mention (if any) the challenges/difficulties faced by the current electric vehicle owners.

_____

Q.8 How easy or difficult do you think it will be to avail these benefits/subsidies for purchasing an electric light goods vehicle?

1	2	3	4	5
Almost impossible	Very difficult	Moderate - Neither difficult nor easy	Very easy	Extremely easy

Q.9 Which one of these facilities/services will positively contribute to meet your operational requirements towards electrification? Please rank in the order of preference (1 to 5)

Lower Financing - Interest Rate	Cheaper Electricity Charges - lower than Rs 5/KW/h	Availability of more options of vehicle models	Parking & Charging infrastructure	Maintenance / Service Facility
Other -				

Travel Diary (previous day journey details)										
	Home to 1st loading point		1st loading point to drop point		Drop point to 2nd loading point		2nd loading point to drop point		Drop point to Home	
Time	Start Time	Stop Time	Start Time	Stop Time	Start Time	Stop Time	Start Time	Stop Time	Start Time	Stop Time
KM										