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User Preference for Electric Vehicle Adoption by Small Commercial Vehicles for Freight Delivery in Delhi, India

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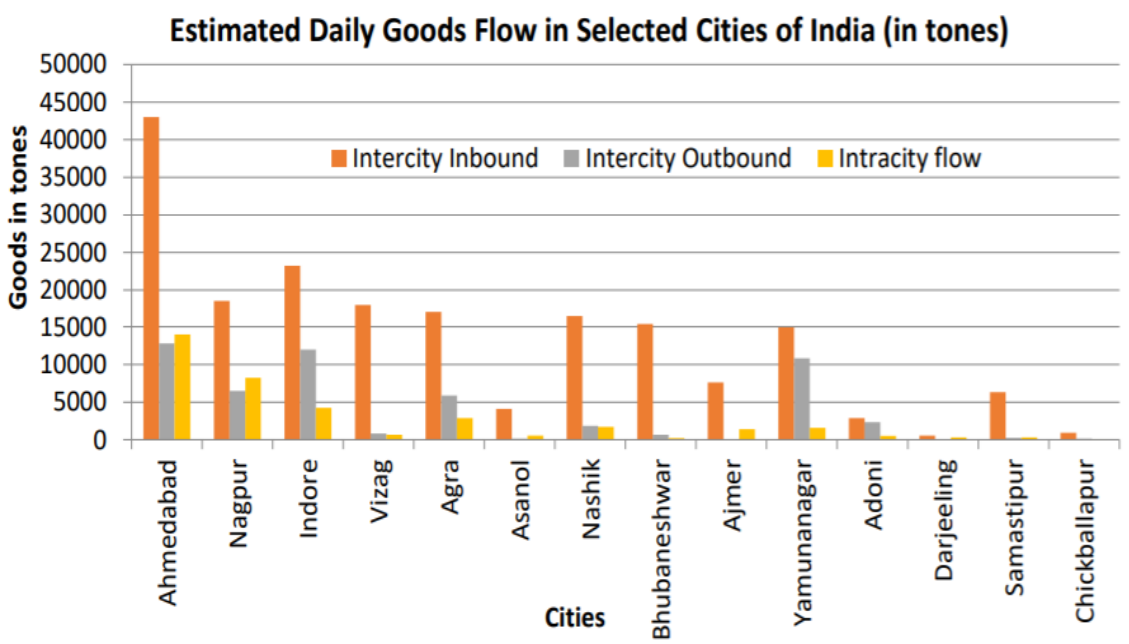
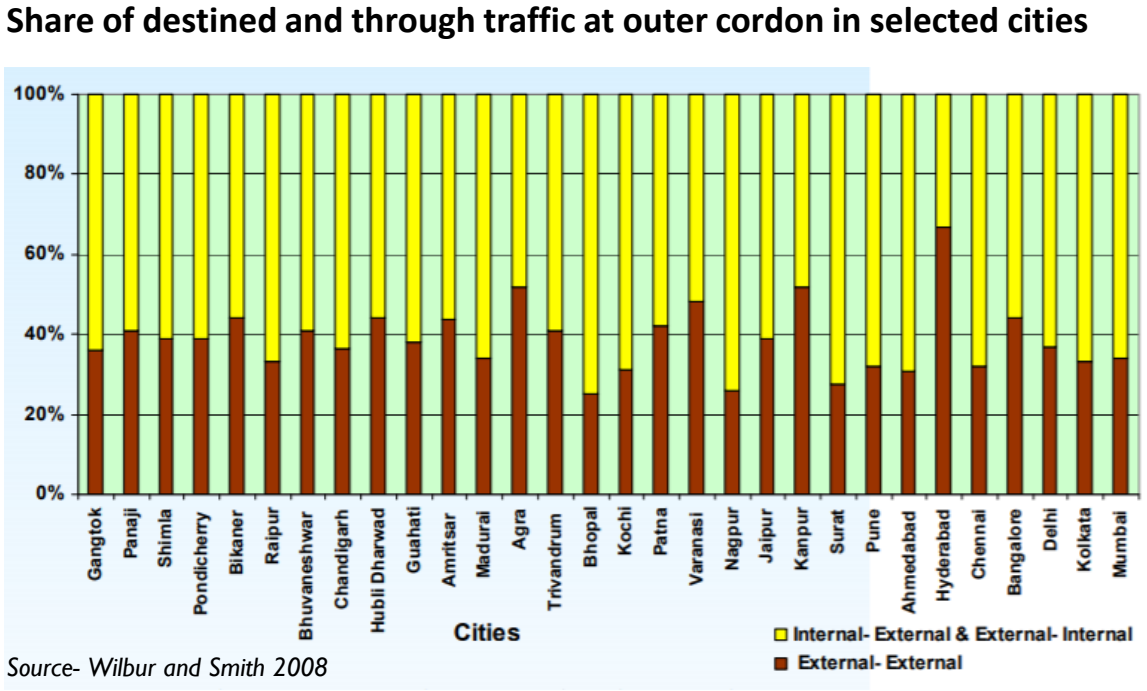
Context

- Goods transport account for 10 to 15 percent of vehicle equivalent km travelled , 31% of the energy use and 31% of the CO2 emissions respectively in urban areas (UN Habitat 2013 report)
- There is an emerging need to decarbonize freight transport in order to reduce negative externalities such as pollutant emissions.
- Many projects around the world aiming to decarbonise Urban Freight are focusing on use of electric vehicles(EVs) in urban logistics (Jacques Leonardi et. Al 2016)
- India's EV market too is poised for significant growth in the coming decade
- The Government of India (GoI) has made an ambitious commitment to creation of demand for EVs through the Faster Adoption and Manufacturing of Electric Vehicles (FAME) India scheme.
- Flipkart in India has become the first e-commerce marketplace to commit to 100 percent adoption of EVs by 2030 in its delivery operations
- While electrification of freight use cases is gradually on the rise largely in e- commerce operations the small commercial vehicle's electrification is still a challenge in Indian cities

Goods Movement Pattern in Indian Cities



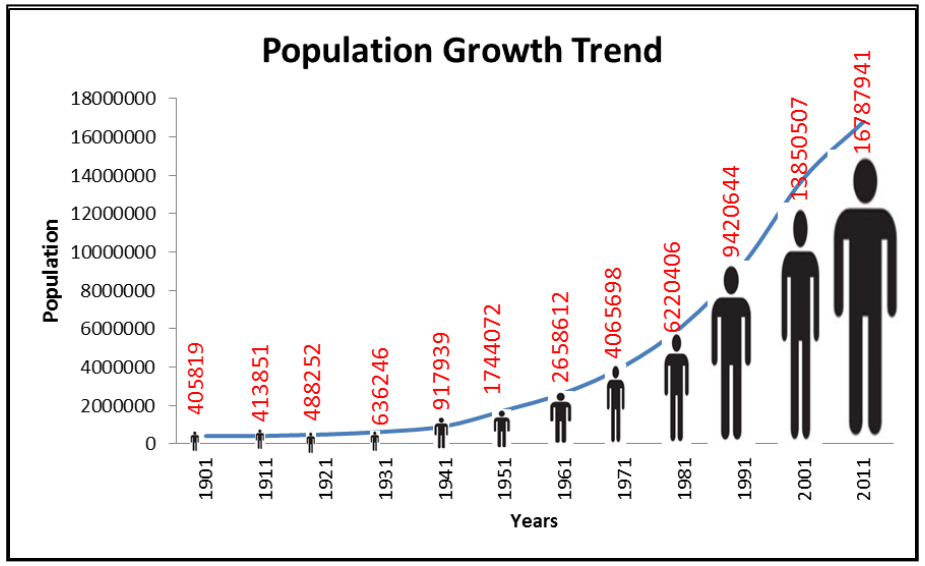
Source- CRRI, 1998



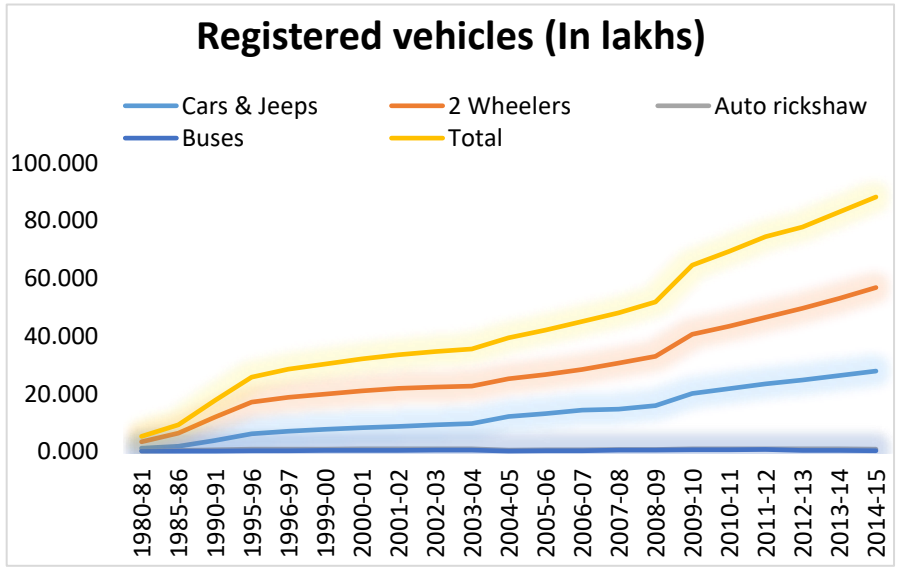
Source- Wilbur and Smith 2008

- Freight intensities in Indian cities continue to rise . However there is need for decarbonisation of urban freight
- Electrifying urban freight is one of the potential strategy

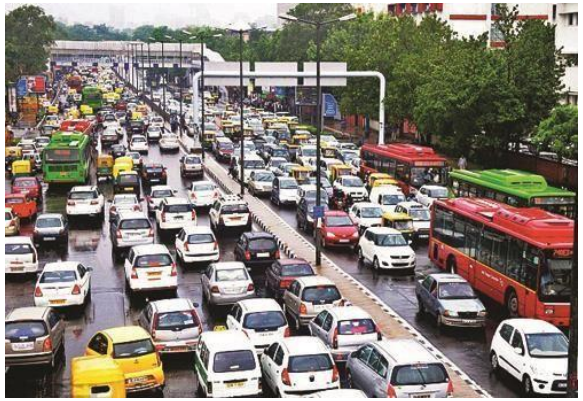
Profile of Case City – Delhi

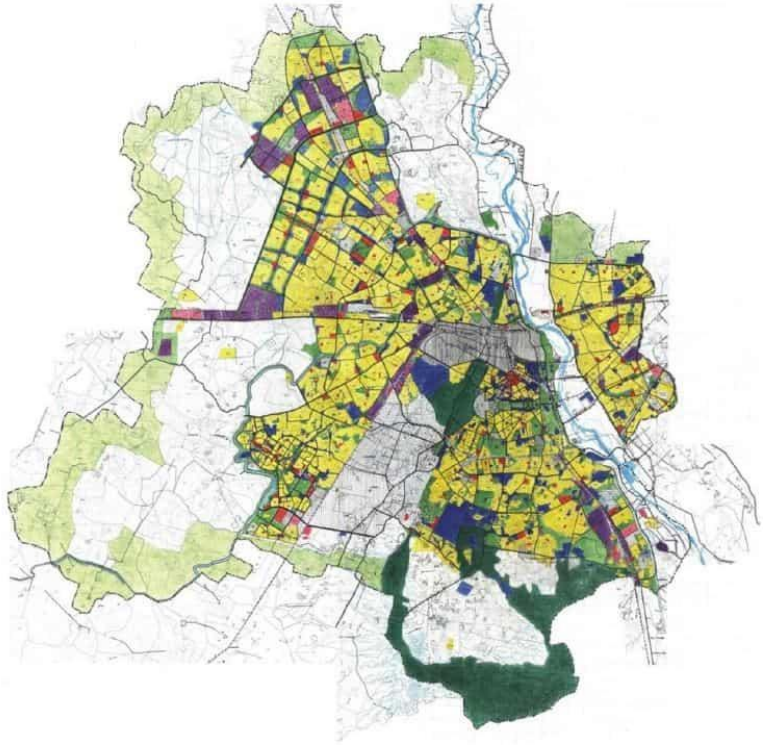


Population : 16.7 Million (2011)
20 million (2020) estimated



10 lakhs = 1 million



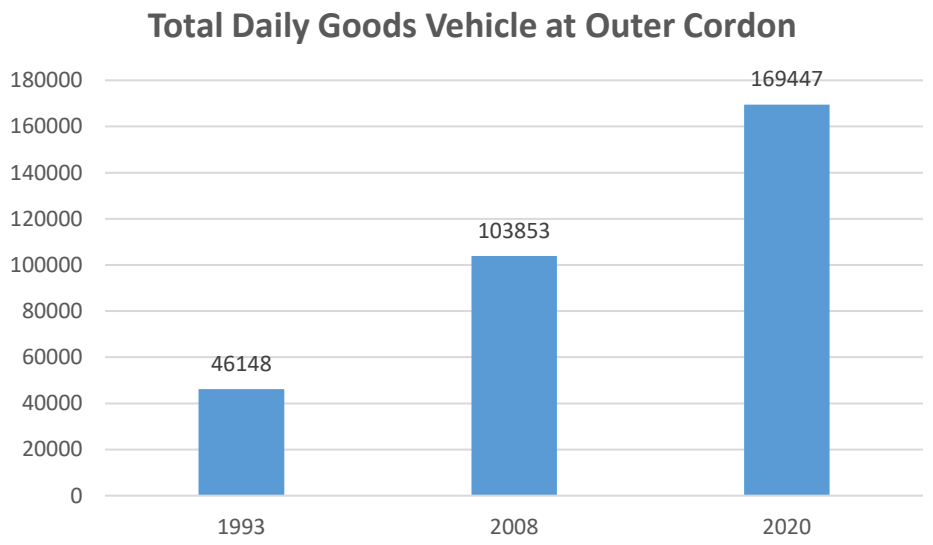


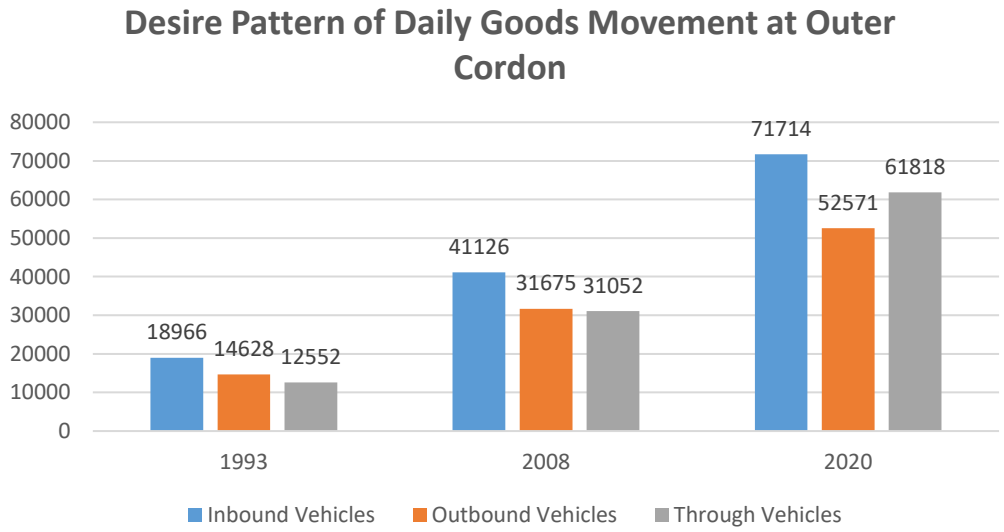
Area : 1484 sq.km

315 000 goods vehicles registered in Delhi (2019) ; 63,000 three wheelers

Estimated E-Commerce deliveries in Delhi : 3.05 million orders/ day (2020)

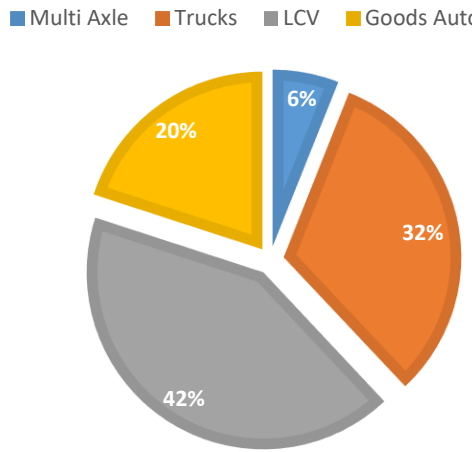
Freight Movement Characteristics in Delhi





Source- : SPA (1993, 2020), RITES (2008)

Estimated Composition of Goods Vehicles (2020)



- Final-mile delivery commonly accounts for more than 50% of the total logistics costs *(Source : RMI 2021)*

Estimation of Regional Payload for 2020

Year	1993 (SPA Study)	2008 (RITES)	2020 (Estimated)
Average Payload	4.01	4.86	5.67

Impact on Pollution

- Freight delivery vehicles (both LDVs and HDVs) contribute around 45% of NOx , 41% of PM10 and a large portion of PM2.5 vehicular pollution in Delhi *Source Malik et al , 2019*
- Registered delivery vehicles (three- and four-wheelers) emitted 0.7 million tons of CO2 in 2019 in Delhi *Source RMI 2021)*

Stakeholder Survey Design - Transport Operators

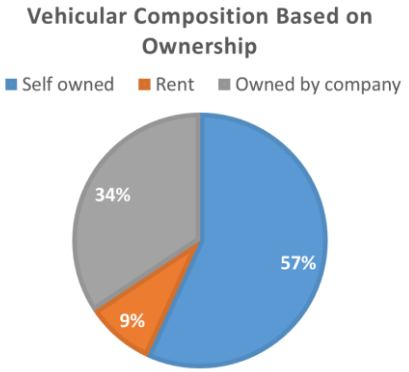
Aim - To identify the barriers and strategies related to the adoption of EVs by small commercial vehicle operator

Sample Size – 200 (Small commercial vehicle operators) captured in South Delhi comprising of fruits and vegetables delivery operators and e- commerce service providers of groceries and parcels

Data Collection Method– Face to face interview (pen and paper method)

Fruits and Vegetables deliveries

Groceries and Parcels deliveries



Transport Operation Characteristics - Fruits and Vegetables

Total No. of Samples- 111 (55.5%)

Ownership Details	3-W Loader (CNG)	Vans (CNG)
Self	76	90
Rented	9	6
Owned By Company	15	4

Operational Characteristics	3-W Loader (CNG)	Vans (CNG)
Average Trips (Nos./Day)	2.02	2.27
Average Dry Run (Nos./Day)	1.10	1.36
Average Vehicle Utilization (Kms/Day)	**57.10**	**40.91**
Average Quantity Transported (Kg/Day)	732.80	110
Average Business Hours (Hours/Day)	**10.8**	**10.09**
Average Operational Cost (INR/Day)	325.56	138.18
Average Operational Revenue (INR/Day)	790.48	402.73

Source- Analysis by authors (2021)

3-W Loader (CNG)

CNG Vans

Transport Operations Characteristics - Groceries and Parcels

Total No. of Samples- 89 (44.5%)

Category	Average Trips (Nos/Day)	Average Vehicle Utilization (Kms/Day)	Average Quantity Transported (Kg/Day)
Vehicle Type			
3-W Loader (CNG)	10.2	68.34	487
2-W (Petrol)	14.67	57.21	14.3
EV-3W	8.35	47.59	338
EV-2W	10.56	49.63	13.34
Commodity Type			
Groceries	12.7	59.8	324
Parcels	9.8	43.2	153

Other Details

Ownership pattern	Owned by Company
Operational Area	Within 22 km radius of the warehouse
Earnings	Drivers work on salary basis (12,000 -14,000 INR/month)

Average Age of Vehicle

EV (2-W & 3 W)	1.2 years
3-W Loader (CNG)	4.3 Years
2-W (Petrol)	6.8 years

Source- Analysis by authors (2021)

Stakeholder's Response about EVs

Are you aware about E-Vehicles used for Urban Goods Movement

Response	Fruits and Vegetables (%)	Groceries and Parcels (%)
Yes	88.3	94.4
No	11.7	5.6

If Yes,

Are you aware of the subsidies for EVs ?

Response	Fruits and Vegetables (%)	Groceries and Parcels (%)
Yes	69.4	73.0
No	30.6	27.0

Rate your knowledge about these subsidies

Response	Fruits and Vegetables (%)	Groceries and Parcels (%)
Somewhat familiar	10.8	52.8
heard about it	89.2	47.2

Where would you like the charging Infrastructure ?

Response	Fruits and Vegetables (%)	Groceries and Parcels (%)
At warehouses	29.7	30.8
Near O/D	51.3	58
At public parking	18.9	11.2

Source- Analysis by authors (2021)

Weights for Barriers across Stakeholder types using AHP

Barriers	Stakeholder Types		
	Self/Rented vehicles (CNG /Petrol) (%)	Owned by Company (CNG/ Petrol) (%)	Electric Vehicles (%)
Inadequate Charging Infrastructure	30.7	19.5	14
High Cost of Vehicle	17.2	1.7	1.5
Less Electric Range/Charge	19.7	29.8	34.7
Less Repair and Maintenance shops	3.1	4.5	2.8
Less Battery Life	8.3	7	6.3
High Battery Replacement Cost	8.5	3.1	3.1
Few EV Models	2.5	3	1.9
High Electric Price on Charging	4	7.6	8.1
Absent Battery Swapping Facility	2.5	14.9	16.6
Limited Financing options	2.5	3.1	2.8
Poor Awareness	1.9	6.7	7.9
Consistency Ratio (%)	**8.8**	**4.6**	**3.9**

All weight fall within the acceptable consistency ratio range

Source- Analysis by Authors (2021)

Weights for Technical & Economic Barriers across Stakeholder types using AHP

Barriers	Stakeholder Types			Overall (%)	Rank
	Self/Rented vehicles (CNG /Petrol)(%)	Owned by Company (CNG/ Petrol) (%)	Electric Vehicles (%)		
Technical Barriers					
Less Electric Range/Charge	67	68	74	70.7	1
Less Battery Life	30	18	22.2	22.3	2
Few EV Models	3.6	14	4	7	3
Consistency Ratio (%)	4.3	2.1	5.6	3.6	
Economic Barriers					
High Cost of Vehicle	56.6	11.9	12.7	20.5	3
High Battery Replacement Cost	27.5	29.7	19.3	25.1	2
Limited Financing options	4.7	17.5	16.2	11.0	4
High price on Charging	11.2	40.9	51.7	28.7	1
Consistency Ratio (%)	**4**	**6**	**1.7**	**3.4**	

All weight fall within the acceptable consistency ratio range

Source- Analysis by Authors (2021)

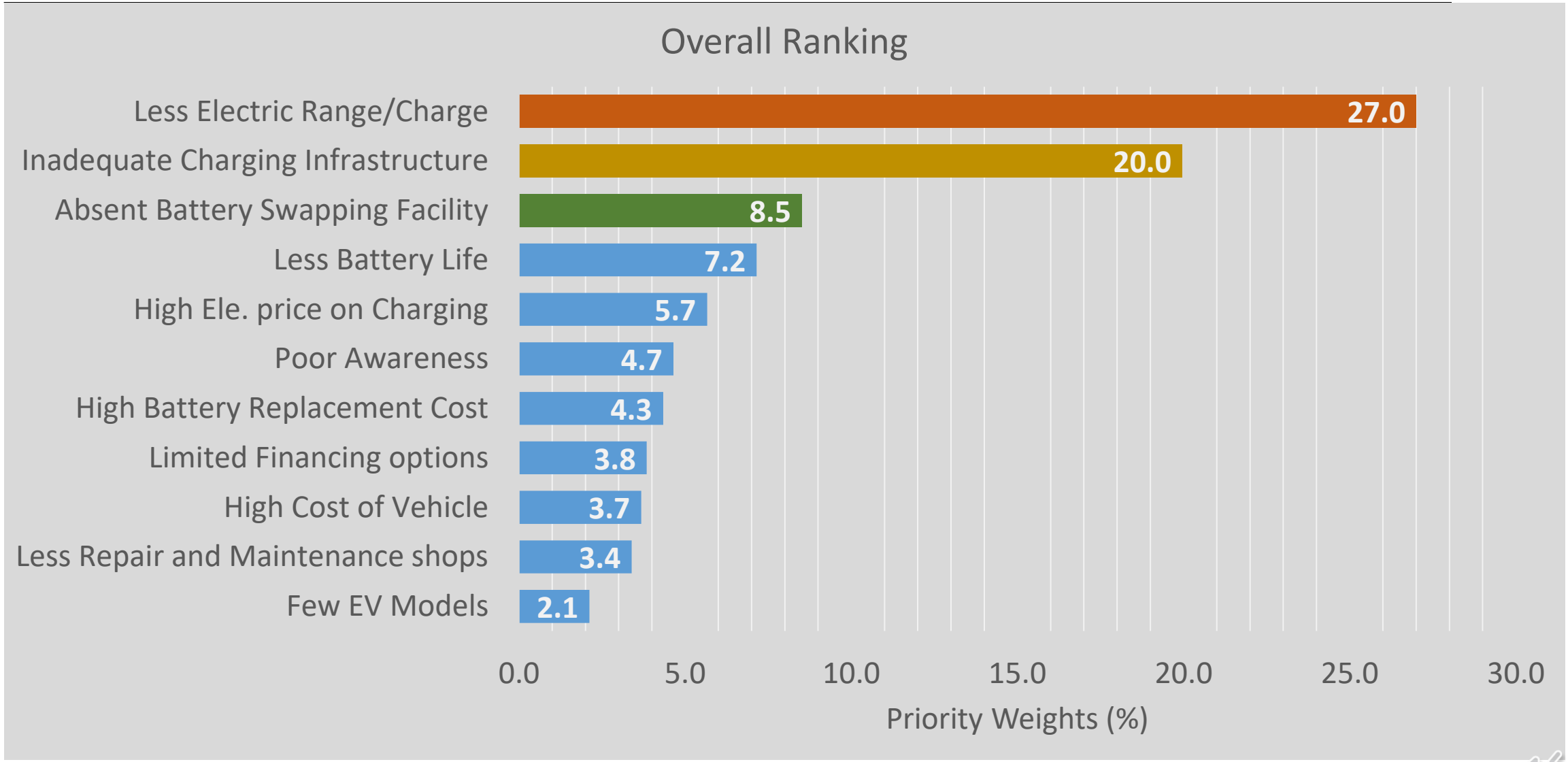
Weights for Infrastructure Barriers across Stakeholder Types using AHP

Barriers	Stakeholder Types			Overall (%)	Rank
	Self/Rented vehicles (CNG /Petrol) (%)	Owned by Company (CNG/ Petrol) (%)	Electric Vehicles (%)		
Infrastructure Barriers					
Inadequate Charging Infrastructure	77.9	14	9.5	21.8	**3**
Less Repair and Maintenance shops	14.3	33.3	25	22.8	**2**
Absence of Battery Swapping Facility	7.9	52.8	65.5	30.1	**1**
Consistency Ratio (%)	**1**	**4.5**	**1.9**	**2**	

All weight fall within the acceptable consistency ratio range

Source- Analysis by Authors (2021)

Overall Ranking of Weights for Barriers using AHP



Consistency ratio 5.4 %

All weight fall within the acceptable consistency ratio range

Source- Analysis by Authors (2021)

Weights for Solutions and Strategies across Stakeholder types using AHP

Solutions & Strategies	Stakeholder Types			Overall (%)	Rank
	Self/Rented vehicles (CNG /Petrol) (%)	Owned by Company (CNG/ Petrol) (%)	Electric Vehicles (%)		
Extensive EV Charging Infrastructure	**56.6**	**66.8**	**62.1**	**61.7**	**1**
Awareness Campaigns for logistics providers	**31.8**	**13.7**	**22.2**	**21.3**	**2**
Financing from public banks	9.2	11	9.4	9.8	3
More Subsidies	5.5	6.8	6.2	6.1	4
Consistency Ratio	**1.1**	**1.5**	**1.7**	**1.4**	

All weight fall within the acceptable consistency ratio range

Source- Analysis by authors (2021)

Summing Up

- Indian cities are witnessing intense freight movement expected from one of the world's fastest growing and emerging economy like India

- Electrifying urban freight is one of the potential and emergent decarbonisation strategy in Indian context

- Studies reveal that the diverse categories of small commercial vehicles in Delhi are fairly consistent in their preference of EV adoption criteria

- Stakeholder response studies reveal that the following policy imperatives are desirable to scale up EV adoption amongst small commercial vehicle operators :

  i. Strengthen EV charging infrastructure for freight vehicles
  ii. Conduct sensitisation programmes for small commercial vehicles fleet operators on EVs
  iii. Ensure technological improvements in enhancing electric range per charge, possibilities of battery swapping facilities etc.
  iv. Facilitate financing from banks and more subsidies

- Need for desired incentive for commercial vehicles of various categories in the EV policies, both at national and state level, along with supporting policies to enable for faster adoption of EVs in urban logistics

Thank You

Contact Us

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