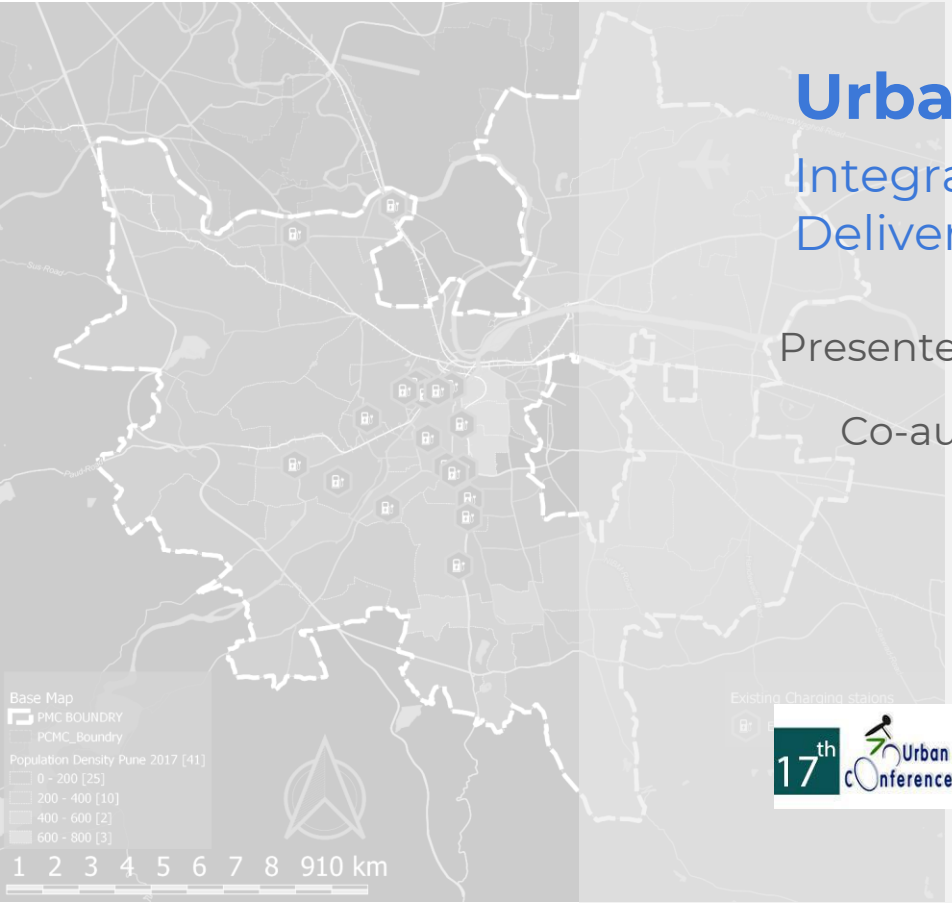

Urban Freight Electrification:

Integrating Charging Stations with Digital Delivery Lockers in Pune

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17th Urban Mobility India Conference & Expo 2024

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Technological Advancements in Urban Transport

26th October 2024

Mahatma Mandir Convention Centre, Gandhinagar

IIT Kharagpur, Department of Architecture and Regional Planning

01 The Urgent Need for Electrification

At COP26, India pledged to reduce the carbon intensity of its economy by 45% by 2030 and achieve the net zero emissions target by 2070.

Of all the Sectors Transport sector causes 23% of the GHG Emissions.

The Indian freight sector accounts for about 5% of India's gross domestic product (GDP) less than 3% of the total vehicular population and contributes to almost 14% of the country's total greenhouse gas (GHG) emissions.

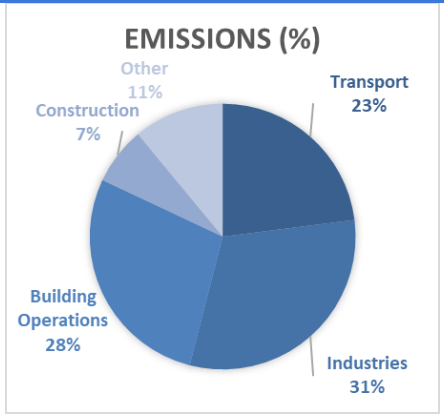

Figure: Carbon Emissions by Industry Source: NITI AAYOG

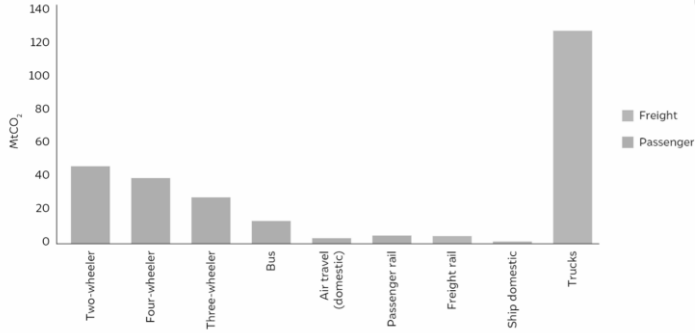

Figure: Carbon Emissions Produced by Transport sector in 2020
Source: CEEW India Transport Energy Outlook

02 Challenges In Urban Electrification

Insufficient Charging Infrastructure

- One of the primary barriers to electric vehicle (EV) adoption in India's urban freight sector.
- Without a widespread charging network, range anxiety remains a major issue for EV operators.

Range Anxiety

- Drivers fear running out of charge before reaching a charging station, hindering the shift from internal combustion engine (ICE) vehicles to EVs.
- This is particularly critical for last-mile delivery vehicles that need predictable routes and minimal downtime.

Land Scarcity for Charging Stations

- Urban areas face constraints in identifying and allocating space for new charging stations.
- Competing demands for land use in densely populated cities like Pune exacerbate this issue

Growing E-commerce and Demand for Efficient Deliveries

- Rising e-commerce activity increases the demand for fast, efficient last-mile delivery.
- Traditional delivery methods increase emissions and congestion, especially in dense urban areas.

Need for Integrated Solutions

- Integration of charging stations with digital delivery lockers
- Solving two issues: charging and parcel delivery

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Dr. Shreyas P Bharule

03 Objective

AIM

Accelerate Electric Vehicle (EV) Adoption in the urban freight sector through an innovative infrastructure solution.

OBJECTIVES

01 Optimize Location Selection for EV Charging Stations

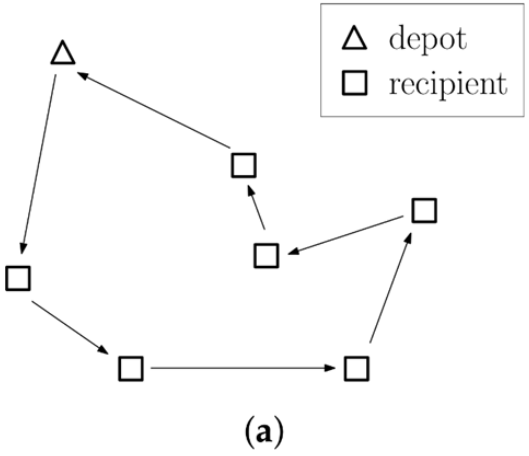
02 Integrate Charging Stations with Digital Parcel Lockers

03 Address Barriers to EV Adoption

04 Support Sustainable Urban Development Goals

04 EV Charging + Delivery Lockers

A parcel locker is an automated postal box that allows users for a self-service collection of parcels and oversize letters as well as the dispatch of parcels.



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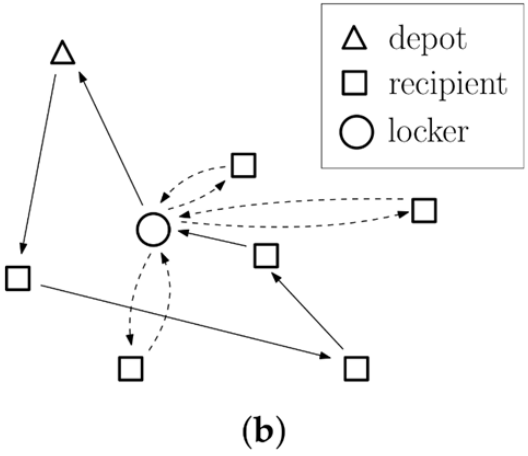

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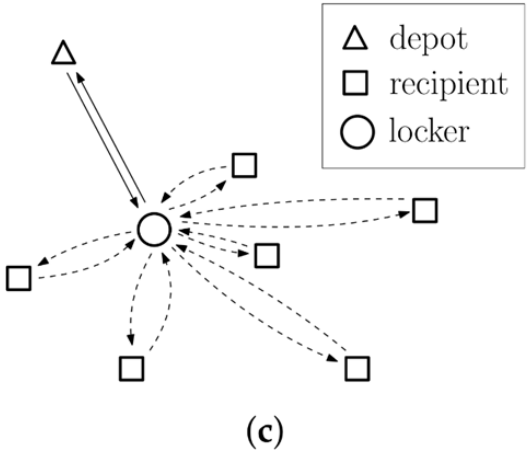

(c)

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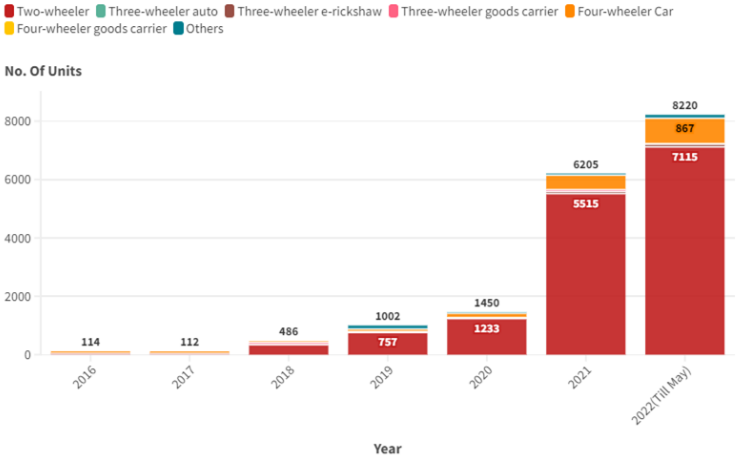
05 Why Pune?

High EV Adoption

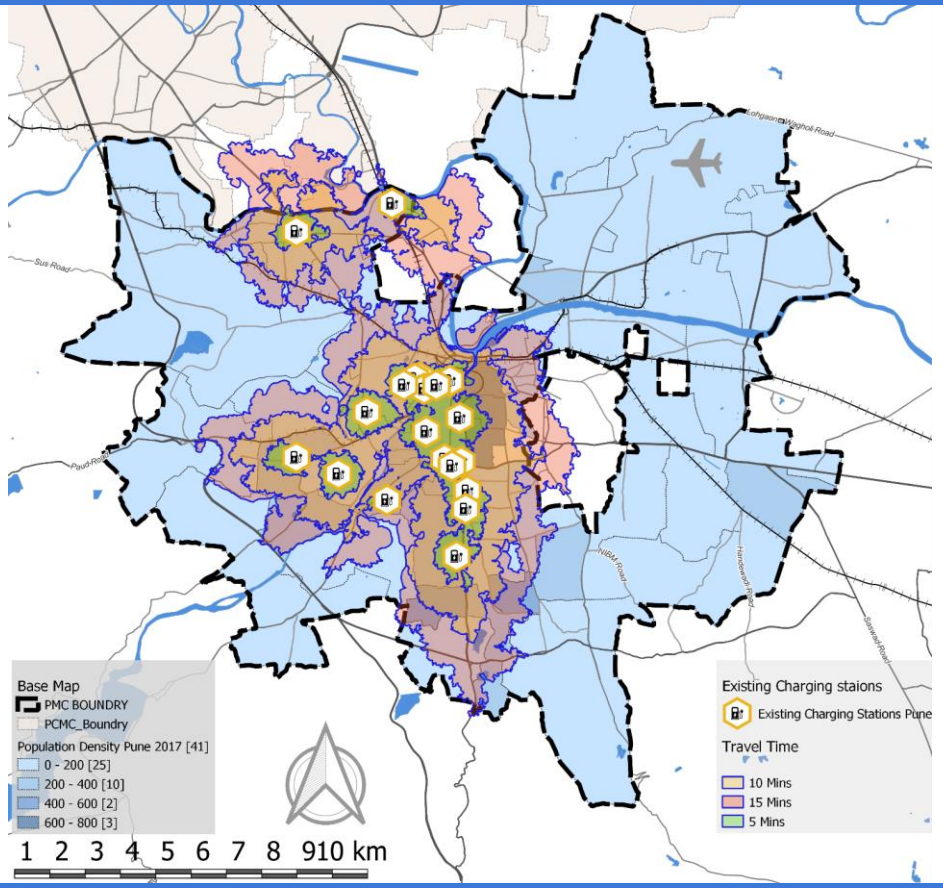
Service Gaps in EV Infrastructure

Rapid Population Growth

E-commerce Boom



Source: Vahan Dashboard https://vahan.parivahan.gov.in/vahan4dashboard/



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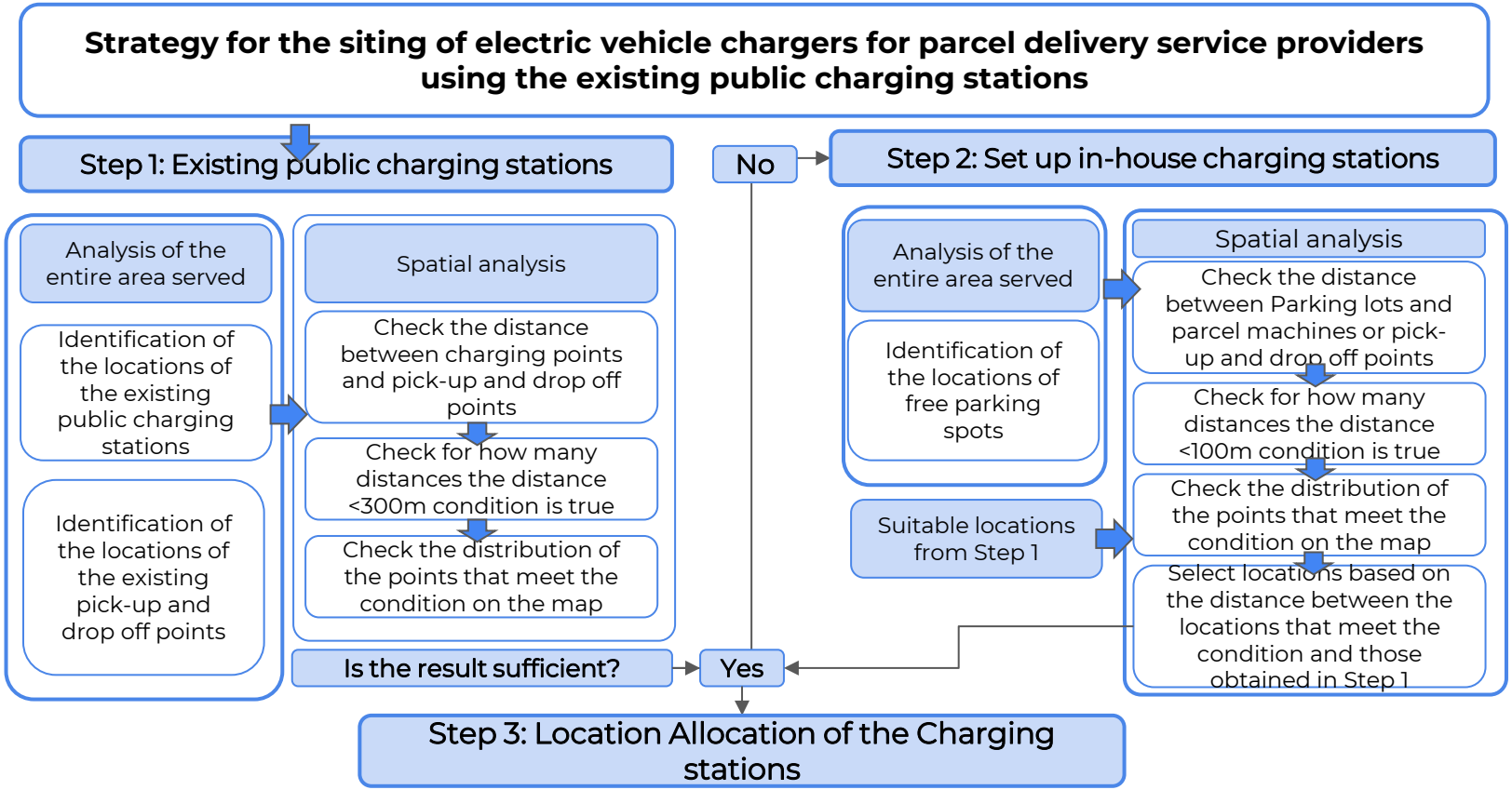
06 Methodology



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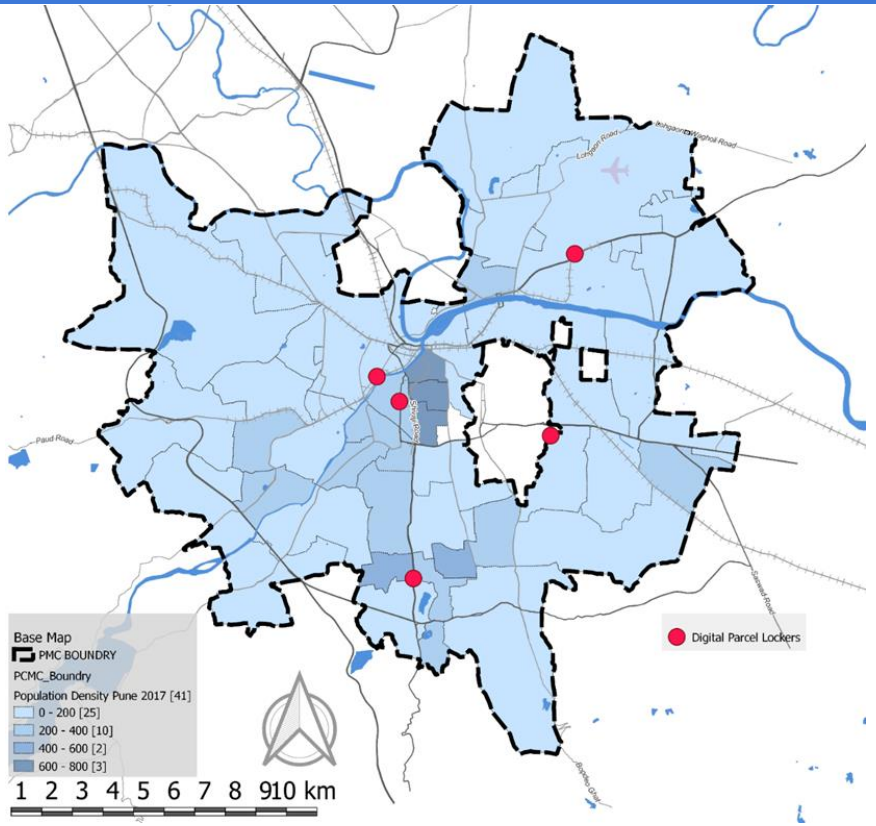
Parcel Delivery Lockers Locations

Area Near Proposed Charging Stations and Collection Centre

1. Nagar Road
2. Jangli Maharaj Road
3. Bajirao Road
4. Solapur Road
5. Satara Road

Area Near Public Parkings and Collection Centre

1. Jangli Maharaj Road
2. Bajirao Road



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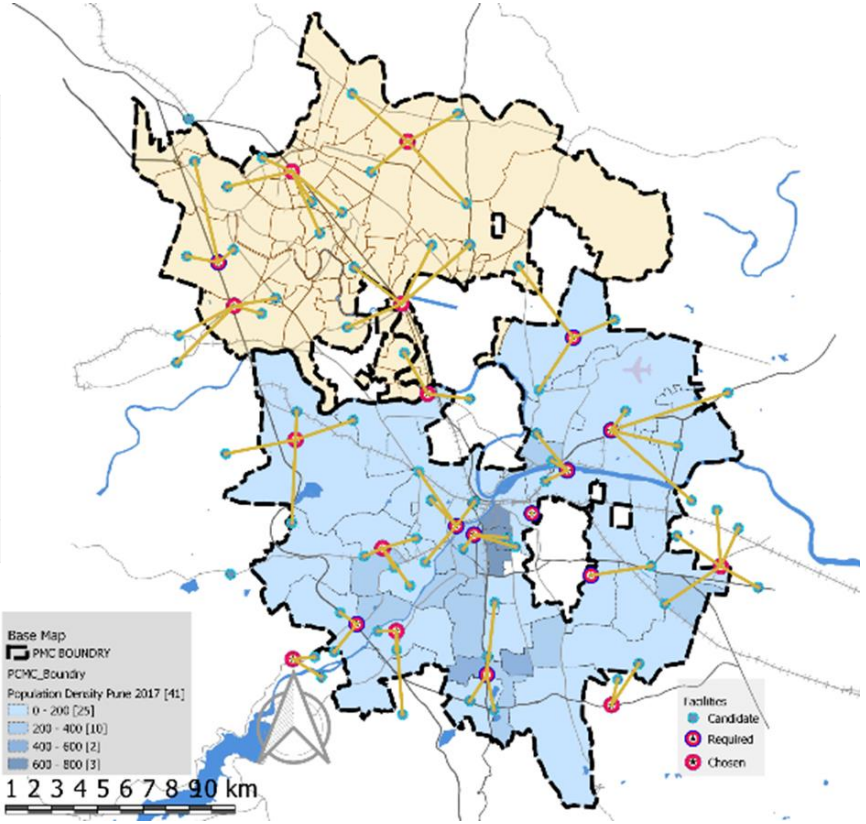
08 Location Allocation Model

Parameters

Sr. No.	Attribute	Value
1	Mode	Driving
2	Impedance/ Cost Attribute	Distance
3	Cost Function	Linear
4	Cutoff Value	6000m
5	Capacity (Charging Vehicles)	Parking Capacity at each Centre
6	Type of Location Allocation Analysis	Maximize Capacitated Coverage
7	Direction	Away from Facility
8	No of Facilities	22



Output

1. 22 Public Charging Stations including
   a. 5 Hubs
   b. 4 Parcel Locker with Charger

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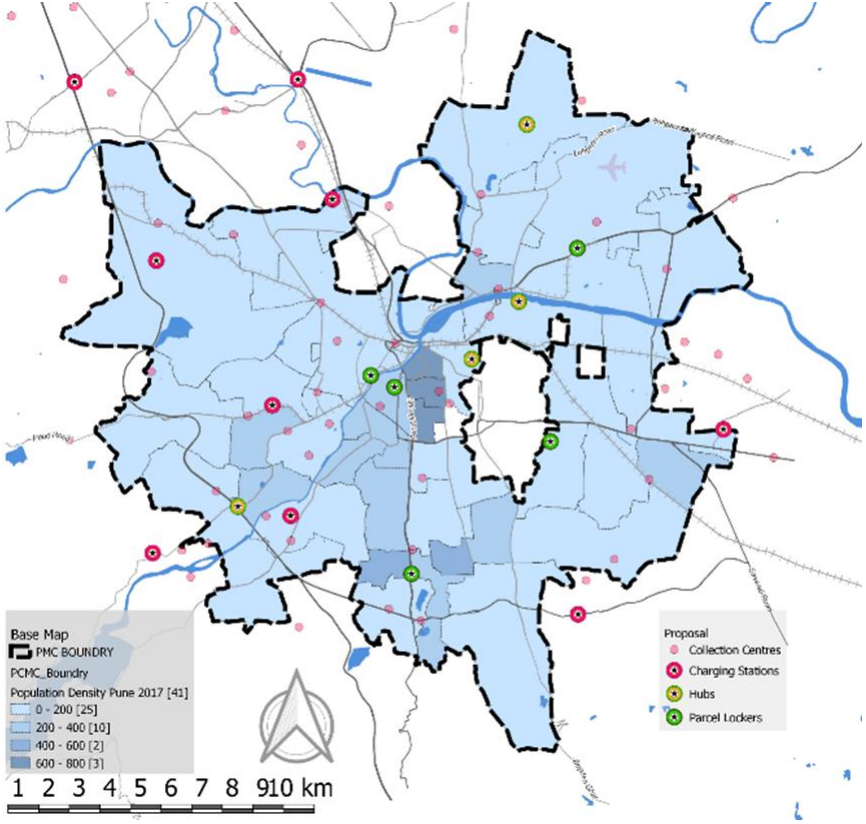
09 Results



Location of Charging Stations, Parcel Lockers and Collection Centres for Shree Maruti

Collection Centre: 43

Charging Stations: 4

Hubs: 4

Parcel Locker With Charging stations: 5``

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10 Collaborative Framework

- **Public-Private Partnership (PPP)**:

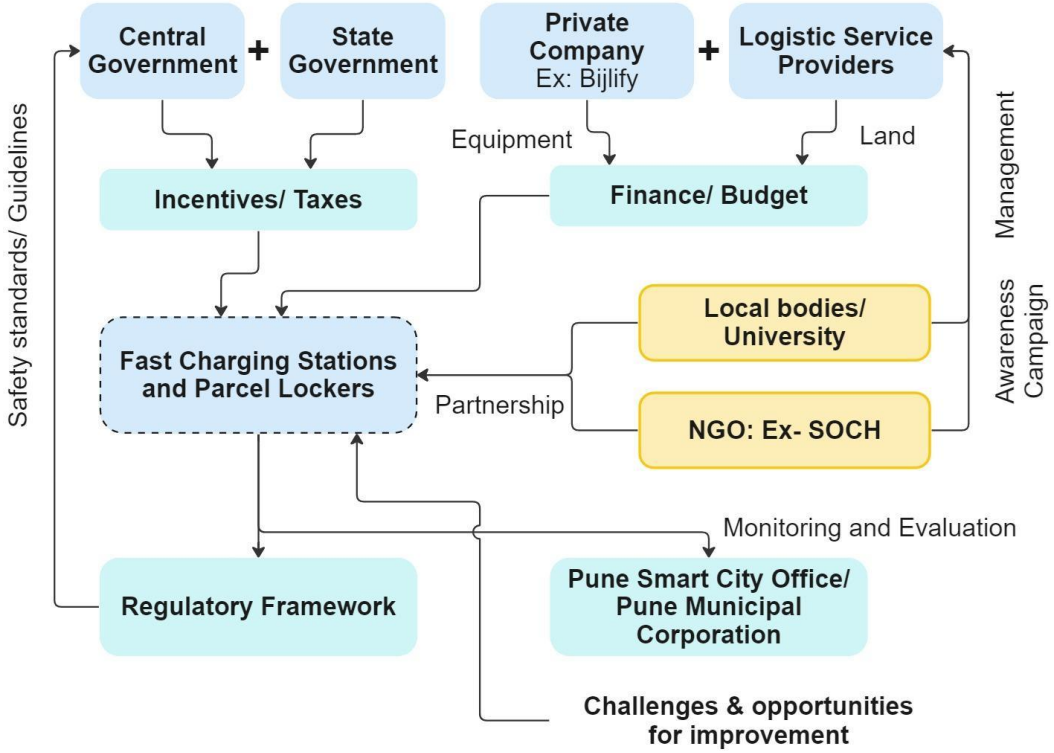
Municipal authorities can collaborate with private logistics companies and charging point operators to share land and infrastructure, reducing costs and accelerating the development of EV charging stations integrated with delivery lockers.

- **Shared Infrastructure**:

The dual-use of charging stations for both public EV users and logistics fleets ensures higher utilization, with delivery vehicles charging at night and the stations being available for public use during the day.

- **Government Incentives**:

Municipalities can provide regulatory support and financial incentives to private companies for transitioning to electric fleets, encouraging the adoption of shared EV infrastructure.



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11 Benefits

Efficient Use of Space	By combining EV charging and parcel lockers, urban areas can address the challenge of land scarcity. Using the same space for both services maximizes the utility of land, especially in densely populated cities like Pune where land availability is limited.
Convenience for Logistics Providers	EV charging stations located near parcel lockers offer logistics providers a convenient solution to charge their vehicles while dropping off or picking up parcels. This reduces downtime and improves operational efficiency for last-mile delivery services, particularly in urban freight operations.
Reduction in Delivery Costs and Emissions	Parcel lockers streamline delivery by centralizing multiple deliveries to one location, reducing the need for door-to-door service. This reduces both delivery costs and emissions. When integrated with EV charging stations, the entire process becomes more sustainable, contributing to reduced carbon footprints in urban logistics.
Support for EV Adoption	Range anxiety and lack of sufficient charging infrastructure are key barriers to EV adoption. By combining parcel lockers with charging stations, the system provides more frequent charging opportunities for delivery vehicles, which can help ease range anxiety and promote wider EV usage in urban freight sectors.
Revenue Generation:	Integrating parcel lockers with charging stations provides additional revenue streams. Delivery services can generate income from locker services while simultaneously supporting the EV charging infrastructure, creating a sustainable business model.

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12 Conclusion

- This study presents a practical solution for accelerating **urban freight electrification** by integrating **EV charging stations with digital delivery lockers** in Pune.
- Through **geospatial analysis** and **location allocation modeling**, we identified optimal sites for these combined infrastructures, ensuring **convenient access** for delivery operators while maximizing land use efficiency.

Key Benefits:

- Addresses **range anxiety** for electric freight vehicles.
- Provides **flexible infrastructure** that can adapt as EV adoption increases.
- Supports **last-mile logistics**, improving efficiency for parcel deliveries.

Policy Implications:

- Promotes **sustainable urban development** and contributes to India's carbon reduction goals.
- Encourages **Public-Private Partnerships (PPP)** to facilitate infrastructure development.
- Serves as a scalable model that can be adapted to other urban areas facing similar challenges.

Next Steps:

- Future research could focus on optimizing locker locations based on real-time delivery data and addressing regulatory challenges for implementation.