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Policy Brief

Planning Framework for Low Emission Zone (LEZ) in Core Areas of Indian Cities

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Abstract
This policy brief is based on the project on Planning Framework for Low Emission Zone (LEZ) in Core Areas of Indian Cities, which investigated an approach to facilitate actions towards addressing transportation challenges and GHG emissions for the core area of Ahmedabad, India. The project explored interventions for the core area with the support of stakeholders and formulated strategies and next steps for implementation.

Keywords	Low Emission Zone, Electric Mobility, Urban Mobility, Air Quality, Vehicle Emissions, Green Mobility Solutions
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1. Introduction

Low- and Middle Income Countries are faced with rapid urbanisation and higher rates of motorisation leading to an increase in travel demand and congestion. Transportation systems significantly influence the economic development of cities, regions and nations. They also cause adverse externalities like congestion, delays, accidents, energy dependence, air and noise pollution and GHG emissions. With the increased demand for travel and reliance on non-renewable energy, transport has emerged as one of the significant contributors to air pollution and GHG emissions. Given the inter-relationship of land use and transport, actions towards improved urban planning and transport systems are essential to address the high transport emission levels in the city. Globally, Low Emission Zones (LEZs) has become most frequent transport tool adopted by cities to tackle the air quality challenges at the city level(1).

Low Emission Zone is a defined geographical area with a regulatory measure of access restriction for polluting vehicles, in such area vehicles with higher emissions cannot enter the area or must pay higher charges for access. The establishment of LEZ intends to reduce air pollutants, such as NOx, PM and ozone, specifically that create greatest health impacts, however, it subsequently reduces carbon emissions and increases the growth of cleaner or low emission vehicles(2). Europe has over 320 LEZs as of 2022 with significant growth of 40% since 2019 and some of the successful non-European examples are Haifa, Seoul, Beijing and Jakarta(1). This air quality improvement strategy with restriction of vehicles also has the potential to catalyse faster adoption of EVs as well as shift to active and public transportation(1). However, the establishment of LEZ in Indian cities with restrictions on vehicles will not work in isolation as observed in the international cities and has to be designed to be equitable and link to other strategic component to reduce air pollution(3).

The High Volume Transport Applied Research Programme project on ‘Planning Framework for Low Emission Zone (LEZ) in Core Areas of Indian Cities’ by CEPT Research and Development Foundation (CRDF) investigated an area-based approach to facilitate actions towards addressing transportation challenges and air pollution. The initiative looked to resolve mobility issues in the core area of the city, aiming for a better quality of life and improved community welfare. The project proposed an area-based approach to tackle traffic and environmental issues in Ahmedabad's core area by establishing a low-emission zone (LEZ). This area, particularly the walled city, experiences high population density and employment, leading to significant passenger and goods traffic. Air quality monitors have highlighted it as one of the most affected areas in the past three years. The project explored interventions for the core area with the support of stakeholders to ensure the successful implementation of actions. This policy brief consolidates findings from this project, strategies, key recommendations and further actions to be taken forward by the city (4).

2. Project Approach

The project was structured around seven key tasks to develop a framework for Low Emission Zone for the Walled City of Ahmedabad. It began with a comprehensive literature review to understand international LEZ practices and India’s policy context, exploring interventions and implementation processes. Stakeholder partnerships were established by identifying and engaging key players and setting up advisory and working groups, including city officials, transport agencies, and community associations, with the support of Ahmedabad Municipal Corporation (AMC) to ensure coordinated efforts. Continual involvement of such groups in various stages of the project was required to disseminate the challenges in a base situation and formulate measures by addressing stakeholder inputs and concerns.

An extensive baseline assessment was conducted to understand the current situation of walled city of Ahmedabad. For the assessment of existing travel behaviour, the following primary and secondary data were utilised from recent projects, the Sustainable Urban Mobility Plan for Greater Ahmedabad Region (SUMP) 2041 (5) and UK Pact Strategy for Electrification of Public Transport and Intermediate Public Transport in Ahmedabad (6). Activity mapping, pedestrian activity, infrastructure placement, parking locations and encroachments were recorded during on-site observation. Information on three-wheelers including passenger and goods vehicles were retrieved from the three-wheeler driver survey, activity survey and freight operator survey. In addition to quantitative data exploration, focus group discussions with residents were conducted to understand their mobility challenges and perception on transition to sustainable modes. By dissecting various aspects of urban mobility and environment, the baseline assessment threw light on mobility and air quality challenges in Ahmedabad's core area, analysing street usage, travel behaviour, freight operations and air pollution levels.

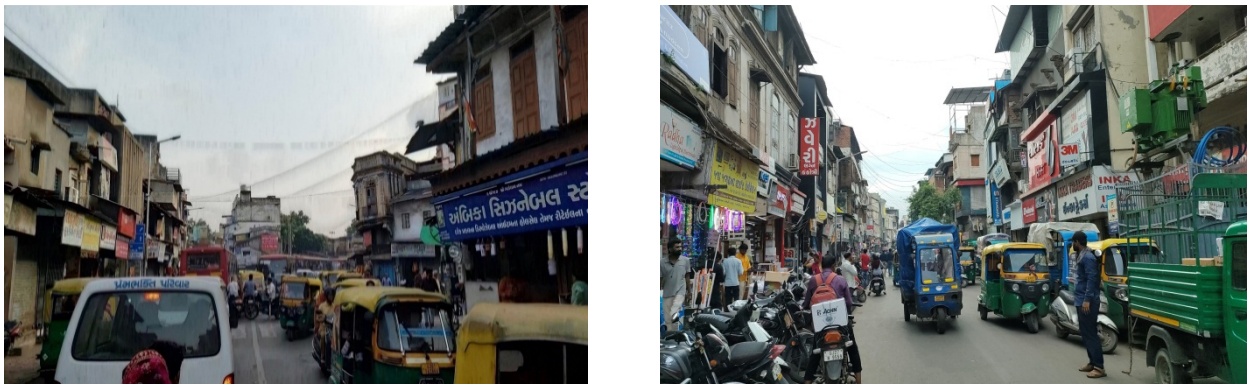
Further, approach for LEZ in the walled city of Ahmedabad was outlined based on the mobility and economic characteristics of the area. A strategic approach for long-term sustainable impact was defined considering mobility and clean vehicle technology strategies. The approach was discussed with advisory group members and further taken to city officials and mobility experts to gain their inputs. Various scenarios including mobility and electrification cases were formulated considering the strategy mix and assessed based on reduction in air pollutants to determine the optimal combination to achieve significant benefits. Further, strategies for mobility management, enhancing public transport and clean vehicle technology interventions were developed. The strategies were finalised based on the discussions with the advisory group members.

3. Key Findings

The walled city of Ahmedabad is a vibrant hub of economic, social and cultural activities, featuring traditional residences, historic monuments, bustling commercial retails, office complexes, wholesale markets and religious sites. This heterogeneous mix of activities depicts 42% of residential land use followed by 17% of mixed-use and 16% of commercial use. However, the high concentration of economic activities in the core area has caused a notable decline in residential population, dropping from 11% of the AMC population in 1991 to 4% in 2021, as residents relocate to newer city areas for an improved quality of life. Those households which remain in the walled city belong to the poorest income group and this income level also influences vehicle ownership with 87% of households owning 2Ws as this vehicle is affordable for all, irrespective of their income. Only among 13% of households, is there an ownership of 2Ws, 4Ws and a cycle.

The walled city situated between the Sabarmati River at its west and the railway line at its east is connected well by the roadway systems. The arterial roads that form the backbone of the city run along the periphery of the walled city and traverse through this area to connect the railway station, state transport bus terminal and industrial areas in the east of Ahmedabad. Relief Road and Gandhi Road connecting east-west direction serve as key economic corridors within the walled city. In terms of public transport, its coverage is significant and connects to different parts of the city. Public transport service comprises nine BRTS routes, 117 AMTS routes, three AMTS depots/terminals, three metro stations of east-west line and two regional transport nodes. In addition, 3W operations are predominant with seven autorickshaw stands in the walled city.

Due to the presence of several economic activities and connectivity to the walled city, this area attracts a surfeit of residents and jobs from different parts of the city, generating significant footfall and traffic. The core area accounts for 10% of AMC's employment. In terms of passenger travel characteristics, nearly 72% of trips taking place across the walled city are originating or destined to different parts and 56% of trips take place for work. Two-wheelers are the most used mode of transport, accounting for 42% of trips with an average trip length of 5.4 km. Due to the availability of public transportation and 3W services, people also utilise buses and autorickshaws for commuting. Three-wheeler trips mark 15% of passenger trips and it is 9% for public transport. For travelling within the walled city, people prefer to walk, and it accounts for 63% of the internal trips. There is therefore a significant potential for a shift to non-motorised modes of transport.



(a) High share of passenger three-wheeler along Mirzapur Road

(b) 3W goods to wholesale market in Relief Road

Figure 3-1 Glimpses of Vehicle Traffic along Inner Roads

Credits: CoE-UT, CRDF

The numerous markets in the walled city function as distribution hubs that deal with of wide range of commodities such as textiles, electronics, vehicles/auto parts, food grains and oil and more. Each market generates significant freight vehicle traffic for receiving and distributing goods both within Ahmedabad and beyond. Over 40% of incoming freight trips are dedicated to textile markets while the remaining trips involve electronics, vehicle/auto parts, food grains, etc. These specialised wholesale markets heavily rely on 3W goods vehicles for transporting commodities. Nearly 60% of the incoming freight traffic is accounted by 3W goods and this mode ply throughout the day. In terms of weight carried, 3W goods carry almost similar tonnage of commodities as LCVs towards the walled city. The predominant locations of arrival of 3W goods are along Relief Road and Gandhi Road.

The traffic mode share reveals the dominance of 3W segment in both passenger and freight movement. The operational characteristics reveals that CNG fuelled passenger 3W operates 80 to 100 km per day and good 3W of various fuel type runs 45 km per day on an average. Majority of the drivers belong to lower income group and their vehicles are purchased with the support of loans. While exploring their awareness regarding EV reveals that more than 70% of the drivers are aware of the EV, however, there is a significant knowledge gap in terms of its technology, availability of financial incentives and economic benefits.

The presence of these several commercial units and businesses within the walled city has led to spillage of activities onto the street that reduces the effective right of way and availability of pedestrian pathways. The roads and footpaths are encroachment by shops, street vendors and parking by 2Ws and 3Ws. This significantly compromises the walkability in this area and people are forced to walk on the road along a high incidence of vehicular traffic. Two-wheeler users and pedestrians are the most impacted groups in accidents and fatalities. Although the traffic department has introduced a one-way road system, parking on one side of the road for specific roads and provided off-street parking spaces, these do not resolve traffic and unauthorised parking challenges in the core area.

(a) Pankor Naka

(b) Jamalpur Road

Figure 3-2 Streets with High Pedestrian Movements

Credits: CoE-UT, CRDF

Focus group discussions with the residents reveals that they face significant mobility challenges due to high volume of vehicular traffic, parking unavailability and poor public transport connectivity. Narrow streets and a lack of pedestrian infrastructure exacerbate the problem, making walking unsafe, especially for children, women and elderly residents, forcing many to rely on 2Ws or shared autorickshaw. Heavy commercialisation over the years has led to increase in volume of freight traffic throughout the day adding to congestion and its activities are obstructing the streets. Residents highlighted worsening of air quality over last four to five years and they experience discomfort and health problems. Yet, many of them are reluctant to purchase EVs due to the high cost, financial and safety concerns.

Moreover, a comparison of the air pollution levels across the walled city with the city-wide figures as well as the frequent highest recordings of PM2.5 indicates the necessity to manage traffic and curb air pollution. Two-wheelers significantly contribute for nearly 74% of CO, 74% of HC, 76% of PM and 50% of CO_2, and 3Ws emit 23% of NOx and 13% of PM in the core area. In terms of goods vehicles, LCVs dominate the emission contribution, which is responsible for very high share of CO, HC and NOx by more than 80%, and PM and CO_2 by 60%. This is followed by 3W goods vehicles that contribute 37% of PM and 36% of CO_2.

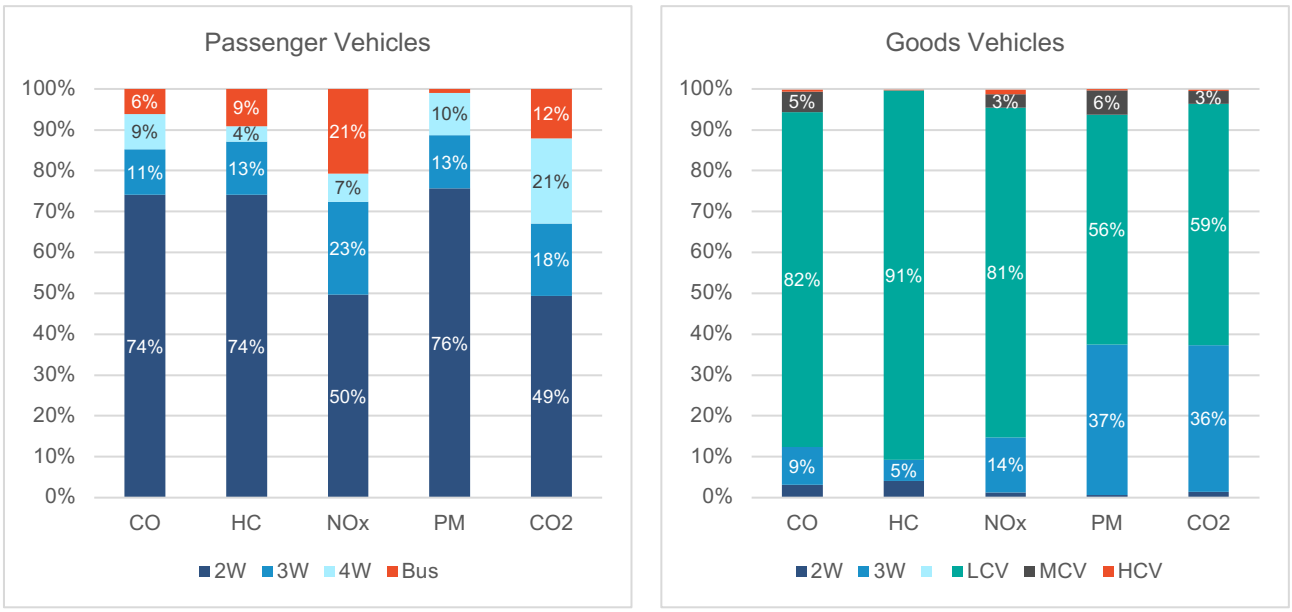


Figure 3-3 Contribution of Air Pollution and Emission by Vehicle Type

Source: CoE-UT, CRDF

The base situation analysis has helped in understanding the mobility and air quality challenges in the walled city along with the economic importance of this area across the city. To improve the urban liveability, it is important to consider the mobility scope without disrupting the economic activities in the walled city and adopt interventions to reduce the pollutants.

4. Strategic Approach

The presence of several activities in the core city area such as residential, retail businesses and commodity markets has led to a high volume of traffic movement causing problems such as passenger and goods vehicles conflicts for limited road space, blocking of traffic flow, improper parking, etc. leading to congestion and air pollution. Given the economic strategic importance of the walled city area, the LEZ strategy should ensure that there is minimum disruption to economic activities while addressing environmental concerns in the core area.

LEZ strategies in terms of Avoid-Shift-Improve framework are developed focussing on reducing motorised traffic, shifting towards sustainable transport modes and enhanced vehicles technology. This approach aims to ensure the core area's growth and liveability while adopting measures to attain better air quality.

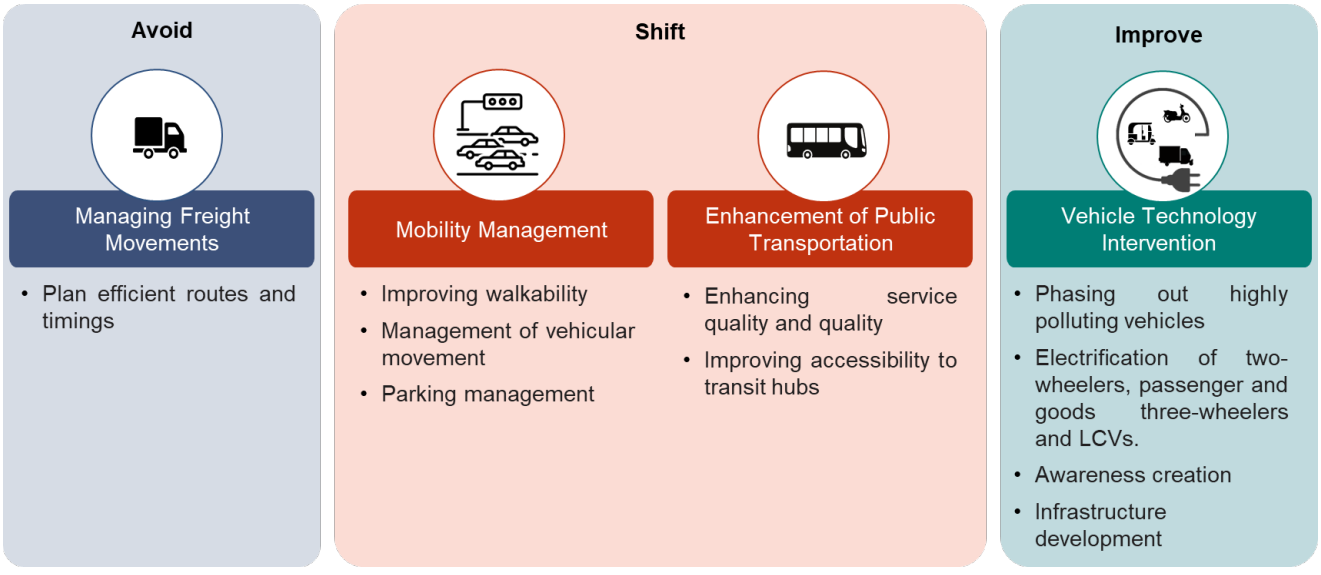


Figure 4-1 Approach for Strategy Development

A mix of mobility and clean vehicle technology strategies is considered to formulate scenarios for shaping the trajectory of LEZ implementation. In case of mobility interventions, facilitating shift to sustainable modes by improvement in NMT and enhancement of public transport is considered, and it aimed mode shift from 9% to 20% and NMT from 30% to 38%. Considering the national level target and pollution contribution, electrification both PT and IPT by 50% and private vehicles by 10% is defined.

The impact of NMT improvement, PT enhancement and electrification of vehicles were assessed based on reduction in air pollutants and emissions. The assessment indicates that electrification of vehicles has impact but only up to 18% of air pollution reduction on an average; whereas PT and NMT improvement alone can reduce pollutants up to average of 27%. Further, there is a significant impact of 43% pollution reduction with these three interventions.

5. Policy Recommendations

This has guided the way to formulation of LEZ strategies based on combined consideration of all interventions to achieve improvement in air quality and enhanced urban mobility. The strategies are outlined as follows:

Clean Vehicle Technology Intervention

The contribution of air pollution based on vehicle technology indicates that pre-BS VI vehicles contribute more than 70% of the pollutants, comprising passenger and goods vehicles, as per the assessment on air pollution contribution by vehicles. It is critical to phase out pre-BS IV vehicles and plan phased programme that gradually eliminate BS IV vehicles for subsequent years, ensuring a seamless transition to new technology.

Transitioning to EVs is a key step toward addressing the challenges pollution in this densely populated urban core. Promoting electrification of LCVs, 3Ws and 2Ws can significantly reduce pollution. Raising awareness and setting up of charging infrastructure and electrification of the buses and IPT by the city can sensitise the public to adopt EV. In addition, it is important for the state government to implement targeted policies including financial incentive to encourage the transition to the electric LCV segment.

Enhancement of Public Transport

The city bus service has very low service frequency and reliability due to which people are discouraged to use public transport and depend on private and intermediate transport modes. To enhance shift to public transport, it is essential to improve the service quality by rationalising the routes, including circular routes, enhancing fleet mix with minibuses and enhancing the accessibility to transit hubs by integrating public transport systems.

Street Accessibility Improvement

Streets in the walled city are characterised by bustling movement of people as well as vehicles, hence, it is important to enhance the accessibility by adopting complete streets, which is an approach that requires streets to be planned, designed, operated and maintained to enable safe, convenient and comfortable travel and access for all users regardless of their mode of transport. In addition, restricting entry of 4W on narrow roads and provide special sticker permit for residents to access during restricted hours.

Parking Management

Parking in undefined spaces reduces the effective carriageway, obstructs pedestrian pathways and contributes to traffic congestion. On roads with the bus operations, this issue further compounds the problem by slowing down bus speeds, disrupting schedules, and diminishing the efficiency of public transport services. To ensure smooth movement of both vehicles and pedestrians, it is essential to manage parking by defining 3W stands, eliminating 4W parking along congested roads and limiting on-street parking with time-based parking fee structure.

Pedestrianisation of Streets

Walkability is compromised, specifically along streets with high pedestrian footfall and measures focusing on pedestrian safety are essential. Markets with high pedestrian volume could be transformed to pedestrian only zones with time regulated entry for goods vehicles and access for buses and 3Ws for connectivity. The restrict time to be explored needs to be specific to each market. This effort could restrict

the entry of vehicular traffic and ensure safe and smooth movement for all users, including vulnerable groups such as children and the elderly.

6. Actions to be taken forward

The study has identified the next steps for improving the traffic and environmental conditions in the walled city. It is suggested that specific studies could be taken up by AMC in order to outline an implementable plan and financing:

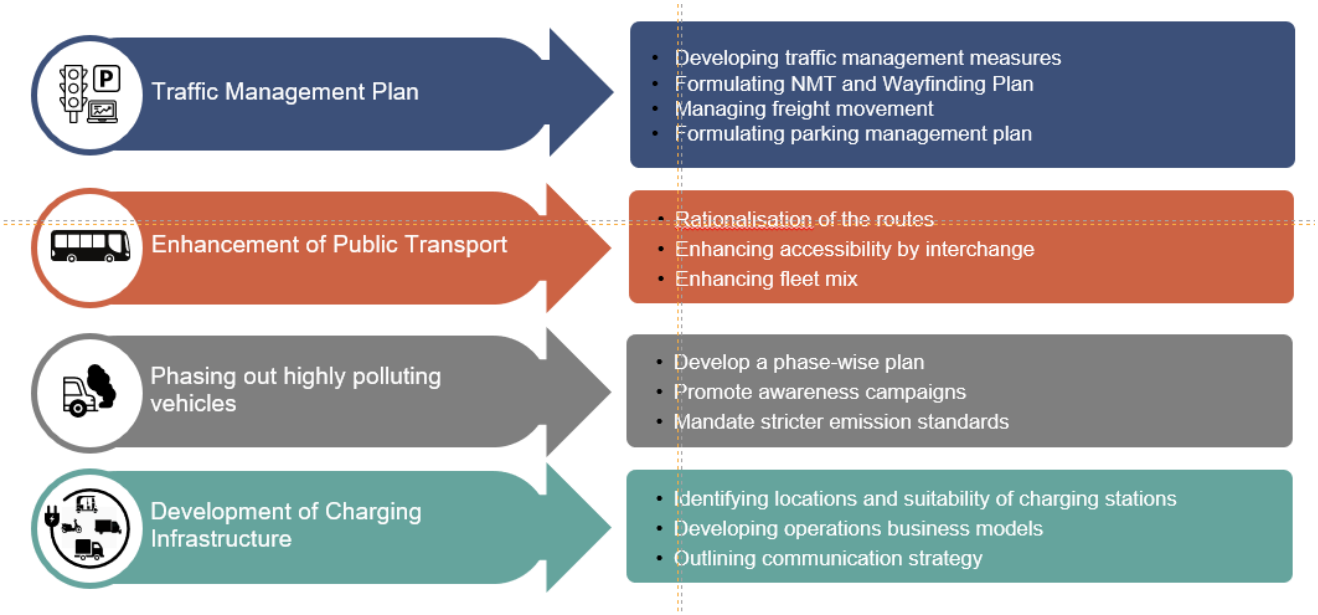


Figure 6-1 Action areas of LEZ

Source: CoE-UT, CRDF

The meetings with advisory group[1] have been instrumental in informing city officials and agencies about potential action areas that can be adopted to enhance ongoing initiatives in the walled city and Ahmedabad at large. The actions to be taken forward are as follows:

- **Phasing out highly polluting vehicles:** It is identified that phasing out pre-BS IV vehicles and plan phased programme that gradually eliminate BS IV vehicles for subsequent years is important. The city could share details of highly polluting vehicles with Climate State Level Committee, constituted to ensure effective implementation of National Clean Air Programme, and State Transport Commissioner to take necessary actions.
- **Promoting electric vehicles:** The city could undertake promotional activities to enhance the adoption of e-3W. In the current context, TCO of electric LCVs are not comparable with conventional variant and the city could propose to the state government to adopt appropriate policy measures for e-LCV in Gujarat EV Policy.
- **Establishing charging infrastructure:** It is important to develop charging infrastructure as per the demand in the walled city, the city could explore the possibility of setting up 3W charging stations, including a detailed assessment of economic viability, operation model and suitable locations. In addition, the city could adopt pricing mechanism with special rates to make it favourable for 3Ws. The recommendations could be incorporated to term of reference of project on development of charging infrastructure by AMC.
- **Enhancing public transport:** The city intends to develop service and business plan for bus operations in Ahmedabad, including the walled city, hence, this plan could consider enhancing the

[1] The strategies was discussed with advisory group members from Ahmedabad Municipal Corporation (AMC), Ahmedabad Janmarg Limited (AJL), Gujarat Metro Rail Corporation Limited (GMRCL), Regional Transport Office (RTO) and Heritage Department during December 17 to 20, 2024 and January 3, 2025.

fleet mix with electric minibuses and establishing circular routes to improve connectivity across the walled city.

- **Improving street accessibility:** The city could undertake street development to improve the street accessibility and by integrating proposals in the local area plans.
- **Traffic Management Plan:** A traffic management plan can be developed by AMC collaboratively with the Traffic Police by incorporating the suggestions from this study including restricting entry of 4Ws, managing freight movement, formulating NMT and wayfinding plan, and parking management.

Successful implementation of LEZ measures requires significant investments and institutional coordination – mobilising private sector participation for Electric Vehicle (EV) charging infrastructure development and public transport improvements, providing targeted subsidies for EV adoption in the walled city area and funding for Non-Motorised Transport (NMT) and public transport infrastructure, establishing comprehensive monitoring systems to track air quality improvements, emission reductions, and mobility outcomes.

The LEZ framework for Ahmedabad addresses critical urban mobility and air quality challenges through a structured, data-driven approach. By combining emissions reduction, and sustainable transport promotion, the framework sets a roadmap for creating cleaner, more liveable urban cores.

The scalability of this methodology to other Indian cities lies in its adaptability and evidence-based planning. With strong institutional backing, robust stakeholder engagement, and phased implementation, LEZs can become transformative tools in India's transition toward sustainable urban development and low-carbon mobility.

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