AMRUT Centre
of Urban Planning
for Capacity Building

Atal Mission for Rejuvenation and Urban Transformation

AMRUT Centre of Urban Planning
for Capacity Building
A-CUPCB-SPAV

Interim Report

DEVELOPMENT OF
LOW EMISSION ZONE (LEZ)
IN OLD CORE CITY AREAS-
A CASE OF VIJAYAWADA CITY

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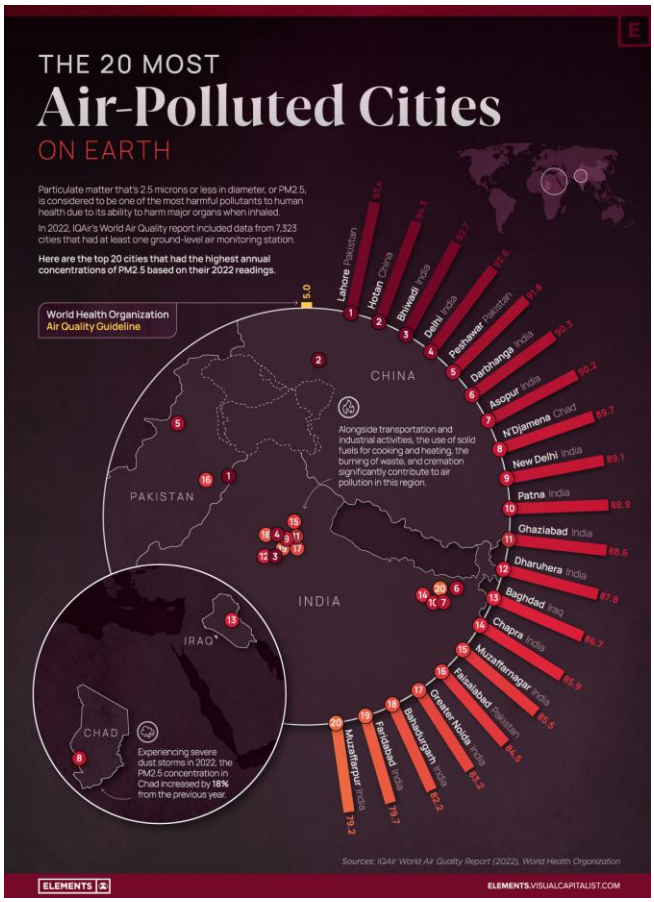
Chapter 01

Project Background

1.1 Air Pollution in India

1.1.1 Ranked: The 20 Most Air-Polluted Cities on Earth Ranked: The 20 Most Air-Polluted Cities on Earth

January 4, 2024 By Selin Oğuz



IMG 1 https://elements.visualcapitalist.com/ranked-the-20-most-air-polluted-cities-on-earth/

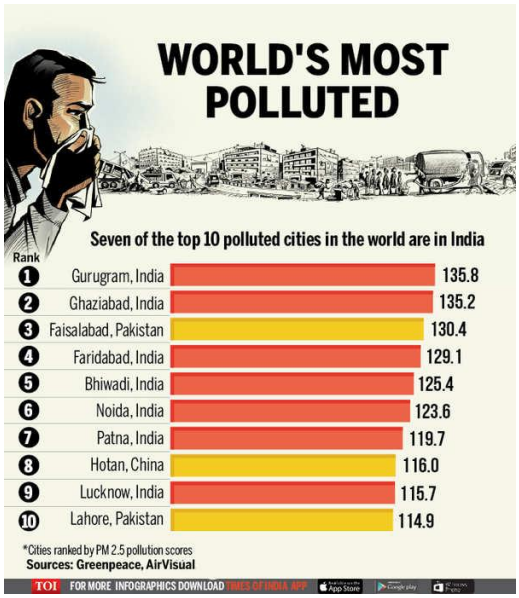
As one of the standard air quality indicators used by the WHO, the PM2.5 concentration refers to the quantity of fine particulate matter with a diameter of 2.5 micrometers or less in a given volume of air. Fine particulate matter that is this small can penetrate the lungs when inhaled and enter the bloodstream, affecting all major organs. Based on annual average PM2.5 concentrations (µg/m³) in 2022, here are the most polluted cities in the world.

At the top of the list, Lahore in Pakistan has a combination of high vehicle and industrial emissions, as well as smoke from brick kilns, crop residue, general waste burning, and dust from construction sites. Air pollution levels can also be impacted by practices such as large-scale tree removal in order to build new roads and buildings. As a result of its growing population and rapidly expanding industrial sector, India has 14 cities on the list, outpacing China, formerly considered the world's number one air pollution source.

1.1.2 India hosts seven of the 10 most polluted cities in the world

TIMESOFINDIA.COM / Updated: Mar 6, 2019, 14:25 IST

Of the 10 most polluted cities in the world, seven are in India alone, according to recently released data by IQAir AirVisual and Greenpeace. Haryana's Gurugram tops the list of the most polluted cities in the world, followed by Ghaziabad, Faridabad, Bhiwadi and Noida.



IMG 2 https://timesofindia.indiatimes.com/world/india-hosts-seven-of-the-10-most-polluted-cities-in-the-world/articleshow/68266084.cms

Indian cities dominate a new ranking of the world's most polluted cities in 2018, claiming 15 of the top 20 spots

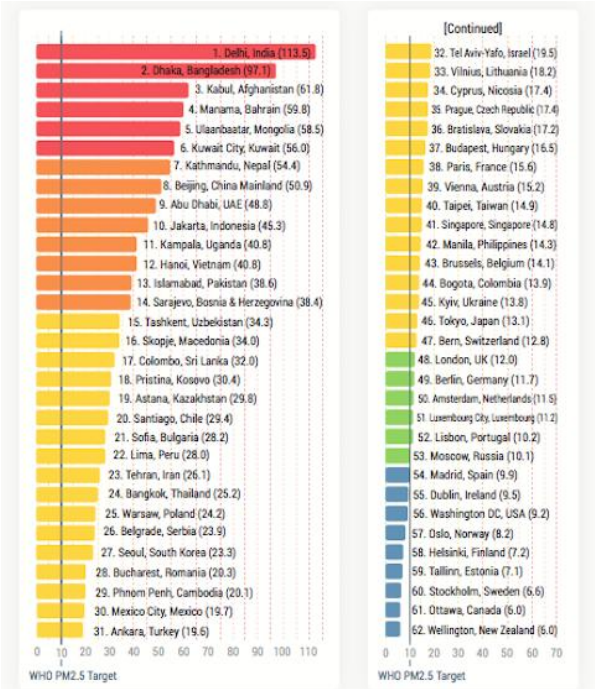
Six cities in the National Capital Region (NCR) — Gurugram, Ghaziabad, Faridabad, Bhiwadi, Delhi and Noida–represent almost half the number of Indian cities in the top 20. Gurugram was the most polluted city in the world in 2018, closely followed by Ghaziabad, recording 135.8 µg/m3 average daily PM 2.5 levels, more than 13 times the limit of 10 µg/m3 recommended by the World Health Organization (WHO).

1.1.3 Highest average PM 2.5 levels found overwhelmingly in South Asia

With 18 out of the 20 most polluted cities found in India, Pakistan and Bangladesh, evidence of a South Asian air quality crisis emerges from the data set out in the report.

Delhi is the most polluted capital in South Asia, with average yearly PM 2.5 concentration at 114 µg/m3, followed by Dhaka at 97 µg/m3–both at levels more than 50% higher than in Manama, Bahrain, the most polluted capital outside the region.

"Vehicle exhaust, open crop and biomass burning, industrial emissions and coal combustion" are the major contributors to high PM 2.5 levels in the region, the report said.



IMG 3 World Regional Capital City Ranking by Average Yearly PM 2.5 Concentration
https://ecologise.in/2019/03/11/gurugram-most-polluted-city-in-the-world-new-report/

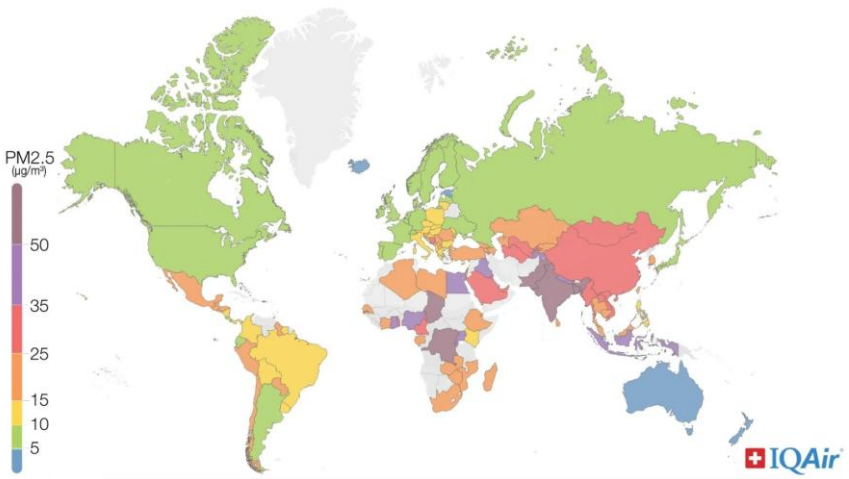
1.1.4 Top 10 most polluted cities in the world (2024-25): 6 of them are in India (Indian Express)

Written by **Cherry Gupta**

Updated: March 15, 2025 13:04 IST

Out of 138 countries and regions assessed, *126 (representing 91.3%) exceeded the World Health Organization's (WHO) annual guidelines for PM2.5 concentrations*, the 2024 World Air Quality Report published by IQAir, recently highlighted. Notably, Central and South Asia host the world's top seven most polluted cities, with India being home to 13 of the 20 cities identified as the most polluted globally.

Methodology: The report has relied on data from 40,000 air quality monitoring stations across 8,954 locations in 138 countries, territories and regions, which has been analysed by IQAir's air quality scientists.



IMG 4 2024 Global Map colour-coded by annual average PM2.5 concentration. (Source: IQAir)

IMG 5 Most polluted cities in the world in 2024.
https://indianexpress.com/article/trending/top-10-listing/top-10-most-polluted-cities-in-the-world-2024-25-6-of-them-are-in-india-9880720/

1.1.5 15 Most Polluted Cities in the World (Earth.org)

by Deena Robinson Africa Americas Asia Europe Global Commons Oceania Mar 26th 2022

The biggest sources of air pollution around the world are from burning fossil fuels in power plants to generate electricity, including coal, oil and natural gas, as well to power fossil fuel-based vehicles and other modes of transportation. The burning process releases significant amounts of air pollutants, emissions and chemicals into the air and atmosphere. These air pollutants, namely nitrogen oxides, would often react to ultraviolet radiation (UV rays) from the sun and forms into smog, which poses higher risks of respiratory illnesses.

Shockingly, 12 of the world's 15 most polluted cities are in India. What's more, the country is also home to 63 of 100 of the most polluted places.

The Lancet estimates that air pollution kills more than 1 million people in the country every year. The IQAir report says that on average, India's cities exceed WHO guidelines for the amount of PM2.5 in the atmosphere by 10 times. Following the updated air pollution guidelines adopted the WHO and based on air quality data for PM2.5 in 2021, people in New Delhi, which was ranked as the capital with the worst air quality in the world, are breathing air 13.2 times higher than the new limit.

Air pollution in India are caused by fumes from vehicular traffic and exacerbated by diesel generators and the burning of fossil fuels in cooking by poorer families. This is in addition to industry as well as the burning of waste and farmers setting fields alight after crops are harvested.

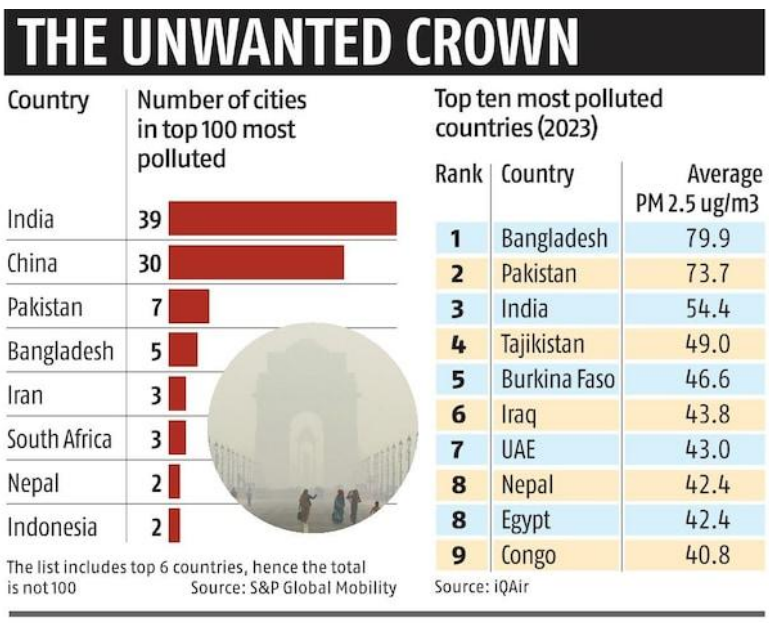
The country is making progress, thanks to its National Clean Air Programme which aims to reduce air pollution levels by up to 30% by 2024. India is also planning the world's largest expansion of renewable energy by 2022.

Rank	City	2021	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2020	2019	2018	2017
1	Bhiwadi, India	106.2	145.8	129.8	120.2	125.7	86.5	95.9	55.6	55.4	37.1	91.1	188.6	136.6	95.5	83.4	125.4	
2	Ghaziabad, India	102	199.9	172.2	97.8	86.3	52.9	47.2	35.3	37.6	30.8	89.7	218.3	163	106.6	110.2	135.2	144.6
3	Hotan, China	101.5			158	91.1	167.4	57.4	70.9	93.2	79.3	126.1	111.5	62.6	110.2	110.1	116	91.9
4	Delhi, India	96.4	183.7	142.2	80.5	72.9	47.4	47.1	35.6	36.9	30.2	73.7	224.1	186.4	84.1	98.6	113.5	108.2
5	Jaunpur, India	95.3	182.2	143.5	91	70	51.1	40.7	33.5	34.2	36.8	75.7	196	195.7				
6	Faisalabad, Pakistan	94.2	207.1	118	71.2	44.6	51.2	44.7	50.4	50	51.9		234.5	241.7	73.2	104.6	130.4	
7	Noida, India	91.4	185.3	143.4	80.5	68.2	48	43.8	33.9	35	26.5	76.9	204.4	154.8	94.3	97.7	123.6	134
8	Bahawalpur, Pakistan	91	173.9	145.1	77.3	51.4	45.2	54.4	42.2	43.7	38.2	67.2	197	221.2	78.7			
9	Peshawar, Pakistan	89.6	103.9	137.2	59.6	48	49.2	68.5	54.3	55.8	60.8	77.5	182.3	176.9		63.9		
10	Bagpat, India	89.1	146.1	106.3	88.3	87.1	65.7	53.9	32.8	31.5	24.3	84.7	213.6	128.1		88.6		
11	Hisar, India	89	114.6	111.5	90.7	67.4	62	62.2	44	40.7	36.8	74.7	205.5	157.4	81.1	81		
12	Faridabad, India	88.9	128	109.3	88.8	76.3	58.4	57.2	40.8	38.7	30.2	82.2	202.7	163.5	83.3	85	129.1	123
13	Greater Noida, India	87.5	185.9	111.4	69	60.2	48	53.1	49.4	50.1	36	78.4	191.3	160.4	89.5	91.3		
14	Rohtak, India	86.9	147.3	109.4	80.5	64	47.6	46.6	48.8	43.5	40.8	76.9	217.5	139.9	74.4	59.7	81.6	96.7
15	Lahore, Pakistan	86.5	140.6	135.1	55.8	38.7	33.8	27.9	25	36.5	45.6	85.1	205.4	212.1	79.2	89.5	114.9	133.2

IMG 6 https://earth.org/most-polluted-cities-in-the-world/

1.1.6 The unwanted crown: 39 of world's 100 most polluted cities are from India (Business Standard)

Surajeet Das Gupta New Delhi
Nov 19 2024 | 10:41 PM IST



IMG 7 https://www.business-standard.com/india-news/the-unwanted-crown-39-of-world-s-100-most-polluted-cities-are-from-india-124111901145_1.html

India has earned the dubious distinction of becoming the country with the most cities in the top 100 worst polluted cities globally, far ahead of its rival, China.

As residents in Delhi grapple with one of the worst pollution levels this winter — air quality index (AQI) readings regularly exceeding 500 — the central and state governments, as usual, blame each other for the crisis.

A recent S&P Global Mobility web presentation identified 39 Indian cities in the top 100 most polluted globally. In comparison, China, the nearest rival, has 30 cities on the list.

1.2 Air pollution in Vijayawada

1.2.1 Vijayawada in the grip of air pollution as PM10 reaches alarming level

The New Indian Express 12 Jun 2019, 10:08 am

Construction activity, indiscriminate burning of garbage and rise in vehicular pollution in Vijayawada are some of the factors that led to the rise in PM10 level.

Speaking to TNIE, **T Sri Kumar, an environmentalist and a Physics lecturer of Andhra Loyola College**, said "Due to exposure to high concentration of PM10 level, many people are prone to asthma attacks, high blood pressure and increased risk of heart ailments. Air pollution can also lead to premature death".

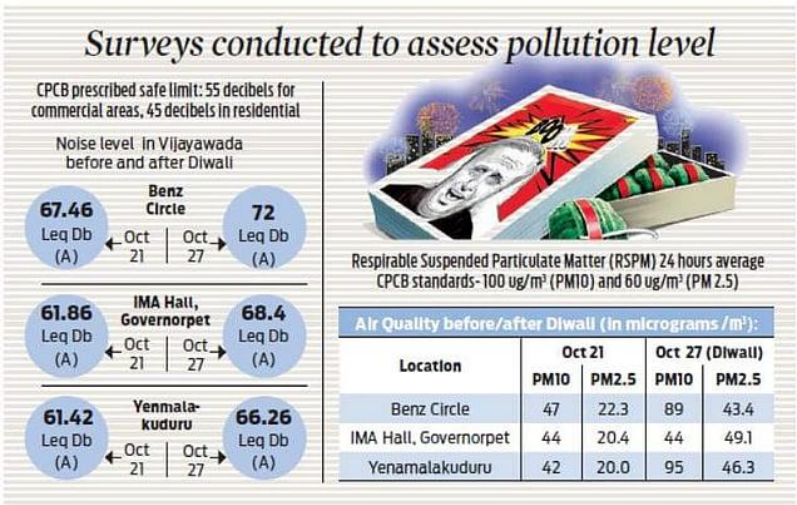
Special Chief Secretary (Environment, Forest, Science and Technology) Neerabh Kumar Prasad stressed the need for an action plan and micro-planning to reduce PM10 level in the city. So, Neerabh Kumar Prasad has directed the Pollution Control Board to coordinate with the municipal administration department, realtors and other stakeholders to take steps to reduce air pollution with the help of an online real time monitoring system.

1.2.2 Air pollution below national average in Vijayawada this Diwali

Sistla Dakshina Murthy 30 Oct 2019, 7:30 am The New Indian Express

APPCB conducts ambient air quality and noise level surveys in three locations by installing diffusion tubes.

The CPCB officials carried out a survey in all the three locations on October 21 to check noise levels from 6 pm to 12 midnight. Similarly, an air quality check was conducted from 6 am on October 21 to 6 am the next day to assess SO2, NO2 and suspended particulate matter (SPM) concentration in the air. The survey was repeated on the day of Diwali. The CPCB officials carried out a survey in all the three locations on October 21 to check noise levels from 6 pm to 12 midnight. Similarly, an air quality check was conducted from 6 am on October 21 to 6 am the next day to assess SO2, NO2 and suspended particulate matter (SPM) concentration in the air. The survey was repeated on the day of Diwali.



IMG 8 https://www.newindianexpress.com/cities/vijayawada/2019/Oct/30/air-pollution-below-national-average-in-vijayawada-this-diwali-2054560.html

1.2.3 Reduce air pollution in Vijayawada: NGT to Andhra Pradesh Pollution Control Board (The New Indian Express)

20 Nov 2019, 4:16 am

Vijayawada stands at 45th position among pollution-hit cities in the country with air quality worse than that of Visakhapatnam and Guntur.

According to APPCB officials, depletion of greenery and sharp rise in construction activity coupled with vehicular emission has taken a toll on the air quality in the city, with the particulate matter 10 (PM10) rising alarmingly high and worse than in Visakhapatnam, Guntur, Kurnool and Nellore.

In June, the Central Pollution Control Board (CPCB) declared all the five cities as non-attainment areas with respect to Ambient Air Quality standards (2011-15) and the World Health Organisation's (WHO) report.

IMG 9 https://www.newindianexpress.com/cities/vijayawada/2019/Nov/19/reduce-air-pollution-in-vijayawada-ngt-to-andhra-pradesh-pollution-control-board-2064221.html

1.2.4 Long way to go for Vijayawada to meet WHO air pollution standards (Times of India)

Ujwal Bommakanti / TNN / Updated: Sep 26, 2021, 07:12 IST

According to Andhra Pradesh Pollution Control Board (APPCB) data, the 2020 average of PM 10 annual mean stands at 55 ug/m3, which is 72% more than what the WHO demands and 63% more than the 2005 standards.

However, when compared to National Ambient Air Quality Standards (NAAQS), the city's PM 10 annual average is only 27% higher. Experts point out that there is much difference between a lockdown-induced year like 2020 and a normal year like 2019.

Hence, Vijayawada's 2019 annual PM 10 average stands at 71 ug/m3, which is 43% higher compared to NAAQS and 78% more compared to WHO's latest standards. Similarly, during 2019, the annual average of PM 2.5 concentration was at least three times above the WHO annual air quality guideline value.

1.2.5 PCB allots Rs 100 crore for Visakhapatnam Vijayawada to tackle air pollution threat

Samdani MN / TNN / Updated: Jun 6, 2022, 10:24 IST

The board has allocated Rs 100 crore each to Vijayawada and Visakhapatnam to kick-start green initiatives.

The city action plan for Visakhapatnam is being prepared jointly by Andhra University, IIT (Kanpur) and Duke University of US and the city action plan of Vijayawada is being prepared by IIT, Tirupati," APPCB chairman AK Parida told TOI.

He said that present air pollution levels in Vizag is anywhere around 80 (PM10) and Vijayawada around 60. He said that they have set a target of reducing the air pollution by 30 % in both the big cities by 2025.

IMG 10 https://timesofindia.indiatimes.com/city/amaravati/pcb-allots-rs-100-crore-for-visakhapatnam-vijayawada-to-tackle-air-pollution-threat/articleshow/92029259.cms

1.3 National Clean Air Programme

1.3.1 Overview

National Clean Air Programme has been launched by the Ministry of Environment, Forest and Climate Change as a comprehensive initiative in partnership with various Ministries and States to improve air quality at city, regional and national level. It is a focused and time bound scheme to implement various sectoral policies, strengthen monitoring and enhance public participation in more than 100 cities for effective air quality management.

1.3.2 Goal

Meet prescribed annual average ambient air quality standards at all locations in the country in a stipulated timeframe (long-term).

1.3.3 Target

Tentative national level target of 20%–30% reduction of Particulate Matter (PM_{10} and $PM_{2.5}$) concentration by 2024 is proposed under NCAP. These interim targets are in line with global experiences which highlight that city specific actions led to 35%–40% $PM_{2.5}$ reduction in five years for cities, such as Beijing and Seoul, whereas cities, such as Santiago and Mexico City have shown 73% and 61% reduction in 22 to 25 years with regard to $PM_{2.5}$ and PM_{10} concentrations, respectively.

1.3.4 Objectives

1. To ensure stringent implementation of mitigation measures for prevention, control and abatement of air pollution.
2. To augment and evolve effective and proficient ambient air quality monitoring network across the country for ensuring a comprehensive and reliable database.
3. To augment public awareness and capacity-building measures encompassing data dissemination and public outreach programmes for inclusive public participation and for ensuring trained manpower and infrastructure on air pollution.

1.3.5 Tenure

NCAP is a mid-term, five-year action plan launched in 2019. However, international experiences and national studies indicate that significant outcome in terms of air pollution initiatives are visible only in the long-term, and hence the programme may be further extended to 20–25 years in the long-term after a mid-term review of the outcomes.

1.3.6 Financial Arrangement

Under NCAP, Rs. 1615.47 Crores have been released to non-attainment cities in the period from FY 2019-20 till date. In addition, Rs. 9926.41 Crores have been released to 42 million-plus-Urban agglomerates under 15th Finance Commission Grant from FY 2020-21 till date. Further, City Action Plan (CAPs) of 130 cities are to be implemented by coordinated action of state government and its agencies at state and city level. The funding for implementation of CAPs is to mobilised through convergence of resources from various schemes of Central Government such as SBM (Urban), AMRUT, Smart City Mission, SATAT, FAME-II etc. and resources from State/UT Governments and its agencies such as Municipal Corporation, Urban Development authorities and Industrial development authorities etc. The Funding from NCAP/XV-FC is performance based supplemental grant for funding of unfunded critical gap of CAP.

1.3.7 Approach

1. Collaborative, multi-scale and cross-sectoral coordination between the relevant central ministries, state governments and local bodies.
2. Mainstreaming and integrating the existing policies and programmes of the including the National Action Plan on Climate Change (NAPCC) and other initiatives of Government of India in reference to climate changes.
3. With reference to NAPCC the main focus will be on mainstreaming the initiatives under five national missions of NAPCC viz. National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Mission for a Green India and National Mission for Sustainable Agriculture.
4. While many of these policies and programmes are already part of our current actions, they may need a change in direction, enhancement of scope, and effectiveness and an accelerated implementation of time-bound plans.
5. Use the smart cities framework to launch the NCAP in the 54 smart cities falling in the list of the 130 non-attainment cities
6. The NCAP will be dynamic and will continue to evolve based on the additional available scientific and technical information as they emerge and in response to international best practices and experiences that are available.

1.3.8 Implementation of NCAP

1. The CPCB shall, in consonance with the Air (Prevention and control of Pollution) Act, 1981, and in particular with the provision of Section 16(2)(b) of the Act, execute the nation-wide programme for the prevention, control, and abetment of air pollution within the framework of the NCAP.

1. The NCAP will be institutionalized by respective ministries and will be organized through inter-sectoral groups, which include, in addition to the related ministries, the Ministry of Finance, Ministry of Health, NITI Aayog, CPCB, experts from the industry, academia, and civil society.

2. The Ministry of Road Transport and Highways (MoRTH) acts as a nodal agency for the implementation of various provisions on control of air pollution from vehicles through Motor Vehicle Act, 1988, and Central Motor Vehicle Rules 1989.

3. In addition, various other ministries viz. MoEF&CC, M/o Power, M/o Petroleum and Natural Gas, M/o New and Renewable Energy, M/o Heavy Industry, M/o Housing and Urban Affairs, M/o Agriculture through incorporating pollution in their sectoral policies contribute to air pollution mitigation.

4. Ministry of Environment, Forest and Climate Change (MoEF&CC) is implementing NAPCC with eight missions spreading across various sectors. Five of the missions viz. National Mission for a Green India, National Mission for Enhanced Energy Efficiency, National Solar Mission, National Mission on Sustainable Habitat, National Mission for Sustainable Agriculture have direct link with mitigation of air pollution, which can be one of the benefits of these ongoing missions.

5. Each sector specific Working Group will be tasked to evolve specific objectives spanning the remaining years of this Plan Period and subsequently.

6. Comprehensive component-wise documents detailing objectives, strategies, plan of action, timelines and monitoring, and evaluation criteria would be developed.

7. The Apex Committee in the Ministry will periodically review the progress of these Components. Annual performance will be periodically reported upon. Appropriate indicators will be evolved for assessing the emission reduction benefits of the actions.

https://prana.cpcb.gov.in/#/about

IMG 11 https://urbanemissions.info/india-air-quality/india-ncap-cities/

1.4 Low Emission Zone

1.4.1 Definitions

"Low Emission Zones (LEZs) are areas where the most polluting vehicles are regulated, deterred, or banned to improve air quality." *European Commission*

"A Low Emission Zone (LEZ) is an area where only vehicles that meet certain emissions standards can drive without paying a charge." *UK Government*

"The Low Emission Zone covers most of Greater London and encourages the most polluting heavy diesel vehicles to become cleaner." *London City*

"LEZs are a type of traffic management system that restricts access by vehicles with emissions to reduce pollution and protect public health." *WHO*

"Low Emission Zones restrict the use of high-emitting vehicles in city areas to reduce harmful air pollution and accelerate the transition to clean transport." *C40 Knowledge Hub*

"Low-emission zones (LEZs) are areas where the most polluting vehicles are regulated. They have become a widespread measure in European cities, with more than 320 active LEZs registered by 2022 and over 500 expected by 2025." *Clean City Campaign*

"Low Emission Zones (LEZs) are areas where the most polluting vehicles are regulated. Usually, this means that vehicles with higher emissions cannot enter the area. In some low emission zones, the more polluting vehicles have to pay more if they enter the low emission zone." *Urban Access Regulations in Europe*

"A low-emission zone (LEZ) is a defined area where access by some polluting vehicles is restricted or deterred with the aim of improving air quality. This may favor vehicles such as bicycles, micro mobility vehicles, certain alternative fuel vehicles, hybrid electric vehicles, plug-in hybrids, and zero-emission vehicles such as all-electric vehicles." *Wikipedia*

"LEZs are areas demarcated within cities or regions where access is restricted either through physical restrictions or through differential pricing based on emission levels of vehicles." *CSE*

"Green Zones, or Low-Emission Zones (LEZs), are areas of the city that either restrict or ban the movement of Internal Combustion Engine (ICE) vehicles." *WRI*

"LEZs are geographically demarcated areas in cities where the circulation of polluting vehicles is regulated and a set of mobility interventions are implemented to control and mitigate vehicular emissions with the aim of improving air quality." ITDP

"Low-emission zones (LEZs) are geographically defined areas where the movement of high-polluting vehicles is restricted." ICCT

A defined area or selected corridor that restricts or bans the use of polluting means of transportation and various activities related to it. This can be achieved by:

- Establishment of clearly delineated LEZ zones.
- Active mobility plan for delineated LEZ.
- Public participation with locals and all stakeholders.
- Outline a phased implementation plan.

1.5 About Global LEZ

1.5.1 Low Emission Zones (LEZ) at the Global Level

Low Emission Zones (LEZs) are designated areas where the most polluting vehicles are restricted or charged to improve air quality and reduce greenhouse gas emissions. These zones are becoming increasingly popular in cities worldwide as part of efforts to combat air pollution and climate change.

1.5.2 What is a Low Emission Zone (LEZ)?

A **LEZ** is an urban area where **high-emission vehicles** (typically diesel and older petrol vehicles) are **restricted or fined** to reduce pollution levels. The aim is to lower **particulate matter (PM)**, **nitrogen oxides (NOx)**, and **CO_2 emissions**. Some cities have stricter **Ultra Low Emission Zones (ULEZ)** or **Zero Emission Zones (ZEZ)** that allow only electric or very low-emission vehicles.

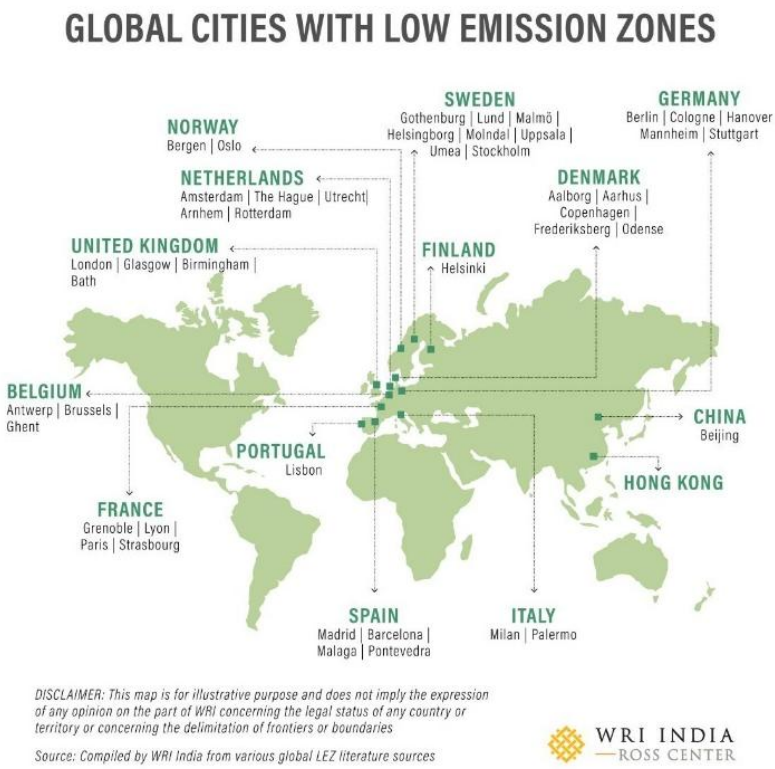
1.5.3 Global Implementation of LEZs

Europe

- **London, UK** – The city has an **Ultra Low Emission Zone (ULEZ)** where vehicles must meet stringent emission standards or pay a daily charge.
- **Berlin, Germany** – Established a LEZ in 2008, requiring vehicles to have a green emission sticker to enter the city.
- **Paris, France** – Operates a LEZ that bans diesel vehicles registered before 2006 and plans to go **fully emission-free by 2030**.
- **Madrid & Barcelona, Spain** – Both cities have strict LEZs to limit high-pollution vehicles.

North America

•**New York City, USA** – Implementing congestion pricing and considering LEZs.
•**California, USA** – Some cities have restrictions on high-emission commercial vehicles.
•**Toronto, Canada** – Encourages low-emission vehicles but does not have an official LEZ yet.



IMG 12 Global Cities with Low Emission Zones - WRI INDIA

Asia

•**Beijing, China** – Enforces strict LEZs, banning high-emission vehicles and promoting electric mobility.
•**Delhi, India** – Has implemented **odd-even vehicle restrictions** and banned certain diesel vehicles to reduce air pollution.
•**Tokyo, Japan** – Enforced diesel vehicle restrictions and promoted hybrid/electric vehicle adoption.

Other Regions

•**Mexico City, Mexico** – Bans older vehicles from the city center on certain days.
•**São Paulo, Brazil** – Operates a vehicle rotation scheme to reduce pollution.

1.5.4 Benefits of Low Emission Zones

Encourages electric vehicle adoption – Promotes the use of EVs and cleaner fuels. **Reduces traffic congestion** – Many LEZs also function as congestion control measures. **Supports climate action goals** – Helps cities meet **net-zero** targets and reduce CO_2 emissions. **Improves air quality** – Reduces pollution-related health issues such as respiratory diseases.

1.5.5 Challenges & Criticism

Economic impact – Affects businesses relying on older vehicles (taxis, delivery services). **Enforcement difficulties** – Requires monitoring and technology investment (cameras, sensors). **Social inequality** – Low-income individuals might struggle to afford compliant vehicles.

1.5.6 Future of LEZs

Many **cities plan to expand** LEZs, making them stricter or transitioning to **Zero Emission Zones (ZEZs)**. **Electric vehicles (EVs), hydrogen fuel, and clean transport solutions** will play a major role. **Smart traffic systems and AI** will enhance monitoring and enforcement.

1.6 LEZ Indian Context

1.6.1 Current LEZ-Like Policies in India

Delhi's "Low Emission Zone" Approach

Delhi has experimented with policies similar to LEZs due to severe air pollution levels:

Odd-Even Rule – Restricts private vehicle movement based on license plate numbers on high-pollution days. **Entry Ban on Older Vehicles** – Diesel vehicles older than **10 years** and petrol vehicles older than **15 years** are banned. **Restrictions on Heavy-Duty Vehicles** – During winter months, entry of **polluting trucks** into Delhi is restricted. **E-Rickshaw and EV Promotion** – Delhi is pushing for **electric vehicles (EVs)** and setting up more charging stations.

Mumbai's Clean Air Initiatives

BMC's Clean Air Plan is considering the **introduction of LEZs**. **Ban on polluting vehicles in certain areas** is being discussed. **Increased EV adoption** – Mumbai plans to convert its **BEST bus fleet** to electric.

Bengaluru's Efforts

The **Karnataka Electric Vehicle Policy** aims to reduce pollution by promoting EVs and banning polluting vehicles in certain areas. **Restrictions on heavy vehicles** entering core city zones.

Other Cities

Hyderabad, Chennai, Pune, and Kolkata have introduced measures like **bus electrification, green zones, and congestion charges** to control emissions

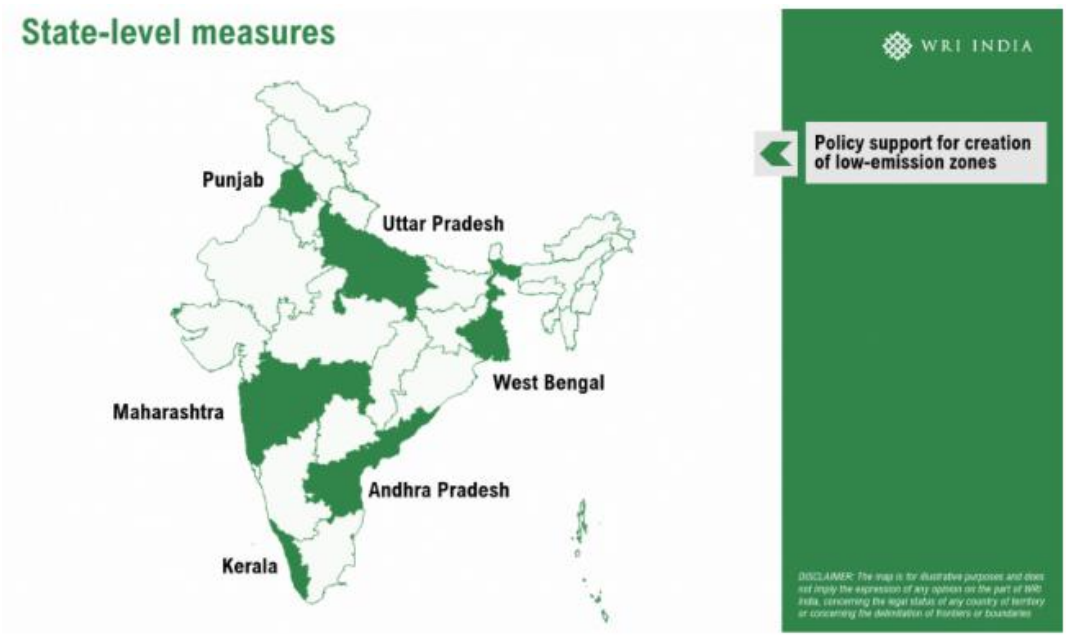
1.6.2 Challenges in Implementing LEZs in India

Traffic Volume & Congestion – High vehicle density makes enforcement difficult. **Lack of Public Transport Alternatives** – Many cities still rely on polluting buses and autos. **Economic Impact** – Small businesses and transport operators may struggle with new vehicle costs. **Enforcement & Monitoring** – No city has a **real-time vehicle emission tracking** system yet.

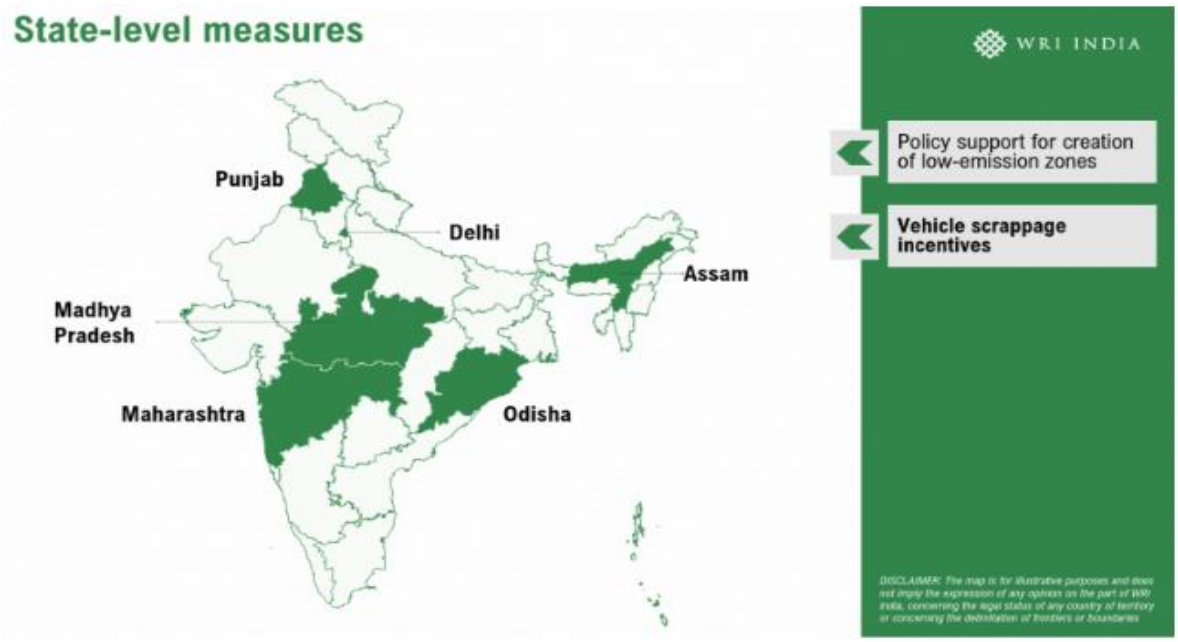
1.6.3 Future of LEZs in India

Pilot LEZ Projects – Some metro cities are exploring dedicated **low-emission corridors**. **Expansion of EV Infrastructure** – More **charging stations and subsidies** for electric vehicles. **Technology-Based Traffic Monitoring** – AI-based **emission tracking & congestion pricing** could be implemented. **Legislative Push for LEZs** – The **National Clean Air Programme (NCAP)** may introduce stricter pollution control zones.

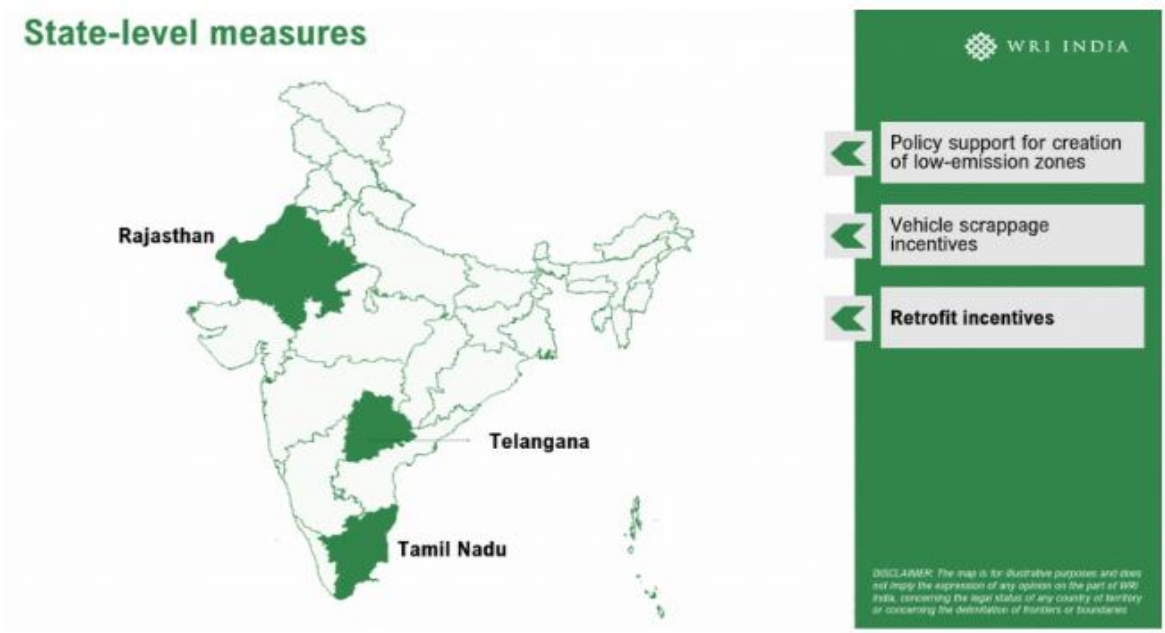
India **does not yet have fully operational Low Emission Zones (LEZs)** like in Europe, but it is moving toward **similar policies through vehicle bans, EV promotion, and pollution control measures**. In the coming years, we might see **formal LEZ implementation** in highly polluted cities like Delhi and Mumbai.



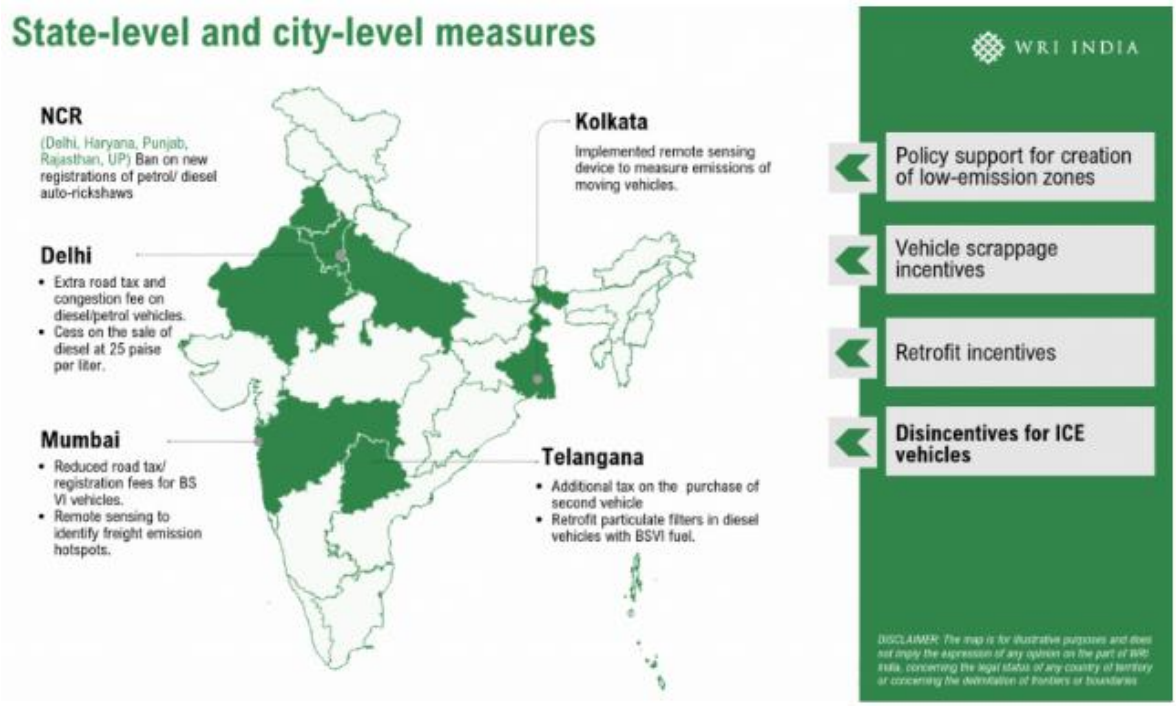
IMG 13 Indian states and cities are rolling out policies to reduce vehicle pollution. Five distinct maps highlight these nationwide initiatives, including designated low-emission areas, incentives for EV adoption, and vehicle retrofitting, penalties for ICE vehicles and four-wheeler restricted zones. Visualization by Kanika Gounder and Safia Zahid/WRI India.



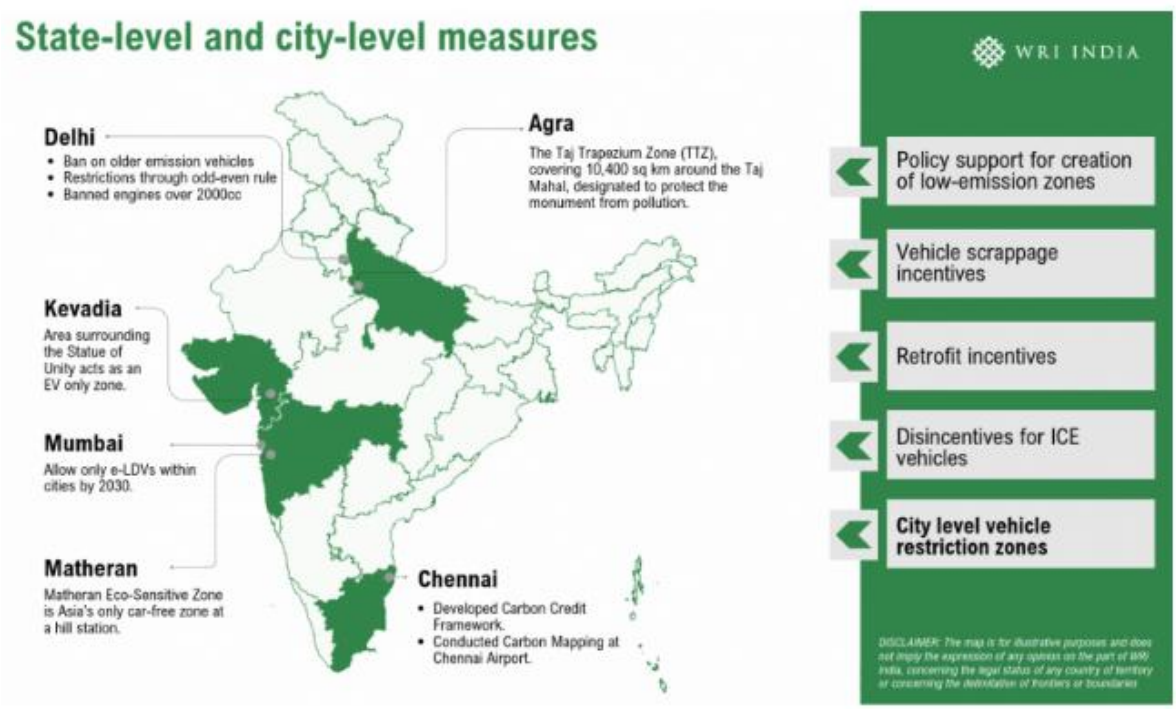
IMG 14 Indian states and cities are rolling out policies to reduce vehicle pollution. Five distinct maps highlight these nationwide initiatives, including designated low-emission areas, incentives for EV adoption, and vehicle retrofitting, penalties for ICE vehicles and four-wheeler restricted zones. Visualization by Kanika Gounder and Safia Zahid/WRI India.



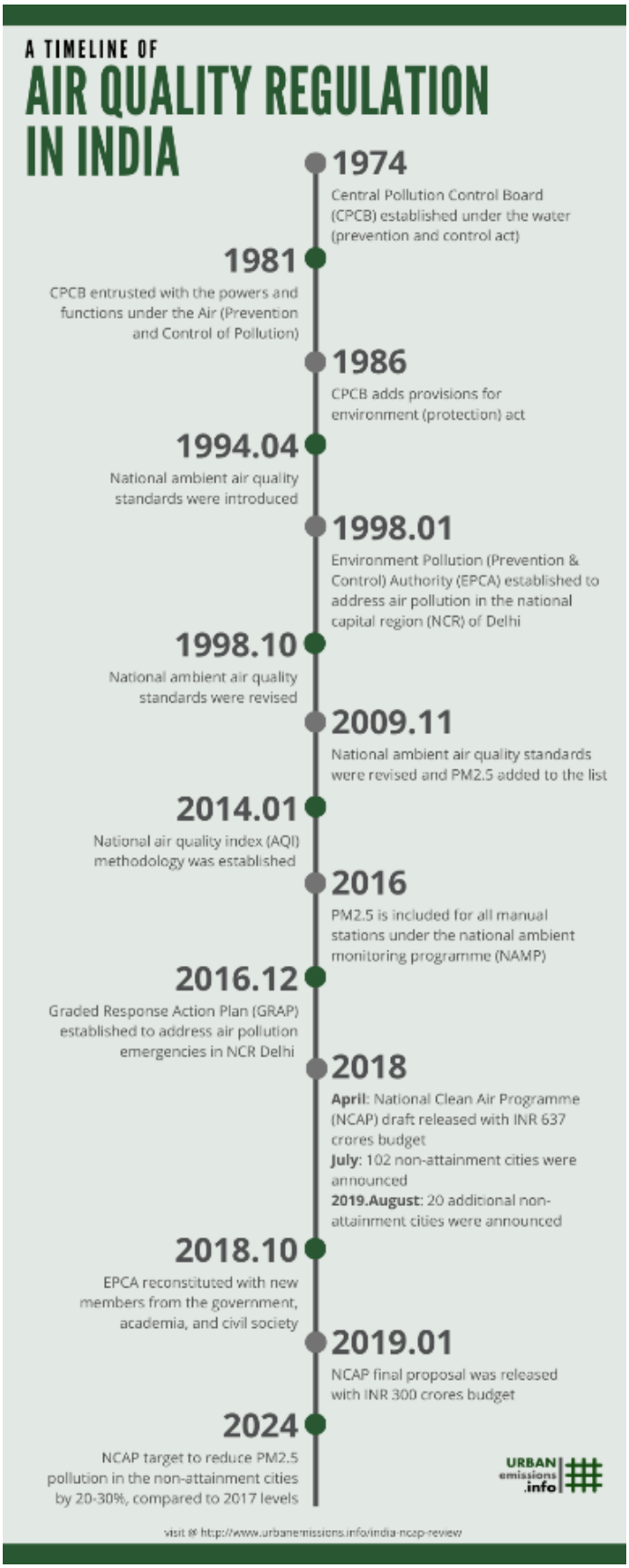
IMG 15 Indian states and cities are rolling out policies to reduce vehicle pollution. Five distinct maps highlight these nationwide initiatives, including designated low-emission areas, incentives for EV adoption, and vehicle retrofitting, penalties for ICE vehicles and four-wheeler restricted zones. Visualization by Kanika Gounder and Safia Zahid/WRI India.



IMG 16 Indian states and cities are rolling out policies to reduce vehicle pollution. Five distinct maps highlight these nationwide initiatives, including designated low-emission areas, incentives for EV adoption, and vehicle retrofitting, penalties for ICE vehicles and four-wheeler restricted zones. Visualization by Kanika Gounder and Safia Zahid/WRI India.



IMG 17 Indian states and cities are rolling out policies to reduce vehicle pollution. Five distinct maps highlight these nationwide initiatives, including designated low-emission areas, incentives for EV adoption, and vehicle retrofitting, penalties for ICE vehicles and four-wheeler restricted zones. Visualization by Kanika Gounder and Safia Zahid/WRI India.



IMG 18 Air Quality Regulation in India- Urban Emissions

Chapter 02

Literature and Case Study

2.1 London, UK – Ultra Low Emission Zone (ULEZ)

2.1.1 Launched

April 2019 (expanded in 2021 & 2023)

2.1.2 Policy

Only vehicles meeting Euro 6 (diesel) and Euro 4 (petrol) standards can enter without a charge.

Penalty for Non-Compliance: £12.50/day for non-compliant cars, £100/day for larger vehicles.

2.1.3 Impact

40% reduction in nitrogen dioxide (NO_2) pollution in the first year.

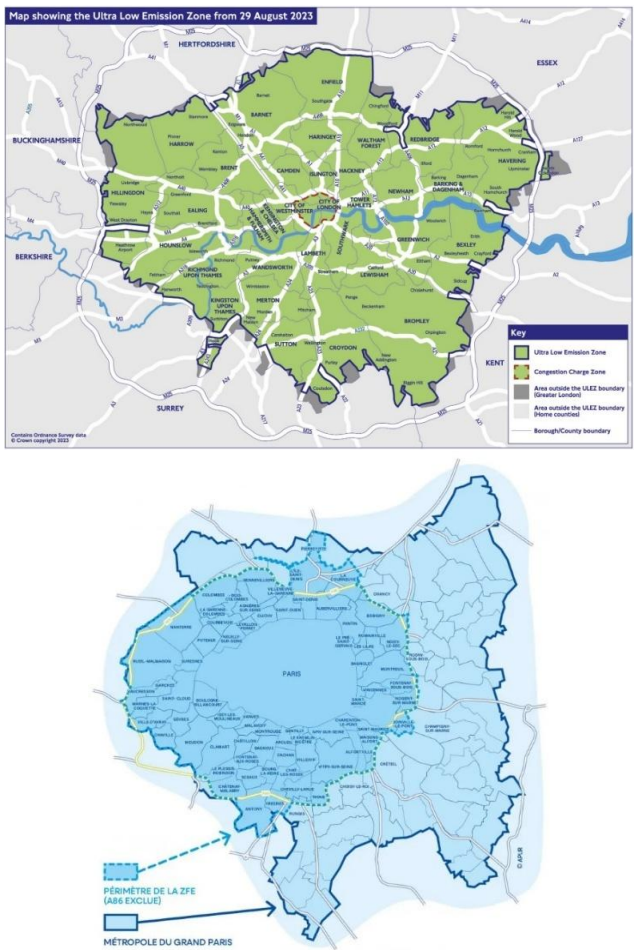
Encouraged EV and hybrid vehicle adoption.

Significant increase in public transport usage.

2.1.4 Challenges

Public backlash over additional cost burden on low-income drivers.

Businesses faced logistics difficulties due to increased operational costs.



IMG 19 Map showing the London and Paris LEZ

2.2 Paris, France – Zone à Faibles Émissions (ZFE)

2.2.1 Launched

2015

2.2.2 Policy

Gradual ban on older diesel vehicles and stringent emission rules. Penalty for Non-Compliance: Fines up to €135 for polluting vehicles.

2.2.3 Impact

15% reduction in PM and NO_2 levels. Shift toward bicycles and public transport. Plans to make Paris a zero-emission zone by 2030.

2.2.4 Challenges

Protests from taxi drivers and small businesses reliant on older vehicles. Tourists unaware of LEZ regulations faced fines.

2.3 Berlin, Germany – Green Emission Zone (Umweltzone)

2.3.1 Launched

2008

2.3.2 Policy

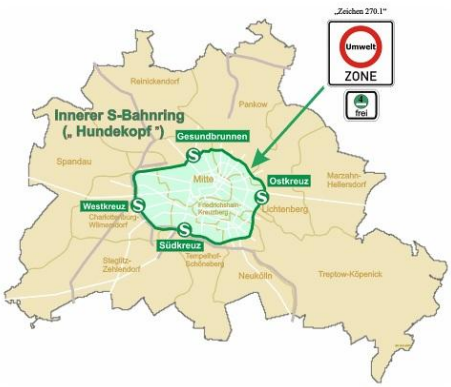
Vehicles need a green sticker (Euro 4/Euro 6 compliant) to enter. Penalty for Non-Compliance: €80 fine.

2.3.3 Impact

Reduced PM10 levels by 20% in the first five years. Increase in eco-friendly vehicle usage.

2.3.4 Challenges

Initial resistance from transport and logistics companies. Difficulty in enforcing the policy across the entire city.



IMG 20 Map showing the Berlin LEZ

2.4 Beijing, China – Low Emission & Zero-Emission Zones

2.4.1 Launched

2008

2.4.2 Policy

Bans on high-emission vehicles and restrictions on diesel trucks.

2.4.3 Additional Measures

Odd-even rule, vehicle rotation bans, and electric vehicle subsidies.

2.4.4 Impact

Significant reduction in smog-related pollution. Beijing saw a 35% drop in PM2.5 levels in the first five years. Massive EV adoption—China is now the largest EV market globally.

2.4.5 Challenges

Difficult enforcement due to Beijing's large population. Expensive EV transition for residents and businesses.

2.5 Milan, Italy – Area C LEZ

2.5.1 Launched

2012

2.5.2 Policy

Entry restrictions on diesel vehicles and congestion charges for others. Penalty for Non-Compliance. €5-15 per entry for non-compliant vehicles.

2.5.3 Impact

30% decrease in traffic congestion. 20% improvement in air quality.

2.5.4 Challenges

Small businesses faced higher logistics costs. Monitoring and fining system needed continuous updates.

2.6 Key Lessons from Global LEZ Case Studies

Strict Emission Standards Are Crucial – Cities with Euro 6 or equivalent norms saw the best results. Public Transport Alternatives Are Necessary – Successful LEZs encouraged public transit usage. Financial Support for Businesses & Low-Income Drivers – Helps reduce economic backlash. Technology-Based Enforcement Is Key – Use of cameras, AI, and sensors improves effectiveness. Gradual Implementation Works Best – Phasing out older vehicles over time is more practical.

2.7 Delhi – Emerging LEZ Policies

Delhi is one of the most polluted cities in the world, with high levels of PM2.5 and NO_2. The city has introduced multiple LEZ-like regulations to reduce vehicle emissions.

2.7.1 Key Measures

Ban on Diesel Vehicles Older than 10 Years & Petrol Vehicles Older than 15 Years. Odd-Even Vehicle Rule – Restricts private vehicles based on license plate numbers on high-pollution days. Restricted Entry of Polluting Trucks – Trucks not meeting BS-VI standards are banned from entering the city during winter. Electric Bus & Public Transport Expansion – Delhi is rapidly electrifying its bus fleet. Green War Room & Smog Towers – Technology-based monitoring of pollution levels.

2.7.2 Impact

Reduction in peak pollution levels during the Odd-Even Rule enforcement. Increase in EV adoption, especially in public transport and two-wheelers. Reduced truck emissions due to strict entry restrictions.

2.7.3 Challenges

Lack of consistent enforcement – The Odd-Even rule is temporary and not a permanent LEZ. Public transport gaps – The metro and bus networks are improving but need further expansion. Economic impact – Truck restrictions impact supply chains and logistics.

2.8 Mumbai – Clean Air Initiatives & Future LEZ Plans

Mumbai faces severe pollution from diesel vehicles, construction dust, and industrial emissions. The city has begun discussing a formal LEZ plan to reduce emissions in key areas.

2.8.1 Key Measures

Green Tax on Older Vehicles – Diesel and petrol vehicles older than 15 years are taxed higher. Transition to Electric BEST Buses – Mumbai is electrifying its public transport fleet. Ban on Polluting Vehicles in Certain Zones – Some areas may be restricted for high-emission vehicles.

2.8.2 Impact

Reduced diesel bus emissions as BEST (Mumbai's bus network) shifts to electric. Better air quality in restricted zones where heavy vehicles is controlled.

2.8.3 Challenges:

Still in the planning stage – LEZ implementation has not been formalized. Traffic congestion issues – Managing enforcement in a dense city is difficult.

2.9 Bengaluru – Towards a Green Transport Model

Bengaluru struggles with high vehicle density and severe traffic congestion, leading to high NO_2 and CO_2 emissions. The city is promoting EVs and emission-based traffic regulations.

2.9.1 Key Measures

Ban on Heavy-Duty Diesel Vehicles in Core Areas. Karnataka Electric Vehicle Policy – Encourages EV purchases, charging stations, and clean transport. Potential Congestion Pricing – Plans to charge polluting vehicles in high-traffic areas.

2.9.2 Impact

Increased EV adoption, especially among two-wheelers and public transport.
Lower diesel truck emissions in core city zones.

2.9.3 Challenges

Enforcement issues – Monitoring emissions in a high-traffic city is complex. Charging infrastructure needs improvement – Many areas still lack EV chargers.

2.10 Hyderabad – Green Transport Transition

Hyderabad is one of India's fastest-growing metro cities, facing rising pollution due to vehicle growth. The city is pushing for EVs and public transport electrification.

2.10.1 Key Measures

Hyderabad Metro Expansion – To reduce reliance on personal vehicles Emission-Based Vehicle Restrictions Considered. Electric Bus Fleet & Charging Stations Installation.

2.10.2 Impact

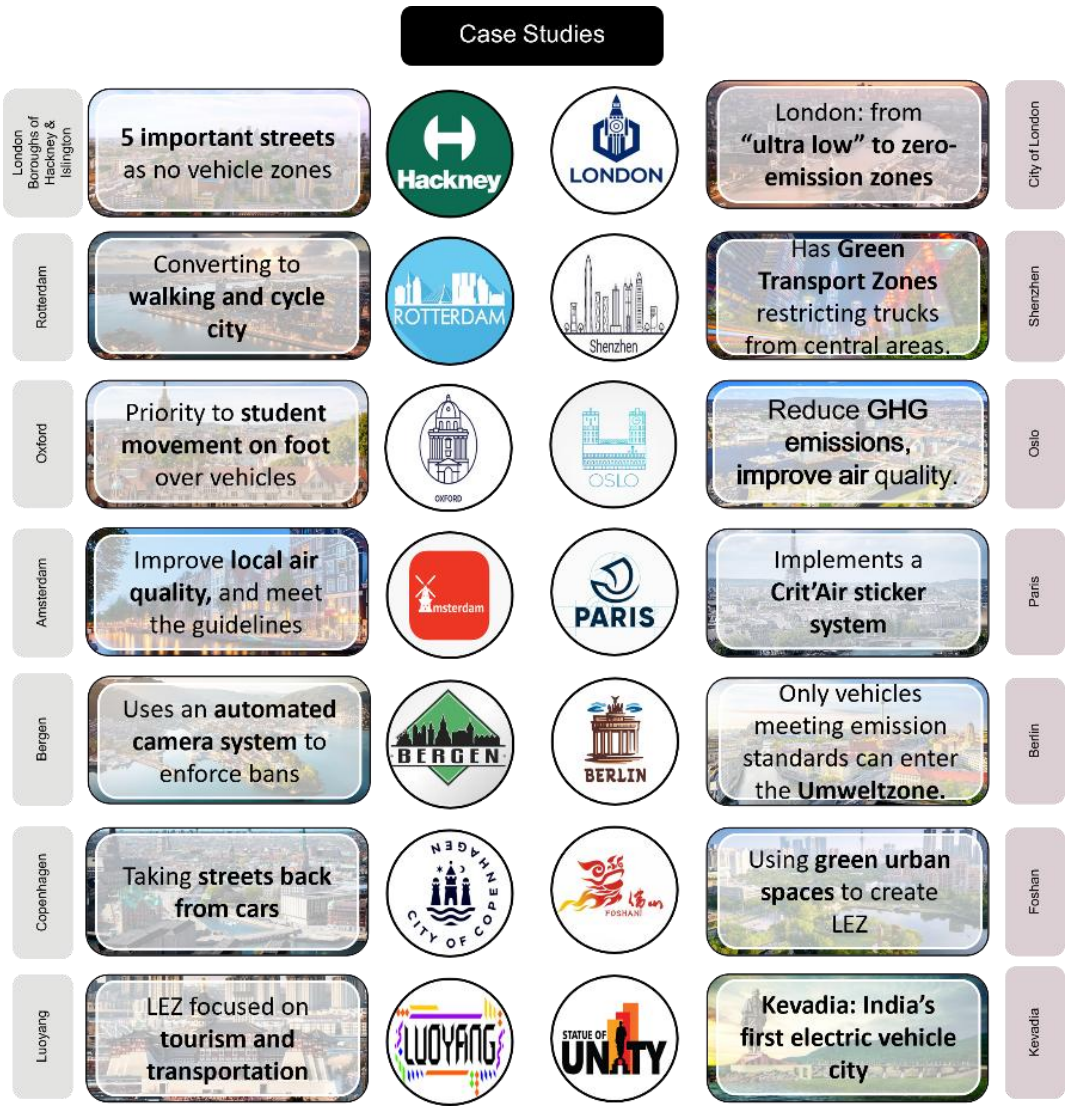
Lower emissions from public transport. Reduced fuel dependency, encouraging a shift to clean mobility.

2.10.3 Challenges

Lack of strict vehicle bans or congestion pricing. Still in the early stages of implementing an LEZ framework.

Jurisdiction	Type	Implementation Date	Operation Scheme	Vehicles Affected	Area Affected	Upgraded from existing LEZs or not
Implemented Schemes						
London Boroughs of Hackney & Islington	Near ZEZ	September 2018	Road Access Restriction	All	Five Streets	No
City of London	Near ZEZ	March 2020	Road Access Restriction	All	One Street	No
Rotterdam	ZEZ-F	January 2015	Road Access Restriction	Heavy Duty Trucks >3.5 Tons	One Street	No
Shenzhen	No	July 2018	Road Access Restriction	Light Duty Trucks <4.5 Tons	22 km^2	No
Planned Schemes						
Oxford	ZEZ	Spring 2022	Charging Scheme	All	Eight Streets 1.6 km^2	No
Oslo	ZEZ	2026	Road Access Restriction	All	13 km^2	No
Amsterdam	ZEZ	2030	Road Access Restriction	All	City Wide	Yes
Paris	ZEZ	2030	Road Access Restriction	All	Greater Paris Metropolitan	Yes
Bergen	ZEZ	2030	Unspecified	Unspecified	City Centre	Unspecified
Berlin	ZEZ	Unspecified	Unspecified	Unspecified	Urban area within the S-Bahn Ring	Yes
Copenhagen	ZEZ-F (Pilot)	2025	Unspecified	Delivery Vans and Trucks	Medieval City	Unspecified
Foshan	Near ZEZ-F	Unspecified	Road Access Restriction	All	Unspecified	No
Luoyang	Near ZEZ-F	April 2023	Road Access Restriction	Delivery Vans and Trucks	Urban Centre	No
Kevadia	ZEZ	Unspecified	Road Access Restriction	Unspecified	Unspecified	No

A global overview of zero-emission zones in cities and their development progress - Hongyang Cui, Pramoda Gode, and Sandra Wappelhorst – August 2021 - 2021 INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION



IMG 21 Case Study Inferences

Chapter 03

Site Description

3.1 Vijayawada

3.1.1 About

Vijayawada, often called the "Business Capital of Andhra Pradesh," is one of the state's most significant cities. It is known for its economic importance, transportation hub, cultural heritage, and political influence.

3.1.2 Geographical & Strategic Importance

Located on the banks of the **Krishna River**, Vijayawada is surrounded by the **Eastern Ghats**, making it a scenic yet strategically important city. It serves as a **gateway to Andhra Pradesh**, connecting coastal and Rayalaseema regions. The city's **central location** makes it a crucial transport hub for **rail, road, and air networks** in South India.

3.1.3 Economic & Industrial Hub

Trade & Commerce: A major centre for **automobile, textile, and consumer goods trade** in Andhra Pradesh. **Agriculture:** Surrounded by fertile land, the city is known for **mangoes, sugarcane, and rice cultivation**. **Industries:** Hosts **industrial estates**, and is emerging in **IT and manufacturing sectors**. **Real Estate Boom:** Due to its proximity to Amaravati (the proposed capital), Vijayawada has seen rapid urbanization and infrastructure development.

3.1.4 Transportation & Connectivity

Railway Junction: One of the busiest in India, Vijayawada Junction connects major cities across the country. **Road Network:** Lies on **NH-16 (Chennai-Kolkata Highway)** and NH-65, making it a key road transport hub. **Airport: Vijayawada International Airport (Gannavaram)** connects it to major cities and is expanding its international services.

3.1.5 Cultural & Historical Significance

Kanaka Durga Temple: A major pilgrimage site dedicated to Goddess Durga, attracting thousands of devotees. **Undavalli Caves:** Rock-cut caves showcasing ancient Buddhist and Hindu architecture. **Prakasam Barrage:** A landmark structure regulating Krishna River's flow and adding to the city's beauty. **Gandhi Hill:** A memorial with a library and planetarium, honouring Mahatma Gandhi.

3.1.6 Political & Administrative Importance

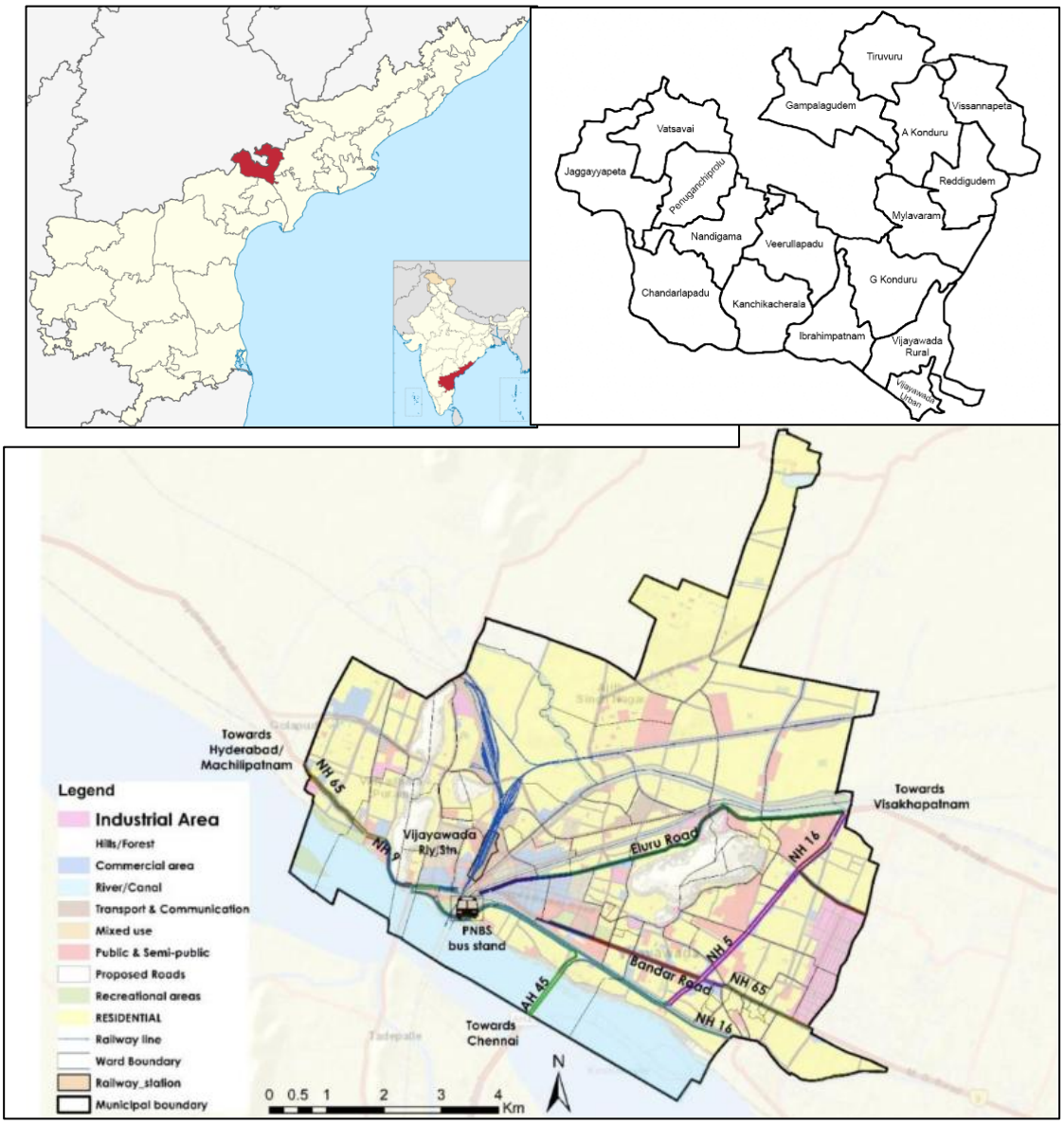
It was a **temporary capital** of Andhra Pradesh after bifurcation in 2014. Part of the **Andhra Pradesh Capital Region Development Authority (APCRDA)**. A crucial centre for political activities and governance in the state

3.1.7 Education & Healthcare

Home to top institutions like **V R Siddhartha Engineering College, KL University, NTR University of Health Sciences, and SRM University**. Several **multi-specialty hospitals** make it a medical hub in the region.

3.1.8 Challenges & Future Growth

Urbanization & Traffic Congestion: As the city expands, road infrastructure and transport systems need upgrades. **Water & Flood Management:** Being on the Krishna River, the city faces seasonal flooding risks. **Smart City Initiatives:** Part of India's **Smart City Mission**, focusing on infrastructure, green spaces, and digitization.



IMG 22 Location Map of Vijayawada

3.2 One Town

3.2.1 Historical & Cultural Importance

Home to ancient temples, old markets, and traditional architecture.
Important temples:

- Kanaka Durga Temple (on Indrakeeladri Hill, near One Town)
- Subramanya Swamy Temple
- Malleswara Swamy Temple

Streets still reflect a heritage vibe with narrow lanes and old-style houses.

3.2.2 Commercial Hub

Bustling markets for gold, textiles, electronics, groceries, etc. Known for wholesale trading and traditional business setups.

3.2.3 Densely Populated Area

High population density with old residential colonies. Some areas still lack proper infrastructure or planned development

3.2.4 Traffic & Congestion

Narrow roads and overcrowding make traffic management a challenge. Frequent traffic jams during peak hours or festive seasons

3.2.5 Urban Challenges

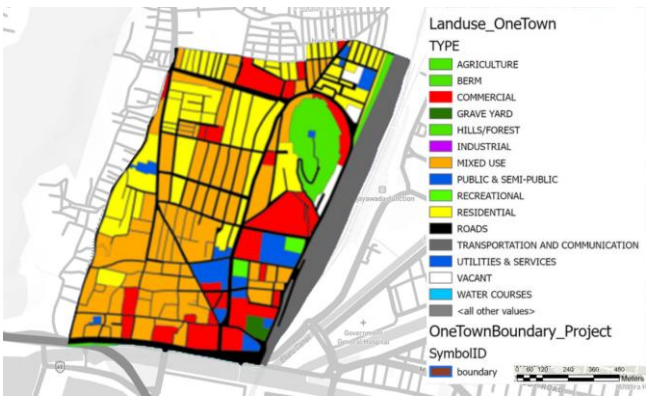
Faces issues like:

- Poor drainage in some parts
- Waste disposal problems
- Air and noise pollution due to congested roads

3.2.6 Connectivity

Well-connected by:

- Road (city buses, autos)
- Close to **Vijayawada Railway Station**
- Also has access to **Durga Flyover** and arterial roads



Area:
.9 km^2
Population:
41,236
Density:
45.817.77/km^2
Ward Numbers:
37, 52, 53

IMG 23 One Town Map

AMRUT Centre
of Urban Planning
for Capacity Building

Atal Mission for Rejuvenation and Urban Transformation

AMRUT Centre of Urban Planning
for Capacity Building
A-CUPCB-SPAV

Chapter

04

Objectives and Methodology

4.1 Objectives

4.1.1 General

The primary objectives of low-emission zones (LEZs) are to improve air quality and reduce environmental pollution, ultimately protecting public health, by restricting or banning high-polluting vehicles from designated areas.

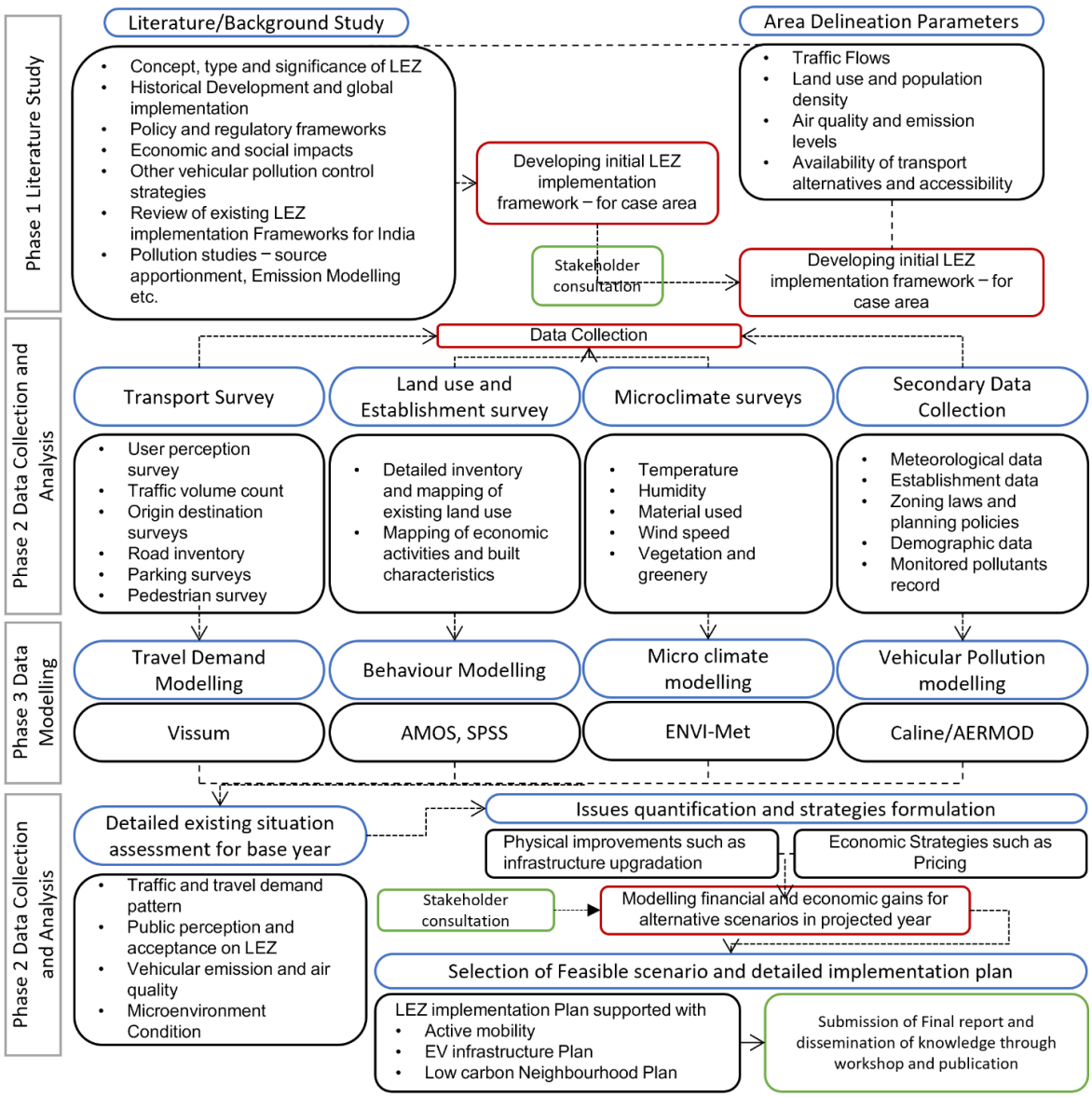
Here's a more detailed breakdown:

- **Improved Air Quality:**
  LEZs aim to reduce harmful pollutants like particulate matter (PM10) and nitrogen dioxide (NO2) by limiting the presence of older, more polluting vehicles.
- **Reduced Environmental Pollution:**
  By focusing on cleaner vehicles and transport modes, LEZs contribute to a reduction in greenhouse gas emissions and other forms of environmental damage.
- **Enhanced Public Health:**
  Cleaner air leads to improved health outcomes, particularly for vulnerable populations like children and the elderly, who are more susceptible to respiratory and cardiovascular problems caused by air pollution.
- **Sustainable Mobility:**
  LEZs encourage the use of sustainable transportation alternatives like public transport, cycling, and walking, promoting a shift away from reliance on fossil fuels.
- **Traffic Congestion Reduction:**
  In some cases, LEZs are combined with congestion charges to further reduce traffic volume and improve traffic flow within the designated area.
- **Public Space Transformation:**
  LEZs can lead to a transformation of public spaces, making them more pedestrian and cyclist friendly, ultimately creating safer and more enjoyable urban environments.

4.1.2 Local to the Project

- Establishment of clearly delineated LEZ zones.
- Active mobility plan for delineated LEZ.
- Public participation with locals and all stakeholders.
- Outline a phased implementation plan.

4.2 Methodology



IMG 24 Methodology

AMRUT Centre
of Urban Planning
for Capacity Building

Atal Mission for Rejuvenation and Urban Transformation

AMRUT Centre of Urban Planning
for Capacity Building
A-CUPCB-SPAV

Chapter 05

Data Description

5.1 LEZ

Planning a Low Emission Zone (LEZ) requires comprehensive transportation data to assess current conditions, identify emission sources, and develop effective policies. The key data components include:

5.1.1 Traffic and Vehicle Data

- **Traffic Volume** (number of vehicles per hour/day)
- **Vehicle Classification** (cars, buses, trucks, two-wheelers, electric vehicles)
- **Vehicle Age and Emission Standard** (Euro norms, BS standards, fuel type)
- **Vehicle Speed and Idling Time** (congestion impact on emissions)
- **Peak and Off-Peak Traffic Trends**

5.1.2 Air Quality and Emission Data

- **Current Pollution Levels** (PM2.5, PM10, NOx, CO, SO2)
- **Emission Contribution by Vehicle Type**
- **Historical Air Quality Trends** (seasonal variations, pollution hotspots)
- **Weather Conditions** (wind speed, temperature affecting pollution dispersion)

5.1.3 Public Transport and Mobility Data

- **Public Transport Availability** (bus, metro, shared mobility options)
- **Ridership Data** (passenger counts, peak usage times)
- **Service Frequency and Coverage**
- **Intermodal Connectivity** (bus-to-metro links, last-mile options)

5.1.4 Parking and Road Infrastructure Data

- **Parking Demand and Supply** (on-street, off-street parking)
- **Road Capacity and Condition**
- **Dedicated Lanes for Public Transport and Non-Motorized Transport (NMT)**
- **Traffic Bottlenecks and High Congestion Zones**

5.1.5 Travel Behaviour and Demand Data

- **Commuter Travel Patterns** (origin-destination data, trip lengths)
- **Mode Share** (private vehicles, public transport, cycling, walking)
- **Trip Purpose Distribution** (work, education, leisure, shopping)

- **Elasticity to Policy Changes** (willingness to shift to low-emission transport)

5.1.6 Enforcement and Compliance Data

- **Existing Regulations on Emissions and Vehicle Entry Restrictions**
- **License Plate Data and ANPR (Automatic Number Plate Recognition) Records**
- **Public Awareness and Compliance Levels**
- **Penalty and Violation Records**

5.1.7 Alternative Mobility and Infrastructure Readiness

- **Electric Vehicle Charging Infrastructure**
- **Bicycle Lanes and Pedestrian Infrastructure**
- **Carpooling and Ride-Sharing Trends**
- **Low-Emission Freight Logistics**

5.2 Pollution

5.2.1 Air Pollution

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Household combustion devices, motor vehicles, industrial facilities and forest fires are common sources of air pollution. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide. Outdoor and indoor air pollution cause respiratory and other diseases and are important sources of morbidity and mortality.

Air pollution is made up of many components, including particulate matter, carbon monoxide, ozone, sulphur oxides, nitrogen oxides, and volatile organic compounds.

Particulate matter

- Small airborne particles that can come from natural and manmade sources
- Can enter homes through cracks in walls

Carbon monoxide

- A colourless, odourless, and tasteless gas that's poisonous
- Results from incomplete burning of natural gas and other carbon-containing materials
- Displaces oxygen in the blood, which can harm the heart, brain, and other organs

Ozone

- A primary component of air pollution in large cities
- Damage caused by exposure depends on how much is inhaled

Sulphur dioxide

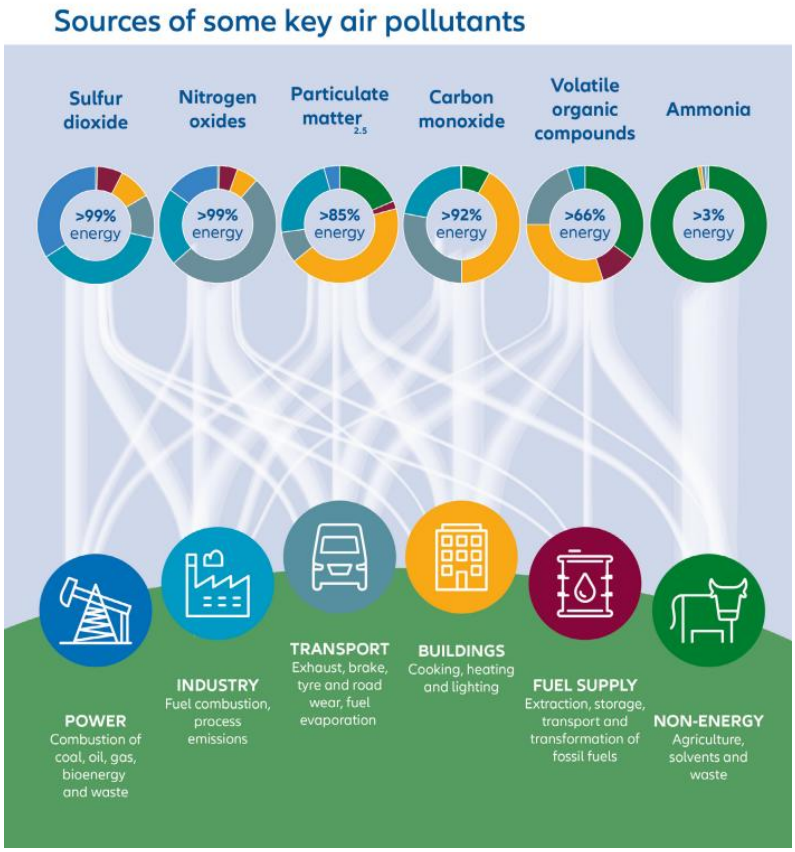
- Created by power plants and motor vehicles that burn sulphur-containing fuels, like coal and diesel
- Can react in the atmosphere to form fine particles
- A health risk for young children and people with asthma

Nitrogen oxides

- A major source of air pollution
- Contributes to acid rain, ozone depletion, and photochemical smog
- Responsible for the reddish-brown cloud called smog

Volatile organic compounds

- Organic materials that are highly volatile at room temperature
- Formaldehyde is the most common type of VOC



IMG 25 International Energy Agency 2016

5.3 Noise pollution

Noise Pollution and Its Data Components

Noise pollution refers to excessive, disturbing sounds that negatively impact human health, well-being, and the environment. It primarily originates from traffic, industrial activities, construction, and urbanization. To assess and manage noise pollution, various data components are considered:

5.3.1 Source Characteristics

- Type of Source (e.g., traffic, industrial, commercial, residential)
- Sound Intensity (measured in decibels, dB)
- Frequency and Duration (continuous or intermittent noise)
- Time of Occurrence (daytime, nighttime)

5.3 2 Environmental & Spatial Data

- Location of Measurement (urban, suburban, industrial, residential zones)
- Distance from Source (proximity to roads, factories, airports)
- Land Use Characteristics (commercial, residential, mixed-use)
- Topography and Obstacles (hills, buildings, vegetation influencing sound propagation)

5.3.3 Human Exposure & Impact Data

- Noise Levels in Residential Areas (dB readings near homes)
- Workplace Noise Exposure (industrial zones, factories)
- Health Impacts (sleep disturbance, hearing loss, stress, cardiovascular issues)
- Public Complaints and Perception Surveys (community feedback on noise disturbances)

5.3.4 Traffic & Transportation Data

- Vehicle Types (heavy trucks, buses, two-wheelers, cars)
- Traffic Volume (vehicles per hour)
- Speed & Acceleration (impacting noise levels)
- Road Condition & Design (pavement quality, flyovers, sound barriers)

5.3.5 Regulatory & Compliance Data

- Permissible Noise Levels (as per environmental regulations)
- Policy & Control Measures (zoning laws, noise barriers, restrictions on honking)
- Monitoring & Enforcement Data (compliance checks, penalties for violations)

5.3.6 Noise Reduction Measures & Solutions

- Use of Sound Barriers (walls, trees, noise-absorbing materials)
- Traffic Management Strategies (speed limits, vehicle bans in sensitive zones)
- Promotion of Low-Noise Technology (electric vehicles, silent machinery)
- Public Awareness & Education Campaigns

5.4 Climate

Climate Data for Low Emission Zone (LEZ) Planning

Climate data is crucial for understanding environmental conditions and designing an effective **Low Emission Zone (LEZ)**. It helps in assessing the impact of emissions, predicting pollution dispersion, and implementing strategies to mitigate climate-related challenges.

5.4.1 Temperature and Atmospheric Conditions

- **Average, Minimum, and Maximum Temperatures** (daily, seasonal, annual trends)
- **Heat Island Effect** (urban areas retaining heat, affecting air quality)
- **Temperature Inversions** (trapping pollutants near the ground)

5.4.2 Wind and Airflow Patterns

- **Wind Speed and Direction** (determines how pollutants disperse)
- **Seasonal Wind Variations** (affecting pollution buildup or clearance)
- **Local Wind Circulation Effects** (e.g., sea breezes, valley winds)

5.4.3 Humidity and Precipitation

- **Relative Humidity Levels** (affecting particulate matter concentration)
- **Rainfall Patterns** (helps wash away pollutants, seasonal variations)
- **Fog and Smog Frequency** (worsens air pollution in winter)

5.4.4 Solar Radiation and UV Index

- **Solar Exposure Levels** (affects photochemical smog formation)
- **UV Index Data** (impact on health and atmospheric chemistry)

5.4.5 Land Cover and Vegetation Data

- **Tree Cover and Green Spaces** (natural pollution absorption)
- **Soil and Land Use Patterns** (urban vs. rural climate impacts)
- **Deforestation and Land Conversion Trends**

5.5 Transportation, Traffic and vehicle data

5.5.1 Public Transportation Data

Public Transportation Data for Low Emission Zone (LEZ) Planning

Public transportation data is essential for designing an effective **Low Emission Zone (LEZ)** by providing alternatives to private vehicles, reducing congestion, and lowering emissions. The following key data components help in assessing the current public transport system and identifying necessary improvements:

5.5.2 Public Transport Infrastructure Data

- **Types of Public Transport Available** (buses, metro, trams, shared mobility, auto-rickshaws)
- **Route Coverage and Network Connectivity** (extent of service, underserved areas)
- **Bus Stops and Metro Stations Distribution** (accessibility and placement)
- **Infrastructure Condition and Maintenance Records**

5.5.3 Ridership and Demand Data

- **Total Daily and Hourly Passenger Count** (peak vs. off-peak usage)
- **Mode-wise Passenger Share** (bus, metro, suburban rail, taxis, etc.)
- **Passenger Load Factor** (occupancy rate, overcrowding analysis)
- **Ticketing and Fare Collection Data** (contactless payments, ticket validation records)

5.5.3 Service Efficiency and Reliability Data

- **Frequency of Service** (buses per hour, metro train intervals)
- **Punctuality and On-Time Performance** (delays, breakdowns, schedule adherence)
- **Average Waiting Time at Stops/Stations**
- **Trip Duration and Travel Time Variability**

5.5.4 Accessibility and User Experience Data

- **First-Mile/Last-Mile Connectivity** (availability of feeder buses, cycle-sharing, pedestrian access)
- **Barrier-Free Access for Persons with Disabilities**
- **Availability of Amenities** (seating, lighting, safety measures)
- **Public Perception and Satisfaction Surveys**

5.5.5 Emissions and Energy Efficiency Data

- **Public Transport Fleet Composition** (diesel, CNG, electric, hybrid vehicles)
- **Fuel Consumption and Emissions Data** (CO_2, NOx, PM emissions per vehicle)
- **Electric Bus and Metro Expansion Plans**
- **Vehicle Age and Compliance with Emission Standards**

5.5.6 Operational and Financial Data

- **Operating Costs and Revenue Generation**
- **Subsidies and Government Support**
- **Public-Private Partnership (PPP) Investments**
- **Future Expansion Plans and Budget Allocation**

5.5.7 Integration with LEZ Policies

- **Effectiveness of Public Transport in Reducing Private Vehicle Use**
- **Traffic Diversion Strategies to LEZ-Compatible Transport Modes**
- **Parking and Congestion Pricing Data** (to encourage public transport use)
- **Policy Incentives for Sustainable Transport Adoption**

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Chapter 06

Survey and Field Visits

6.1 Pilot Surveys

6.1.1 Household Survey One Town Sample size 300-320

A Household Survey collects data on various aspects of households, such as demographics, income, living conditions, transportation habits, environmental concerns, and public perceptions. A similar household survey was conducted for Vijayawada to assess the following characteristics of the One Town Area.

General

- Name of the respondent
- Date
- Address

Demographic Detail

- Sex
- Age
- Availability of License
- Education level
- Occupation
- Income
- Expenditure on Transportation
- Vehicle Owner ship
    - Type
    - Age
    - Fuel
    - Mileage

Trip Information

- Purpose
- Frequency
- Trip Start Time
- Mode
- Link Trips
- Origin
- Destination
- Distance
- Cost
- Travel Time

Public transport survey for users (Connected with Trip information)

- Average Waiting Time
- Comfort
- Service Reliability
- Security
- Punctuality

The household survey conducted in Vijayawada's One Town Area provided valuable insights into the demographic, economic, and transportation characteristics of the residents. The data collected on income levels, vehicle ownership, and expenditure on transportation highlight the economic profile of the population and their mobility patterns. Additionally, trip information such as travel purpose, mode choice, and frequency of travel helps in understanding the commuting behaviour of residents.

The public transport survey further revealed key factors affecting user satisfaction, including waiting times, comfort, service reliability, security, and punctuality. These findings can aid in identifying gaps in the existing transportation infrastructure and guide future planning efforts to improve mobility solutions in the region. Overall, the survey results serve as a foundation for developing efficient and sustainable urban transport strategies tailored to the needs of One Town Area residents.

Household – Mobility survey

Name of Enumerator:	Day/Date:
Name of the Respondent:	TAZ-Location No. .....Street Name.....House no.....

DEMOGRAPHIC DETAILS								Vehicle Ownership			
S. No	SEX	AGE	DRIVING LICENSE	EDUCATION	OCCUPATION	INCOME	EXPENDITURE ON TRANSPORTATION (MONTHLY)	Type	Age	Fuel	Mile Age
1											
2											
3											
4											
5											
6											
7											

TRIP INFORMATION:											
S. No	Trip no.	Purpose	Frequency	Time of the day	Mode	Link trips	Origin	Destination	Distance	Cost	Travel Time
1											
2											
3											
4											
5											
6											
7											
8											
9											

IF USER USES PT THEN TRIP INFORMATION														
S.No of above PT trip	Avg. Waiting time	Comfort			Service reliability			SECURITY			PUNCTUALITY			
		Good	Ok	Bad	Good	Ok	Bad	Good	Ok	Bad	Good	Ok		Bad
		Good	Ok	Bad	Good	Ok	Bad	Good	Ok	Bad	Good	Ok		Bad
		Good	Ok	Bad	Good	Ok	Bad	Good	Ok	Bad	Good	Ok		Bad
Willingness to shift to public transport: Yes/No														
Do you think it is safe and convenient to walk on roads of Pondicherry city?														
Are you satisfied with the way you travel in the city?														
If No, What do you think needs to be improved?														

CODE SHEET				
Code	Education	Occupation	Purpose of Travel	Mode of Transport
1	No Formal Education	Unemployed	Work/Employment	Walking
2	Primary (Up to Class 5)	Student	Education/School/College	Bicycle
3	Secondary (Class 6–10)	Homemaker	Business/Official Visit	Two-Wheeler (Motorcycle/Scooter)
4	Higher Secondary (Class 11–12)	Self-employed/Business	Shopping/Personal Errands	Auto-rickshaw
5	Diploma/Technical Education	Government Employee	Medical/Healthcare	Public Bus
6	Undergraduate Degree	Private Sector Employee	Social/Religious/Cultural Visit	Metro/Local Train
7	Postgraduate Degree	Daily Wage Worker/Labourer	Tourism/Leisure/Recreation	Private Car
8	Doctorate (Ph.D.)	Retired	Returning Home	Shared Mobility (Cab/Taxi/Ola/Uber)
9				Other

Household Survey Format

6.2 Perception Survey Sample Size 300-320

A general Survey on the idea of Low emission Zone in the One Town, Vijayawada was held to get an understanding of the general consensus on the low emission zone initiative among the residents and commercial establishment owners in the area.

The focus of the survey was on the following:

- Acceptability
- Social norm
- Perceived behavioural control
- Attitude
- Personal norm
- Positive affect
- Negative affect
- Perceived benefits
- Perceived costs
- Perceived risks
- Outcome Efficiency
- Trust
- Procedural Fairness
- Distributive Fairness
- Problem perception

The perception survey on the Low Emission Zone (LEZ) in One Town, Vijayawada, provided crucial insights into public awareness, acceptance, and concerns regarding the initiative. The responses highlighted varying levels of understanding about the environmental and health benefits of reducing vehicular emissions in the area. While many residents and commuters acknowledged the need for improved air quality and sustainable transportation, concerns were raised regarding potential impacts on mobility, economic activities, and enforcement challenges.

IMG 26 Household Surveys

The survey results suggest that effective implementation of the LEZ requires targeted awareness campaigns, incentives for adopting cleaner transportation modes, and improved public transport infrastructure. Addressing stakeholder concerns through participatory planning and transparent policies will be key to ensuring long-term success. Overall, the findings emphasize the importance of balancing environmental sustainability with the socio-economic needs of the local community.

Code: Likert Scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree 5 = Strongly Agree)

Category	Statement	1	2	3	4	5
Acceptability	Overall, I would support the introduction of Low Emission Zones in my nearest urban area					
	I think the implementation of Low Emission Zones is an acceptable policy					
	I'd vote in favour of Low Emission Zones in a local referendum					
Social Norm	I think people are becoming much more concerned about air quality					
	My friends and family are worried about the level of air pollution					
Perceived Behavioural Control	It would be straightforward for me to adapt my travel behaviour around a Low Emission Zone					
	I don't need a car to get to the city/town centre, so a Low Emission Zone is unlikely to affect me					
	The implementation of a Low Emission Zone would make my travel arrangements much more difficult (R)					
Attitude	Low Emission Zones should not be considered by policymakers (R)					
	Investing in Low Emission Zones would be a waste of public funding (R)					
Personal Norm	The idea of Low Emission Zones fits in well with my values					
	Improving air quality is a policy which is personally important to me					
Positive Affect	Establishing Low Emission Zones would make me proud					
	I would be excited by the prospect of Low Emission Zones					
	I'd be glad to see Low Emission Zones introduced					
Negative Affect	The introduction of Low Emission Zones would annoy me					
	I think the regulations surrounding Low Emission Zones would cause me frustration					
	I would be disappointed if Low Emission Zones were introduced					
Perceived Benefits	The health of citizens would be better if Low Emission Zones are introduced					
	Walking within a Low Emission Zone would be a more pleasant experience					
Perceived Costs	The public costs of implementing and operating Low Emission Zones would be huge					
	Implementing Low Emission Zones would reduce economic prosperity					
Perceived Risks	Low Emission Zones would just relocate highly polluting vehicles to other areas					
	People will find ways around Low Emission Zone regulations					
	Introducing Low Emission Zones would likely generate negative unintended consequences					
Outcome Efficacy	Low Emission Zones would not be effective at lowering the levels of local air pollution (R)					
	There are better ways to improve air quality than introducing Low Emission Zones (R)					
Trust	I am confident that the Government would introduce Low Emission Zones correctly					
	I trust that Low Emission Zone regulations would be developed and implemented effectively					
	I think the Government would make a mess of introducing Low Emission Zones (R)					
Procedural Fairness	The government would be right to consider restricting the use of polluting cars in towns/cities					
	Low Emission Zones would be an appropriate measure to improve local air quality					
	The types of cars restricted by a Low Emission Zone would be selected carefully by the Government					
Distributive Fairness	While Low Emission Zones may be good for some people, they would significantly hinder other people (R)					
	I think Low Emission Zones would have unfair impacts on some people (R)					
	Low Emission Zones would penalize people who are already in vulnerable positions (R)					
Problem Perception	Car use is having a severe impact on people's health and well-being					
	I am very concerned about the level of air pollution					
	I do not think there is a big problem with air quality (R)					

Perception Survey on Low Emission Zone

IMG 27 Low Emission Zone perception Survey

6.3 Traffic Survey

Traffic Survey for Low Emission Zone (LEZ) Planning

A **traffic survey** is a critical component in the planning and implementation of a **Low Emission Zone (LEZ)**. It helps in understanding traffic patterns, vehicle emissions, congestion levels, and public transport alternatives to design an effective LEZ strategy.

6.3.1 Objectives of a Traffic Survey for LEZ

- **Assess Traffic Flow and Volume** to determine the impact of vehicle restrictions.
- **Identify High-Emission Vehicles** entering the LEZ.
- **Analyse Travel Behaviour and Modal Share** to encourage sustainable mobility.
- **Evaluate Congestion and Road Usage Patterns** for better traffic management.
- **Measure Public Transport Efficiency** to ensure alternatives are viable.

6.3.2 Types of Traffic Surveys for LEZ

- **Classified Volume Count Survey**
  - Counts the number of vehicles entering and exiting the proposed LEZ.
  - Categorizes vehicles (cars, buses, trucks, motorcycles, electric vehicles, etc.).
  - Identifies the proportion of high-emission vs. low-emission vehicles.
- **Origin-Destination (O-D) Survey**
  - Tracks where vehicles are coming from and where they are going.
  - Identifies major routes and corridors used within the LEZ.
  - Helps in planning detours and alternative routes.
- **Speed and Travel Time Survey**
  - vehicle speeds and travel times within the LEZ.
  - Assesses congestion and stop-and-go traffic patterns.
  - Helps optimize signal timing and road usage.
  - Records **Parking Survey**
  - Identifies legal and illegal parking areas.
  - Assesses parking demand and supply.
  - Determines whether parking policies need modification to support the LEZ.

- **Vehicle Emissions and Fuel Type Survey**
  - Measures vehicle emissions (PM2.5, NOx, CO2, etc.).
  - Identifies vehicle fuel types (petrol, diesel, CNG, electric, hybrid).
  - Evaluates compliance with emission standards (BS-IV, BS-VI, Euro norms).
- **Public Transport and Non-Motorized Transport (NMT) Survey**
  - Assesses availability and usage of buses, metro, cycling, and walking infrastructure.
  - Determines the share of commuters using sustainable transport.
  - Identifies gaps in the public transport network.
- **Freight and Goods Vehicle Survey**
  - Tracks the movement of delivery trucks and heavy-duty vehicles.
  - Determines peak freight traffic hours.
  - Helps in developing policies for restricted freight movement in the LEZ.

6.4 IPT Survey

Intermediate Public Transport (IPT) Survey for Low Emission Zone (LEZ) Planning

Intermediate Public Transport (IPT) plays a crucial role in urban mobility, especially in cities where public transport systems are not fully developed. An **IPT survey** helps assess the role of auto-rickshaws, shared taxis, e-rickshaws, and other para-transit services in a **Low Emission Zone (LEZ)**. This survey provides insights into travel patterns, service efficiency, and environmental impact to support sustainable mobility planning.

6.4.1 Objectives of an IPT Survey for LEZ

- **Understand the Role of IPT in Urban Mobility** (availability, demand, and usage).
- **Analyse Emissions Contribution** (fuel type, pollution levels).
- **Assess Travel Behaviour and Passenger Preferences**.
- **Evaluate Operational Efficiency** (waiting time, fares, route coverage).
- **Integrate IPT with LEZ Policies** (shift to electric or low-emission IPT options).

6.4.2 Data Components in an IPT Survey

- **IPT Vehicle Characteristics**
  - **Types of IPT Modes** (auto-rickshaws, shared taxis, cycle-rickshaws, e-rickshaws, minivans, tempos).
  - **Fleet Size and Ownership Patterns** (private vs. fleet-operated).

- **Vehicle Age and Condition** (old vs. new, emissions compliance).
- **Fuel Type and Emission Standards** (diesel, CNG, electric, hybrid).
- **Trip Length and Frequency of Operations** (short vs. long routes).
- **Passenger Demand and Travel Patterns**
  - **Daily Ridership per IPT Mode**.
  - **Peak and Off-Peak Demand Analysis**.
  - **Average Trip Distance and Duration**.
  - **Primary Trip Purposes** (work, shopping, school, leisure, medical).
  - **Willingness to Shift to Cleaner Alternatives (E-Rickshaws, EVs, Public Transport)**.
- **Operational and Service Quality Data**
  - **Fare Structure and Passenger Willingness to Pay**.
  - **Service Frequency and Waiting Time**.
  - **Availability of IPT in Different Areas (LEZ vs. Non-LEZ)**.
  - **Safety, Comfort, and Accessibility Issues**.
- **IPT Route and Network Coverage**
  - **Existing IPT Routes and Overlap with Public Transport**.
  - **Integration with Buses, Metro, and Other Modes**.
  - **Gaps in Coverage and Accessibility**.
- **Environmental and Emission Impact**
  - **Contribution of IPT to Urban Air Pollution**.
  - **Potential for Electrification and Low-Emission Alternatives**.
  - **Adoption of Battery Swapping and Charging Infrastructure for E-Rickshaws**.

6.5 NMT Survey

Non-Motorized Transport (NMT) Survey for Low Emission Zone (LEZ) Planning

Non-Motorized Transport (NMT), including walking and cycling, plays a crucial role in sustainable urban mobility. An **NMT survey** helps assess pedestrian and cyclist behavior, infrastructure quality, and safety concerns to enhance **Low Emission Zone (LEZ)** planning. The survey provides insights into how NMT can be improved to encourage more people to shift away from motorized transport, reducing emissions and congestion.

6.5.1 Objectives of an NMT Survey for LEZ

- **Evaluate Walking and Cycling Trends** in the LEZ.
- **Identify Infrastructure Gaps** (footpaths, cycle lanes, crossings).
- **Assess Safety Concerns** (accidents, lighting, security).
- **Understand User Preferences and Barriers** to NMT adoption.
- **Plan for Better Integration of NMT with Public Transport**.

6.5.2 Key Data Components in an NMT Survey

- **Pedestrian and Cyclist Volume Counts**
  - **Daily and Peak Hour NMT Users**.
  - **Seasonal Variations in NMT Usage**.
  - **Demographics of NMT Users** (age, gender, occupation).
- **Infrastructure and Facility Assessment**
  - **Availability and Condition of Footpaths and Cycle Lanes**.
  - **Width, Quality, and Maintenance of NMT Infrastructure**.
  - **Presence of Pedestrian Crossings and Safety Measures**.
  - **Connectivity to Public Transport Stations (Last-Mile Access)**.
- **Travel Behaviour and Preferences**

  Trip Purpose (work, shopping, school, leisure).

  Average Trip Distance and Duration.

  Barriers to Walking and Cycling (lack of safety, weather conditions, convenience).

  Willingness to Shift to NMT if Infrastructure Improves.
- **Safety and Security Concerns**
  - **Accident Data Involving Pedestrians and Cyclists**.
  - **Availability of Street Lighting and Surveillance**.
  - **Conflict with Motorized Traffic and Encroachments**.
- **NMT Policy and Promotion**
  - **Existing Government Policies Supporting NMT**.
  - **Awareness and Acceptance of NMT-Friendly Policies**.
  - **Public Demand for Better Infrastructure and Incentives**.

6.6 Field Visits

6.6.1 Data Check list

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Project Name: Development of Low Emission Zone (LEZ) in Old Core City Areas - A Case A of Vijayawada City & Operational Plan for VIP Vehicular Movement in Vijayawada

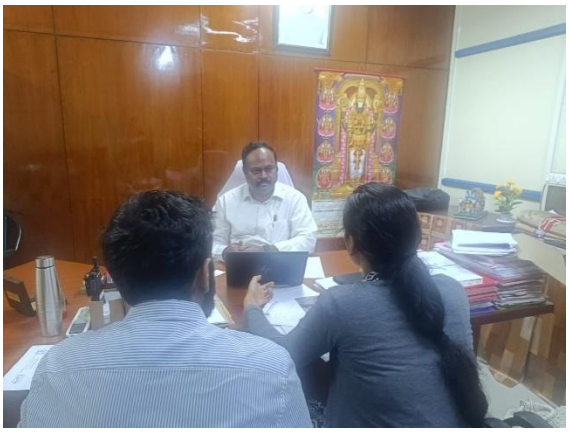
Project Code: CAR_24_01 & TUR_24_02

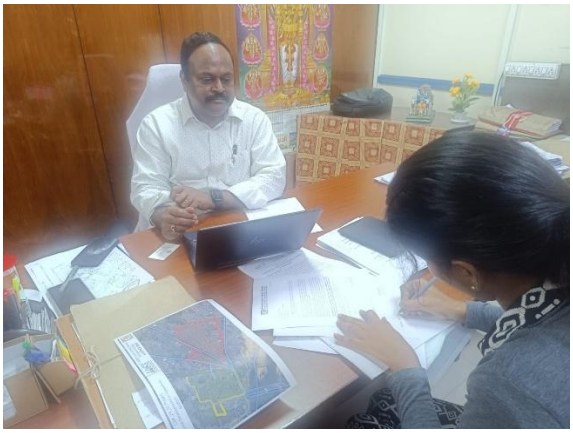
S No.	QUESTIONS	DEPARTMENT	STATUS
`	Recent Master Plan of VMC & Existing landuse	VMC	☐
2	Accident Data (with proper classification, Accident hotspots, Incident Logs)	Traffic Police	☐
3	Is Intelligent Transportation Management system is being used? If yes, data related to it.	APCRDA/ Traffic Police/VMC	☐
4	Intersections design layouts	VMC/NHAI/PWD	☐
5	Traffic Management along the corridors (list intersections with automated traffic signals, manually operated signals, manually regulated traffic, High Traffic zones)	VMC/Transport Department	☐
6	City Road Network -(Classified road maps, Major Intersections, Congestion Hotspots, Toll Loactions, Proposal of New Roads/ Highways/Bridges/Flyovers,etc.)	APCRDA/VMC	☐
7	Traffic Videos at identified locations (One weekday and one weekend)Traffic Volume and Flow Patterns: Detailed statistics on vehicular movement across the city, including peak hours.	APCRDA/Traffic Police/VMC	☐
8	Wards/ population	VMC	
9	Traffic Enforcement, framework & Operation during VIP movement	Traffic Police/VMC	☐
10	Current VIP mobility routes (Points of travel, Frequency of travel, time of travel, classifivation of VIPs and corresponding routes)	Traffic Police/VMC	☐
11	Locations of designated parking areas along the corridors	VMC/APCRDA	☐
12	Information regarding Surveillance, Rapid-Response Units, Emergency access provisions along the corridors	Traffic Police/VMC	☐
13	Expenditure Statement; Advertisment revenue & their sources	VMC	
14	Existing Emergency Response plan and corresponding departments	Traffic Police/VMC	☐
15	Road closure/Barricading during VIP movement	Traffic Police/VMC	☐
16	Status of ITMSs by VMC -2023 Report (Points mentioned: Adaptive Traffic Control System (ATCS), Traffic Enforcement System (TES), Information Dissemination System (IDS), Traffic Surveillance System (TSS) and Traffic Control and Command Centre (TCCC) https://www.newindianexpress.com/cities/vijayawada/2023/Apr/14/smart-traffic-system-to-help-curb-congestion-in-vijayawada-2565825.html	VMC, RTO	☐
17	Maps of Amravati Capital region : https://adcl.in/	VMC, ADCL/ APCRDA	☐
18	Landscaping	VMC	☐
19	Noise levels monitored	VMC/CPCB	☐
20	Health Related		☐
21	Challans - Parking; Wrong side driving, violations	Traffic Police	☐
22	Source Apportionment Study by IIT Tirupati	CPCB	☐
23	Climate Action Plan	CPCB	☐
24	Decisions on LEZ workshop	CPCB	☐
25	Vehicle Registration Data:	RTO	☐
26	Pollution Under Control (PUC) Certificates: Data on vehicles that have undergone emission testing and their compliance status.	RTO	☐
	PUC		☐
	Public transport	APSRTC	☐
27	Source Apportionment Studies: Analysis of pollution sources, such as vehicular emissions, industrial activities, and road dust.		☐
28	Weather Patterns: Information on wind speed, direction, temperature, and humidity, which influence pollutant dispersion.		☐
			☐
	GREEN CORRIDOR PERSPECTIVE: +91 8662576648		
25	No.of Hospitals (Categories)	JEEVANDHAN	☐
26	No.of Transplant Hospitals		☐
27	No.of Transplants takes place in Vijayawada per year		☐

6.6.2 Stakeholders Meeting

11th, 12th March, 2025: Stakeholder Meeting with Mr. Krishna Murthy Naidu, Deputy Commissioner of Police Traffic –Vijayawada

13th, 15th March, 2025: Stakeholder Meeting with Dr. Chandra Sekhar, Additional Commissioner –Vijayawada Municipal Co-operation

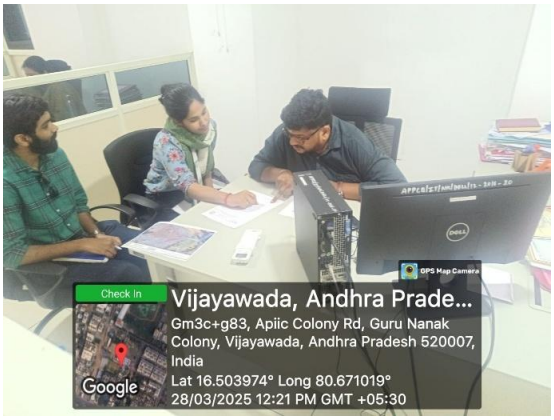




13th March, 2025: Stakeholder Meeting with Commissioner –AP Capital Region Development Authority

17th March, 2025: Stakeholder Meeting with Mr. Manoj Transportation Planner–AP Capital Region Development Authority

28th March, 2025: Stakeholder Meeting with Mrs. Shri Rajani APPCB and Mr. Prashanth CPCB.



Surveyors List

Name	Location	Phone
UNIQUE SURVEY SOLUTIONS	1st floor, KSN complex, 40-25-81, beside SVS function hall, Patamatalanka, Benz Circle, Vijayawada, Andhra Pradesh 520010	9393565756
Land Surveying, (Govt.Licenced Surveyors)	59-5-7, Ist Floor, Pallavi Apartments Govt. ITI College road, beside State Bank of India CHRISTURAJAPURAM BRANCH VIJAYAWADA, Vijayawada, Andhra Pradesh 520008	8332892213
VIJAYAWADA LAND SURVEYORS.	Mallikarjuna Rao St ,Railway station Road, Vijayawada, Vijayawada, Andhra Pradesh 520003	
AK Land Surveyors	Sanyasi Raju St, Beside Andhra Bank, Gandhi Nagar, Vijayawada, Andhra Pradesh 520003	9492533678
SAK DGPS LAND SURVEYORS	33-26-13P, Kadiyala Vari St, near Novodaya High School Chalamala, Kasturibaipet, Vijayawada, Andhra Pradesh 520010	9492944555
Capital Land Survey Technology	# 26-13-28, Alankar Theatre Rd, opp. popular shoes mart, Beside Andhra Bank, Gandhi Nagar, Vijayawada, Andhra Pradesh 520003	
Survey Wing, Sub Collector Office	GJ5H+495, MG Rd, Buckinghampeta, Vijayawada, Andhra Pradesh 520010	
R K Consultancy (Planning, Construction, Surveying, Real Estate)	27-23-265, Gopala Reddy Rd, Governor Peta, Vijayawada, Andhra Pradesh 520002	9059597222
KARAN C SERVICES	D No: 26-23-21A, Gnanolive St, beside Satyanarayana Swamy Temple, Gandhi Nagar, Vijayawada, Andhra Pradesh 520003	9848295857
Rama Krishna Sistla - Civil Engineer in Vijayawada	# 23-22-43, SHOP CF -1, Sravani Appt, Satyaranayana Puram, Vijayawada, Andhra Pradesh 520011	9700803439

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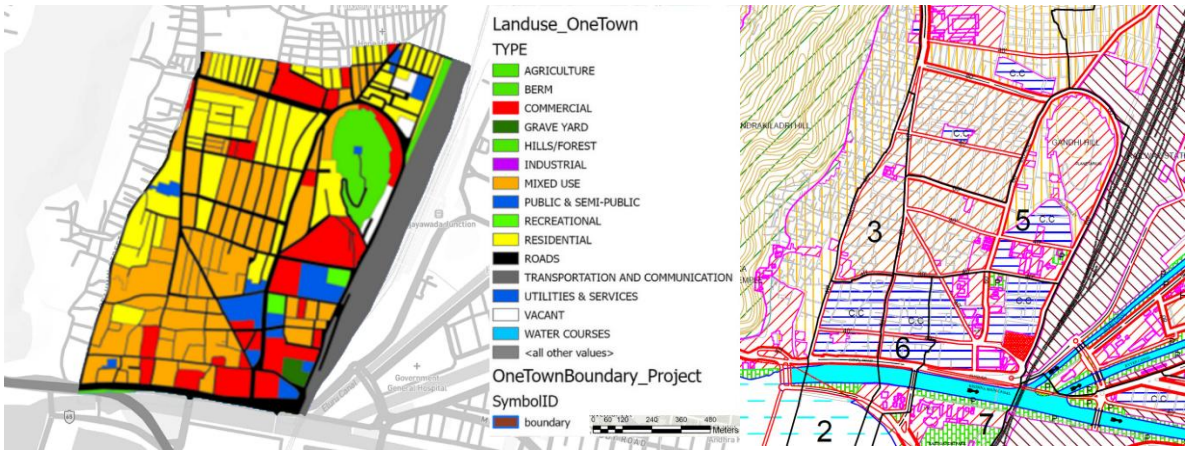
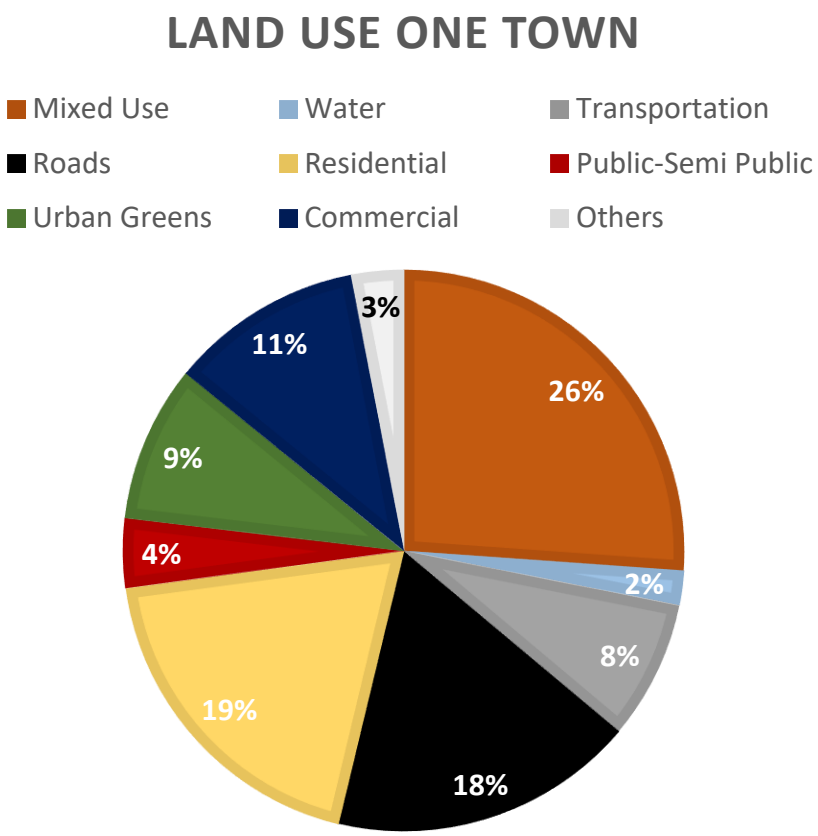
Chapter 07

Preliminary Analysis

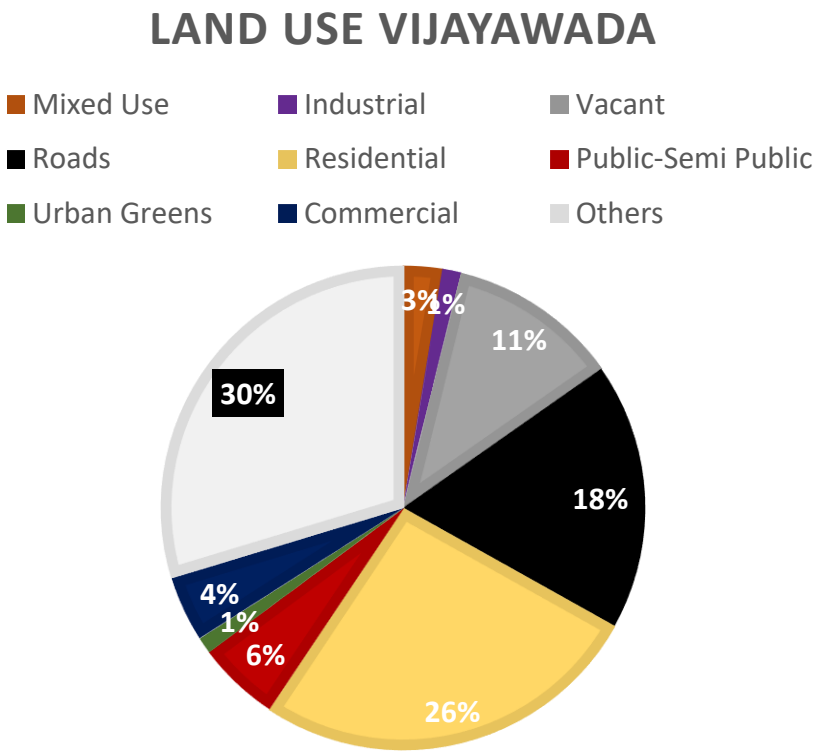
7.1 Land Use



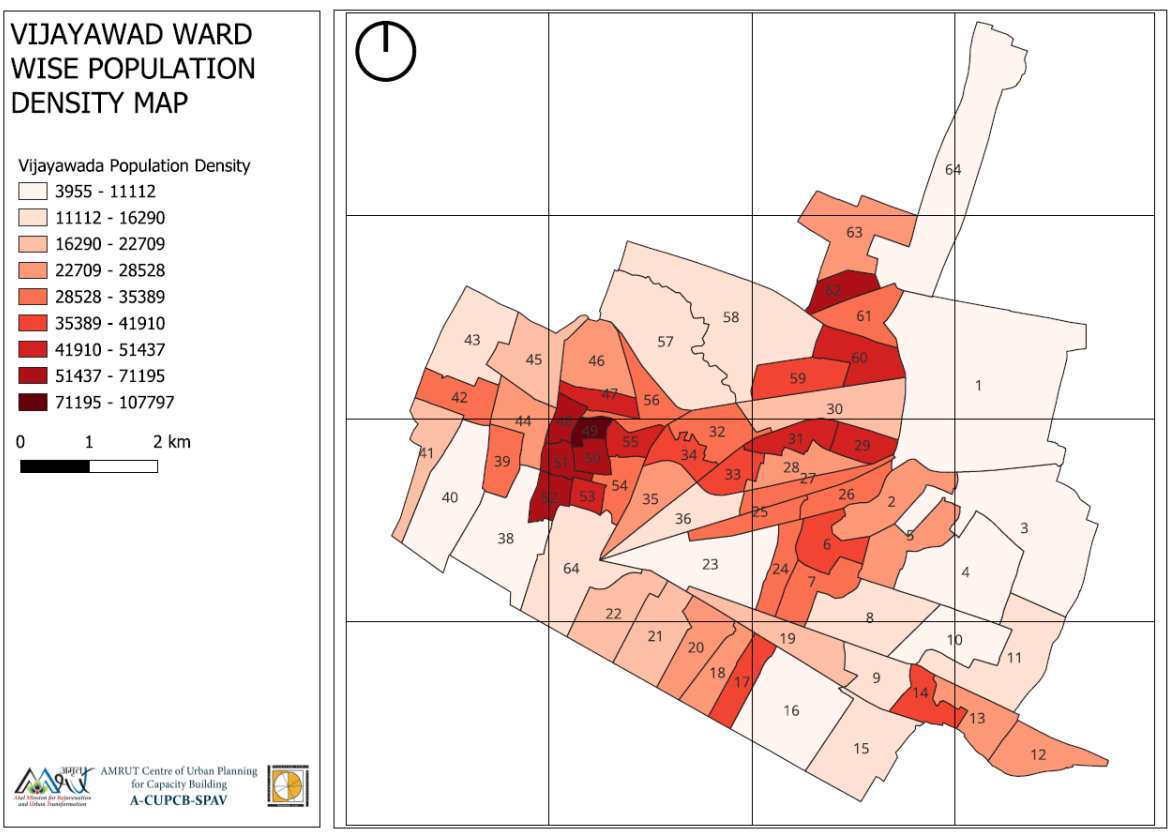
IMG 28 Existing Land use and Proposed Land use 2021



A quick Land use analysis tells us that the one Town are is predominately Mixed-use development and Residential combined. Together they combine to form 45% of the One Town area. Road network in the One Town takes up about 18% of the land use.



7.2 Population



IMG 29 Population Density

7.3 Pollution

APPCB and CPCB has monitoring stations at the following locations.

Station	LAT	LONG
Benz Circle	16°29'40.89"N	80°39'16.25"E
Auto Nagar	16°30'13.75"N	80°40'51.41"E
Police Control Room	16°30'40.09"N	80°37'5.13"E
VRSE College	16°28'56.20"N	80°41'30.62"E
NTR College	16°31'34.34"N	80°46'57.55"E
Gram Panchayat Office	16°29'10.79"N	80°39'48.14"E
IMA Hall	16°30'48.48"N	80°37'24.40"E
Terrace of Zonal Office	16°29'16.12"N	80°41'15.53"E
APIIC Kondapalli	16°37'10.72"N	80°32'32.61"E

Data of pollution openly available from these monitoring locations involves:

- 4- hourly Value of SO_2 (µg/m³) 2 (µg/m³)
- 4- hourly Value of NO_2 (µg/m³)
- Hourly Value of NH_3 (µg/m³)
- 8- hourly Value of RSPM (PM10) (µg/m³)
- 8- hourly Value of TSPM (µg/m³)
- PM2.5 (24 hrs avg) (µg/m³)

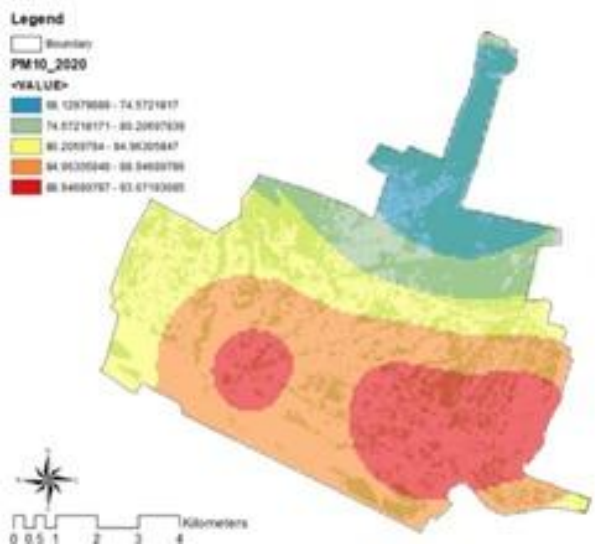
Parameter	2013	2014	2015	2016	2017	2018	Annual Average Standard
PM10	102	97	99	95	89	83	60
SO2	4.7	4.4	6.2	5.6	6.9	5.6	50
NOx	18.8	25.3	42.4	44.8	30.5	22.3	40
NH3	31.1	22.6	32.4	33	30.5	28	100
Ave of No. of Stations	3	4	4	4	7	10	-----
PM2.5	-	50	47	47	38	30	40
CO	-	.8	1	.96	1.11	1	2
Ozone	-	40.1	8.6	7.03	6.7	24.6	100
Benzene	-	2.7	2.6	.71	8	1,8	5

Air Quality monitoring results of Vijayawada

PM10, NOx and PM2.5 are above the national annual standard level.

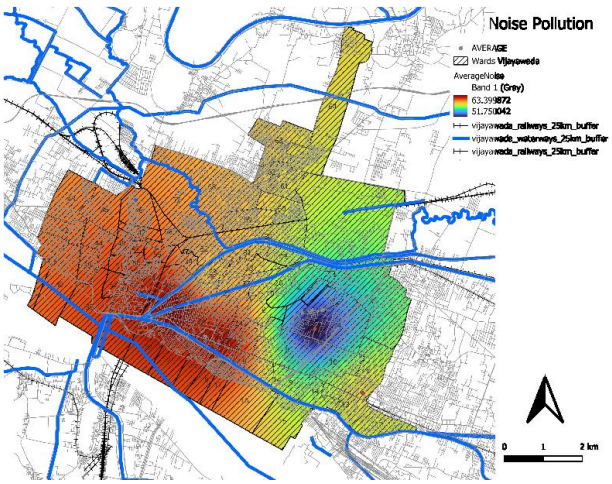
High pollution implies that:

Poor Air Quality – Increased pollutants in the air can cause respiratory diseases, allergies, and other health issues. **Health Problems** – Exposure to pollution can lead to asthma, lung diseases, cardiovascular problems, and other illnesses. **Environmental Damage** – Air, water, and soil pollution can harm ecosystems, wildlife, and plant life. **Reduced Quality of Life** – Polluted environments can make daily living uncomfortable, with bad air, dirty water, and littered surroundings. **Climate Change Contribution** – Air pollution, especially from greenhouse gases, contributes to global warming and extreme weather conditions. **Water Contamination** – Pollutants from industries, agriculture, and waste disposal can contaminate drinking water sources. **Soil Degradation** – Chemical waste and pollution can reduce soil fertility, affecting agriculture and food production. **Economic Consequences** – Healthcare costs rise due to pollution-related illnesses, and tourism can decline in polluted areas.



IMG 30 PM10 Interpolation

High at One Town, Besant Nagar and Auto Nagar Area

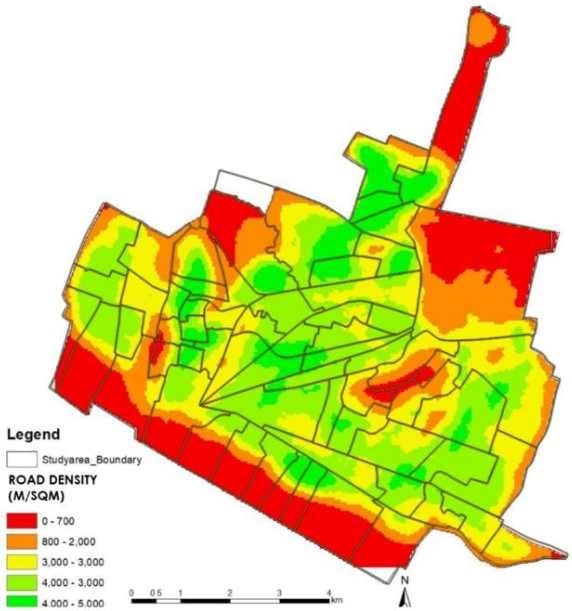


IMG 31 Noise Interpolation

High at One Town, MG Road

Road and Traffic

Road density refers to the total length of roads in a given area, usually measured in kilometers of road per square kilometer of land. It indicates how well an area is connected by roads and is commonly used to assess infrastructure development.

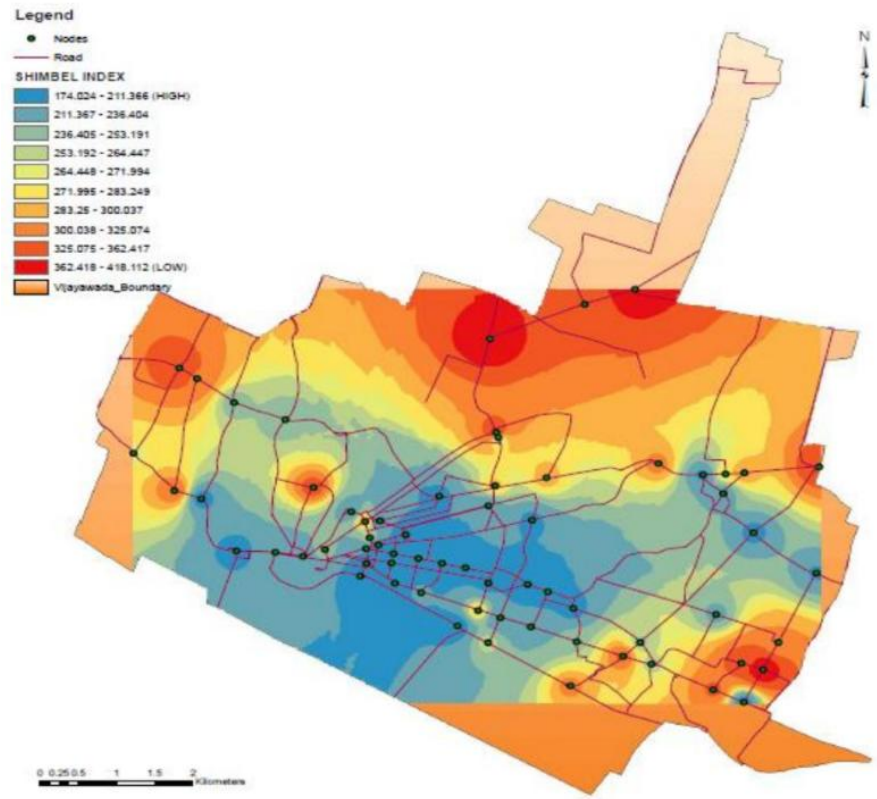


IMG 32 Road density ward wise

High road density in Ward 50, 53, 20, 18, 17, 36, 33, 27, 58, 59, 61, 62, 63 and 64

High road and network density implies that:

Well-Connected Transportation Network – More roads mean better accessibility and connectivity between different areas. **Urbanization & Development** – High Road density is often found in cities and developed regions with advanced infrastructure. **Increased Traffic Flow** – More roads can accommodate higher vehicle movement, reducing congestion in some cases. **Potential for Traffic Congestion** – If not well-managed, high road density can still lead to traffic jams, especially in urban areas. **Higher Maintenance Costs** – More roads require regular repairs, cleaning, and upgrades, leading to increased public spending. **Impact on Environment** – More roads can lead to deforestation, habitat loss, and increased pollution from vehicles. **Economic Growth** – Efficient Road networks facilitate trade, tourism, and business activities, boosting the economy. **Safety Concerns** – A dense road network might lead to more intersections and a higher risk of accidents if traffic regulations are not well enforced.



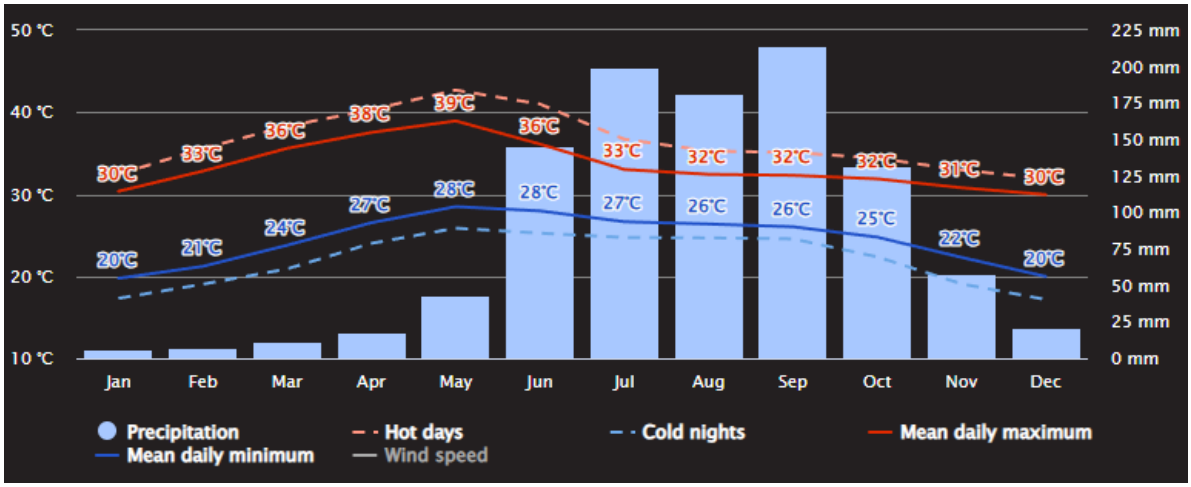
IMG 33 Network density ward wise

Low Shimbel Index is observed at the core area of Vijayawada and along the MG Road and Eluru Road.

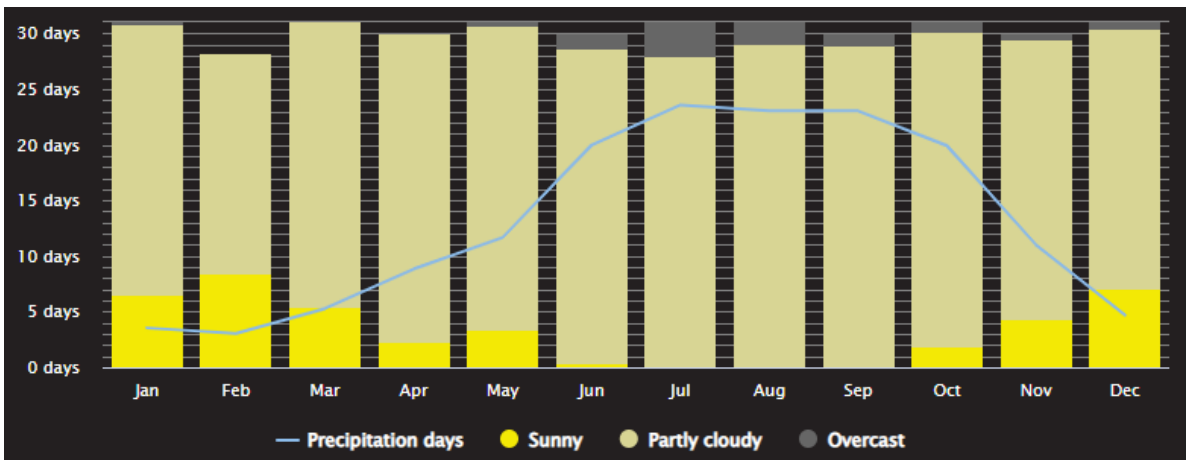
IMG 34 PTAL Analysis

Climate

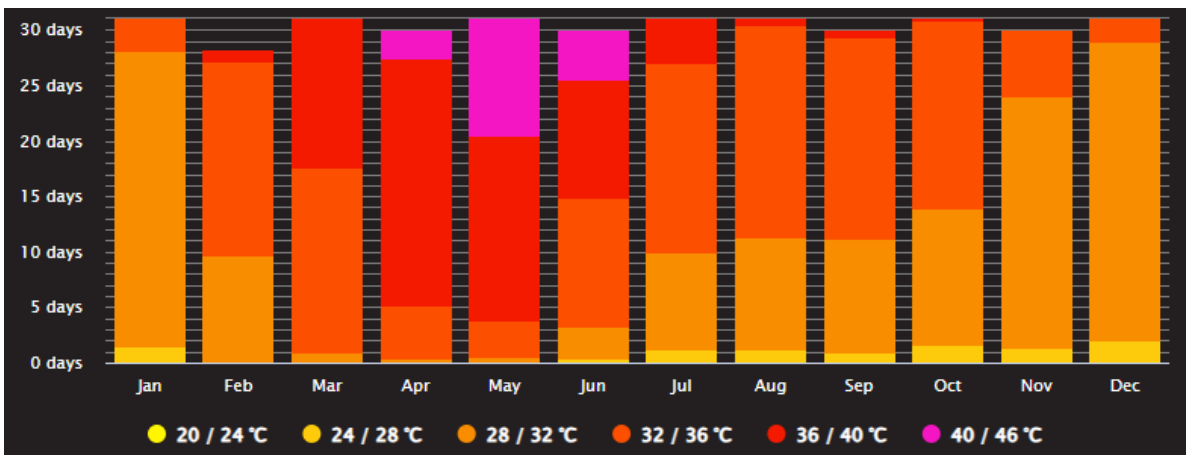
Vijayawada has a tropical wet and dry climate. The annual mean temperatures range between 23.4–34 °C ; with maximum temperatures often crossing 40 °C in the month of May and the minimum in December and January. It receives rainfall from the South-west and North-east monsoons and the average annual rainfall recorded is 977.9 mm.



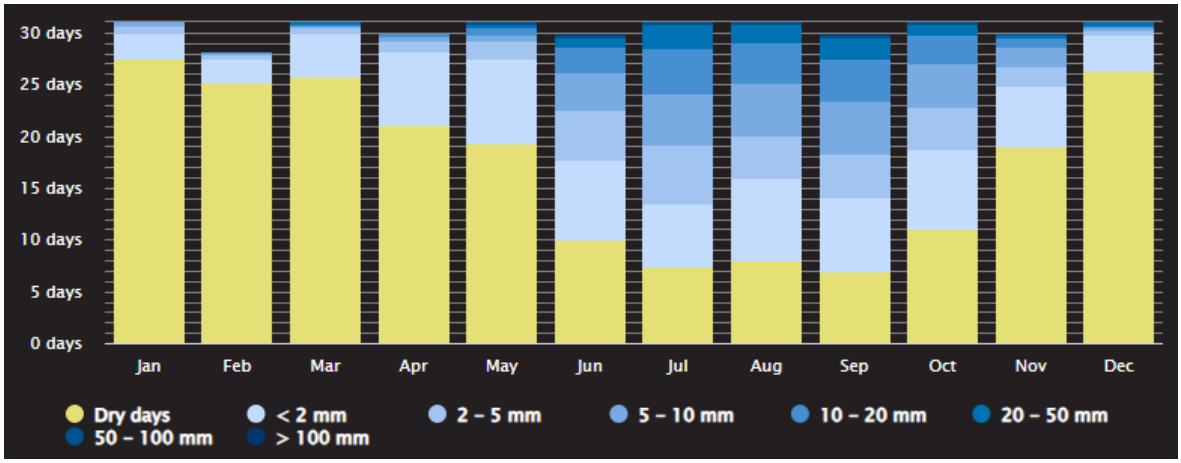
IMG 35 Average Temperature and precipitation



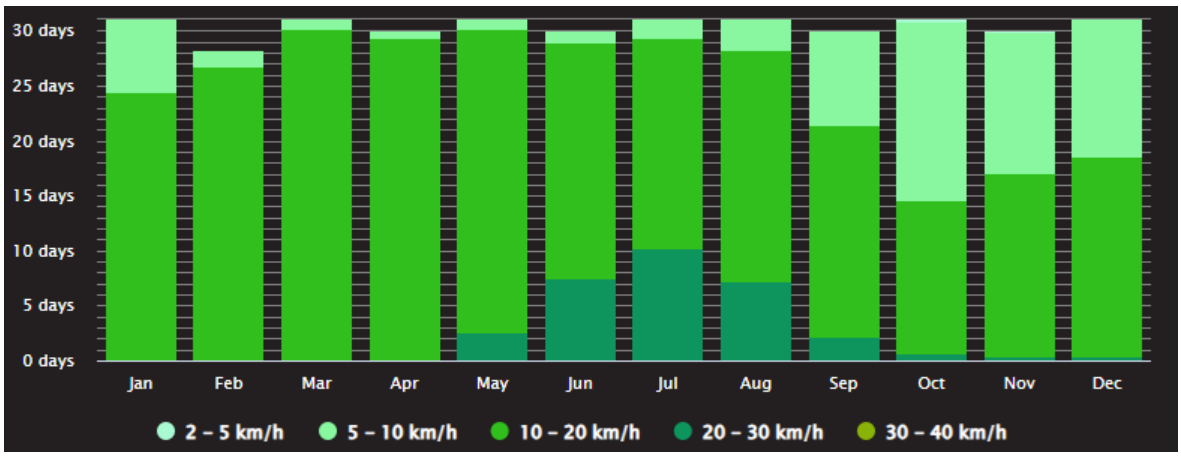
IMG 36 Cloudy, sunny, and precipitation days



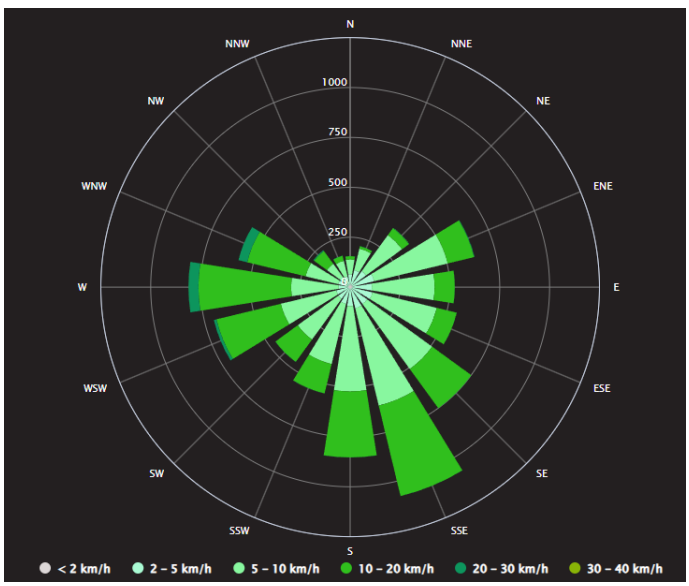
IMG 37 Maximum temperatures



IMG 38 Precipitation



IMG 39 Wind Speed



IMG 40 Wind Rose

Summer: High temperatures and lack of strong winds can cause pollutants to stay in the air longer, increasing smog and haze. Winter: Temperature inversion (cold air trapping pollutants close to the ground) can lead to poor air quality, especially in the early mornings and evenings. Vijayawada's AQI fluctuates, but during peak pollution periods, it can rise to unhealthy levels.

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Chapter 08

Preliminary Findings

8.1 Demographic & Economic Overview

High Population Density Old Town has narrow streets, congested neighbourhoods, and informal settlements. High population density limits new large-scale infrastructure projects. Economic Conditions Predominantly small businesses, street vendors, and traditional markets. Lack of modern commercial spaces discourages big investors. Socioeconomic Challenges Low-income groups dominate the area. Limited access to financial aid, skill development programs, and business growth initiatives.

8.2 Infrastructure & Land Use Challenges

Aging Infrastructure Old buildings lack structural safety, making new development difficult. Poor road connectivity, traffic congestion, and lack of parking spaces. Limited Public Amenities Shortage of green spaces, recreational areas, and proper drainage systems. Poor sanitation and waste management impact living conditions. Encroachment & Land Use Issues Unregulated construction leads to safety risks and lack of organized land use. Disputes over land ownership slow down redevelopment efforts.

8.3.Environmental & Climate Impact

High Air & Noise Pollution Vehicle congestion and industrial emissions worsen air quality. Lack of green cover contributes to the heat island effect. Flooding & Drainage Problems Poor drainage system leads to frequent waterlogging during monsoons. Outdated sewage system poses health risks. Heat Stress & Energy Challenges Tightly packed buildings reduce ventilation, increasing heat stress. High energy demand with unreliable electricity infrastructure.

8.4 Development Bottlenecks

Legal & Policy Restrictions Heritage preservation laws limit modernization of old buildings. Lack of clear zoning policies slows planned redevelopment. Funding & Investment Gaps Limited government funding for urban renewal projects. Private sector hesitancy due to land disputes and ROI concerns. Community Resistance to Change Fear of displacement due to redevelopment projects. Lack of awareness and trust in government initiatives.

8.5 Way Forward for LDZ Revitalization Short-Term Solutions

Basic Infrastructure Improvements (roads, drainage, sanitation). Traffic Decongestion Measures (smart parking, one-way routes). Green Initiatives (tree planting, small parks, waste management).Long-Term Solutions. Mixed-Use Zoning to allow planned commercial & residential growth. Heritage-Sensitive Redevelopment preserving old structures while upgrading utilities. Public-Private Partnerships (PPP) to attract investors for urban renewal projects.

Chapter 09

Way Forward

9.1 Planning & Feasibility Study

Assess Air Quality & Pollution Sources Conduct an Air Quality Study to identify pollution hotspots. Analyze vehicle emissions data (percentage of diesel, petrol, and electric vehicles). Stakeholder Consultation Engage with government bodies (municipal corporation, transport department, pollution control board).Involve transport unions, businesses, and residents to ensure cooperation. Determine LEZ Scope Zone Selection: Identify high-traffic, high-pollution areas (e.g., city center, commercial zones).Restriction Criteria: Decide which vehicles are restricted (old diesel vehicles, high-emission trucks, etc.).

9.2 Policy & Regulatory Framework

Define LEZ Rules & Standards Set emission limits (e.g., only BS-VI or electric vehicles allowed).Implement time-based restrictions (e.g., restrict high-emission vehicles during peak hours). Legal & Financial Framework Introduce fines for non-compliance. Provide subsidies/incentives for electric vehicles (EVs) & cleaner alternatives. Integration with National Policies Align with FAME-II (Faster Adoption & Manufacturing of Electric Vehicles) & state EV policies.

9.3 Infrastructure & Technology Setup

Traffic Monitoring & Enforcement Install Automatic Number Plate Recognition (ANPR) cameras to monitor vehicle compliance. Develop a database of registered vehicles to track emissions and exemptions. Public Transport & Green Mobility Expand electric buses, CNG autos, and cycle lanes to provide alternatives. Increase EV charging stations in LEZ areas. Awareness & Public Participation Launch awareness campaigns to educate people on the benefits of LEZ. Encourage businesses to adopt green logistics solutions.

9.4 Pilot Implementation & Scaling Up

Phase-Wise Implementation

- Phase 1: Start with voluntary compliance & awareness.
- Phase 2: Enforce rules with fines and incentives.
- Phase 3: Expand the LEZ to more zones based on success.

Data Monitoring & Adjustments Use real-time AQI monitoring to assess LEZ impact. Adjust policies based on public feedback and pollution levels.

Chapter 10

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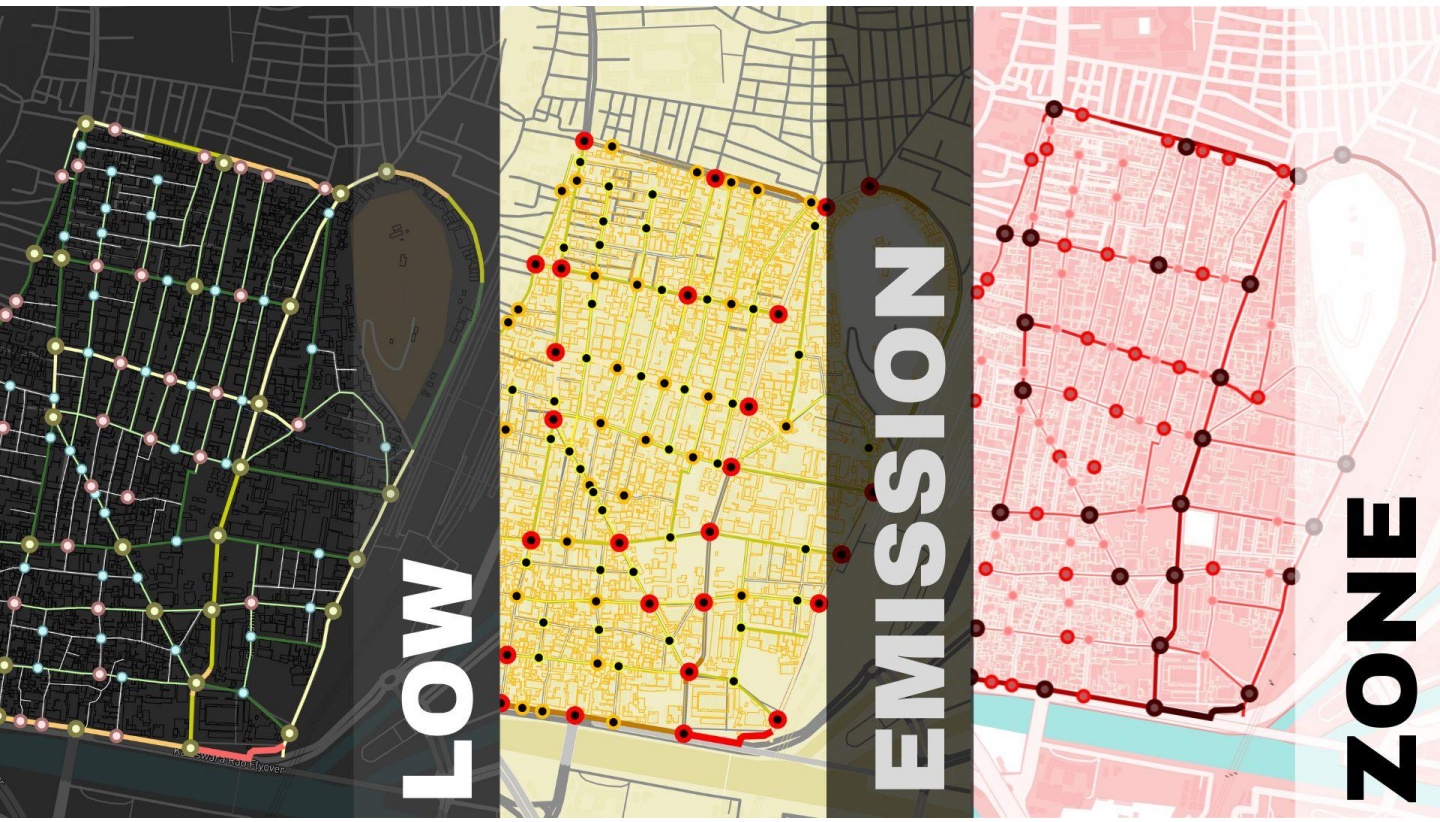

DEVELOPMENT OF **LOW EMISSION ZONE (LEZ)** IN OLD CORE CITY AREAS- A CASE OF **VIJAYAWADA** CITY