JAIPUR

GAPS IN MOBILITY ACTION FOR CLEAN AIR

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Gaps in mobility action for clean air

Jaipur along with Kota, Udaipur, Jodhpur, and Alwar have been identified as the non-attainment cities in Rajasthan under the National Clean Air Programme (NCAP). These cities are in the process of implementing their respective clean air action plans to reduce emissions from the key sectors of pollution including transport, industry, power plants, waste streams, construction, use of solid fuels in households, diesel generator sets and dust sources.

It has been close to five years since the multi-sector action plan is being implemented. Thus, it become necessary to understand how such efforts are working in each sector of intervention – what's working and what's not working? This is needed to ensure that a more detailed sector-wise customized action plans are implemented to make a difference and to meet the clean air benchmark.

From this perspective, the Centre for Science and Environment (CSE) has started this series on action tracker to assess the baseline action in the key sectors of pollution to identify the nature of progress and the gaps in action in targeted cities.

The first in this series is therefore an assessment of interventions in the transport sector to reduce vehicular emissions in Jaipur city. There are several reasons for prioritizing the transport sector.

Vehicles are the second highest contributor to particulate pollution in Jaipur: The emissions inventory prepared by the Indian Institute of Technology, Kanpur, shows that while among the dust and combustion sources the vehicles are the second highest contributor to PM2.5 load, among the combustion sources, the transport sector is the highest contributor to the PM2.5 load at 20 per cent. This is followed by industry at 19 per cent, 5 per cent domestic sources, 3 per cent municipal solid waste burning. Contribution of road dust is 47 per cent. Road dust is also suspended due to the vehicular movement.

If the polluting gases are considered, then vehicles are responsible for 85 per cent of the nitrogen oxides (NOx) – nearly most of it. Industry contributes about 4 per cent and the rest is shared by other combustion sources.[1] NOx is a matter of concern as apart from being a harmful gas in itself, it also contributes towards the formation of ozone pollution – yet another very harmful gas.

Several technology measures have been initiated to control the tailpipe of emissions from vehicles. The national emissions standards of Bharat Stage 6 has been

implemented in 2020 along with 10 ppm sulphur fuels, phase out of old vehicles has begun, and there is a nascent beginning of electrification of new vehicles fleet.

Despite these technology measures, vehicles are the top contributors to the pollution load among the combustion sources. It is clear that only technology measures will not suffice. This therefore requires a deep dive analysis of the transportation and mobility regime in the city. Growing motorisation, increased dependence on personal vehicles, inadequate integrated public transport, limited network of walking and cycling, and lack of demand management measures like parking policy can negate the gains from technology interventions.

This assessment has become necessary because the mobility action has not yet found explicit place among the pollution control measures in the city. It is quite consistent with the national trend in which the dedicated funding that is available to the non-attainment cities under the Fifteenth Finance Commission, is barely used for mobility action. Most of the funding is being spent for dust control.

Also the reporting of progress in action in the PRANA portal created for tracking on-ground change under the NCAP barely report any action on transport and mobility. This is despite the fact that the Central Pollution Control Board (CPCB) has provided indicators for reporting mobility interventions related to public transport, walking and cycling, electrification and parking policy as a demand management measure.

Most of the transport related measures are confined (and that too in a limited way) to enforcement of pollution under control certificate porogramme, and old vehicle phase out etc.

As a result, this critical source of emissions remains grossly underfunded and lacks comprehensive policy framework to enable adequate scoping of action and define the strategies for interventions. The Minutes for Sixteenth Meeting of Implementation Committee for National Clean Air Programme on May 3, 2024 has reported that the overall expenditure on clean air action in Jaipur has been Rs 299.43 Cr out of which physical progress has been filed for Rs 127.12 Cr. But most of the spending is for dust control measures. Previously, as of October 2023, the fund utilisation was about 75 per cent. But expenditure on transport is paltry.

The sector therefore has to rely on the convergence funding which is a separate line funds for the sector either earmarked as part of the state budget or are funded under some central scheme.
In view of this, this assessment has been carried out to understand the nature of the mobility and transportation challenges in the city and the kind of interventions needed to address this. The objective is to inform action to mitigate vehicular pollution in the city.

Therefore, based on this overview assessment of the sector in Jaipur a framework has been proposed for designing mobility action. This is designed to enable and accelerate appropriate mobility action in the city. This framework for developing strategies for implementation indicates grading of different levels of intervention to move from base level to more advanced and holistic action for more effective impact.

This grading of action reflects the service level benchmark and national habitat standards that have been developed by the Ministry of Housing and Urban Affairs and is consistent with the National Urban Transport Policy, Transit Oriented development Policy and related policies. For each parameter in different sub-segments of implementation including public transport, walking and cycling, and vehicle restraint measures, - the nature and scope of action is graded as follow:

- Base action is the common minimum that the city must implement right away.
- Level -1 to Level-3 shows how a city can improve the level of services and the type of improvement needed. This need not be linear and can be combined in the early stages of planning for quicker uptake and impact.

The city administration need to aim for the Level 3 quicker in all or priority parameters for an effective impact. The graded action needs to be implemented cumulatively and within a stringent timeline. The timeline needs to be aligned with the NCAP target of reducing particulate pollution by 40 per cent by 2026.

1. Motorization in Jaipur

Rapid growth: The vehicle numbers have started to increase quite rapidly. Presently, Jaipur has around 33 lakhs of registered vehicles, which is comparable with the other similar size cities in terms of population, like Pune and Lucknow which have around 36 lakhs and 27 lakhs of registered vehicles respectively.

It is quite notable that almost half of the total registered vehicles, i.e., 16 lakhs, have been registered during the past decade, - 2014 to 2023[2]. Additionally, annual motorization trend of the city reflects that during FY 2022-23, the city had registered

BOX: AIR QUALITY TRENDS IN JAIPUR

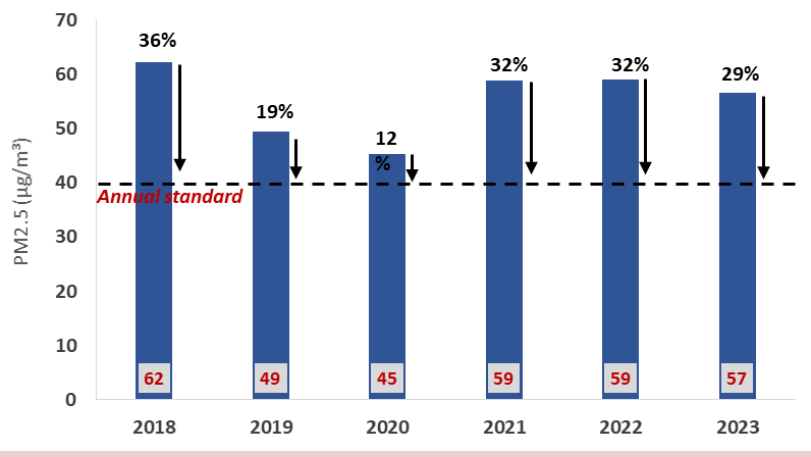
Since the inception of the National Clean Air programme in 2019, there are distinct trends in air quality of Jaipur.

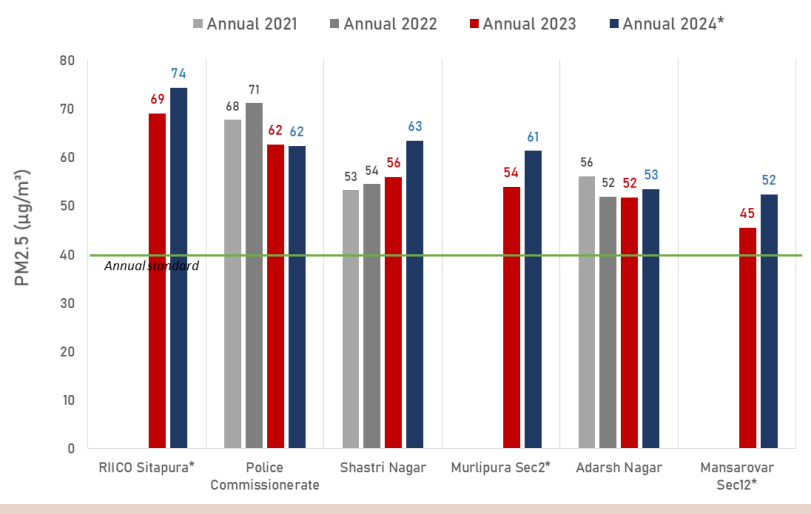
Since 2018, the average annual PM2.5 levels have reduced by 9 per cent.
However, an additional 29 per cent reduction is still needed to meet the National Ambient Air Quality standard.

In 2023, about 5 per cent increase has been noted in annual PM2.5 level when compared with the three-year average (2020–2022). More monitoring stations were added in 2023.

In 2023, among the monitoring locations, Riico Sitapura recorded the highest PM2.5 levels at 69 µg/m^3, followed by Police Commissionerate at 62 µg/m^3 and Shastri Nagar at 56 µg/m^3

Jaipur - long term trend in PM2.5 concentration

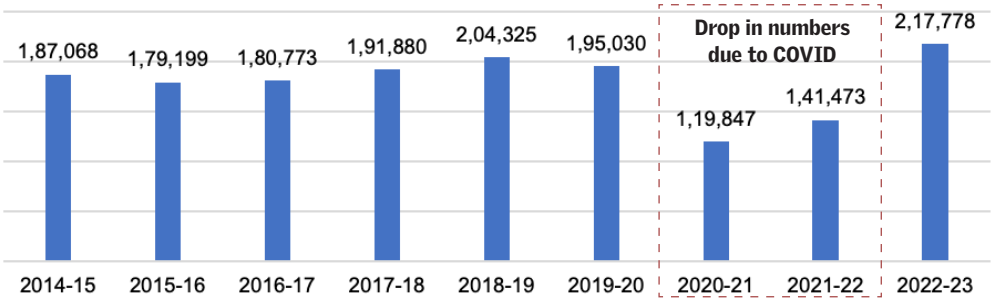




Source: Primary data collected by CSE

the highest number of vehicles, i.e., 2.17 lakhs vehicles, crossing the previous high of 2.05 lakhs vehicles in FY 2018-19[3]. Clearly, with time the pace of growth is increasing that needs to be addressed. *(See* Graph 1: Annual motorization trend in Jaipur*).*

Graph 1: Annual motorization trend in Jaipur

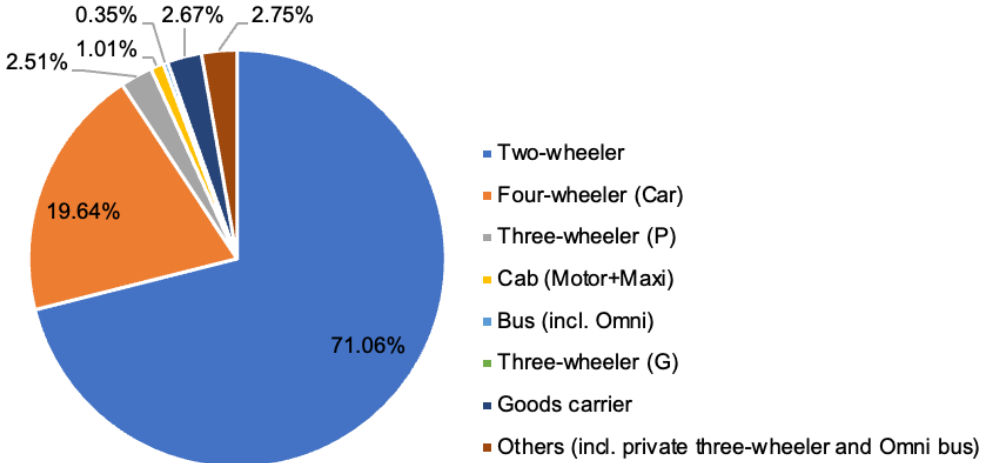


Source: Vahan dashboard (2014-2023)

Personal vehicles dominate:. Two-wheeler are the most dominant segment at 71 per cent of the total registered vehicles in Jaipur. Two-wheelers combined with personal four-wheelers are about 91 per cent of total registered vehicles in the city. (See *graph 2: Vehicle composition in Jaipur*).

In recent years, the demand for private car has increased quite rapidly compare to two-wheelers. FY 2022-23, for the first time in past decade the number of registered private car numbers has crossed 50,000 mark.

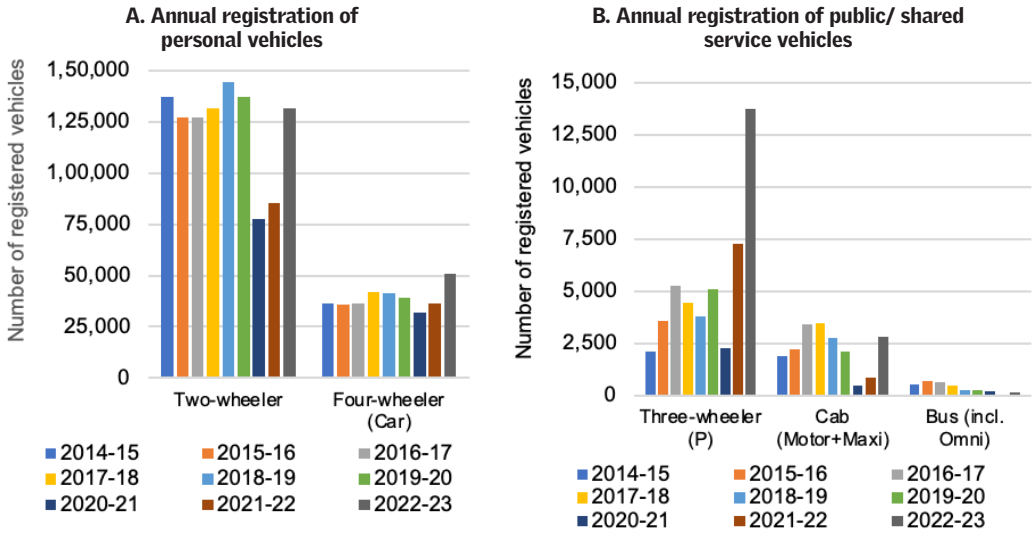
Graph 2: Vehicle composition in Jaipur



Source: Vahan dashboard (Sep 2023)

Share of public transport declining: While dependence on personal vehicles is increasing, there is a constant decline in bus services. This has led to exponential growth in three-wheeler and cab services in recent years. (See graph 3: Annual registered vehicles in Jaipur).

Graph 3: Annual registered vehicles in Jaipur (Passenger)

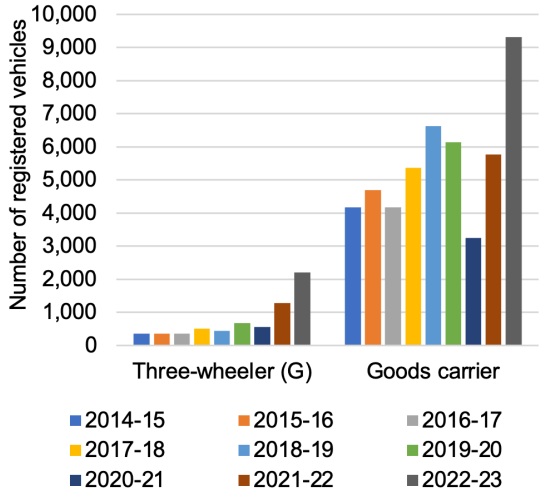


Source: Vahan dashboard (2014-2023

Explosion in delivery and aggregator fleet: Similar to passenger mobility, rapid urbanization along with economic growth also pushed the demand for goods or delivery vehicles.

FY 2022-23 has observed highest annual registration (considering previous eight years annual registration numbers) in both goods three-wheeler and goods carrier segment. Both the segments have marked almost 60 per cent jump from the previous year. (See *graph 4: Annual registered vehicles in Jaipur (Goods)*.

Graph 4: Annual registered vehicles in Jaipur (Goods)



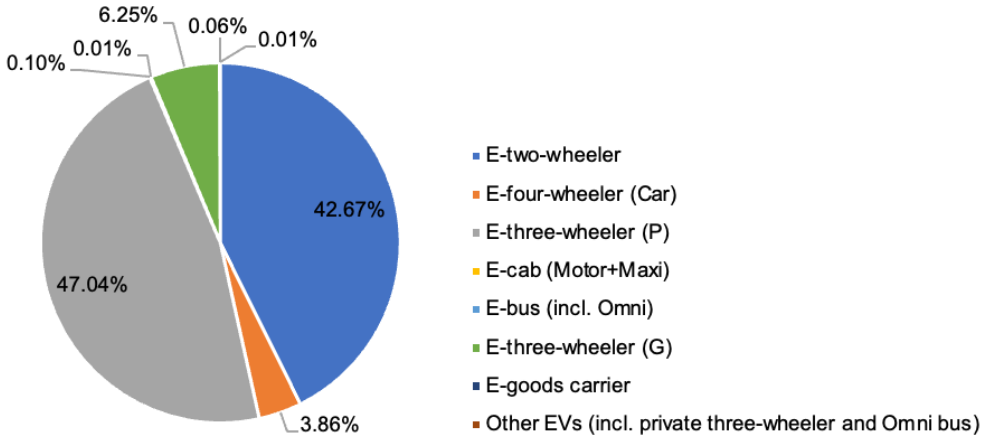
Source: Vahan dashboard (Sep 2023)

2. Electrification of vehicles

There is a nascent trend in electrification of new vehicle fleet. Till Sep 2023, Jaipur has registered around 80,000 electric vehicles. About 40 per cent of these electric vehicles have been registered in last financial year FY 2022-23. It is important to note that Government of Rajasthan has published the state electric vehicle policy in September 2022, - just a year ago. This has provided for additional state incentives for different vehicle categories[4].

Electric three-wheelers, including both passenger and goods, are the most dominant EV segments, followed by electric two-wheelers. Both electric three and two wheelers represent almost 96 per cent of the *total EV fleet in Jaipur*. (See *graph 5: Vehicle category-wise vehicle registration in Jaipur*).

Graph 5: Vehicle category-wise electric vehicle registration in Jaipur

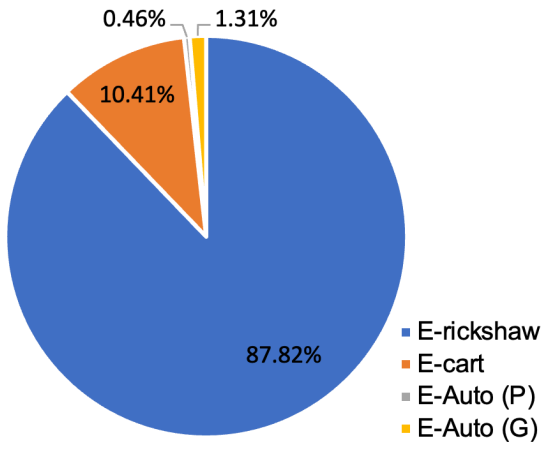


Source: Vahan dashboard (Sep 2023)

A detailed analysis of electric three-wheeler reveals that 98 per cent of the all are L3 category vehicles (i.e., e-rickshaws and e-carts). In this the share of e-rickshaw and e-cart is around 88 and 10 per cent respectively. (See graph 6: Electric three-wheeler category in Jaipur). Migration of EV models to bigger vehicle categories is still very negligible.

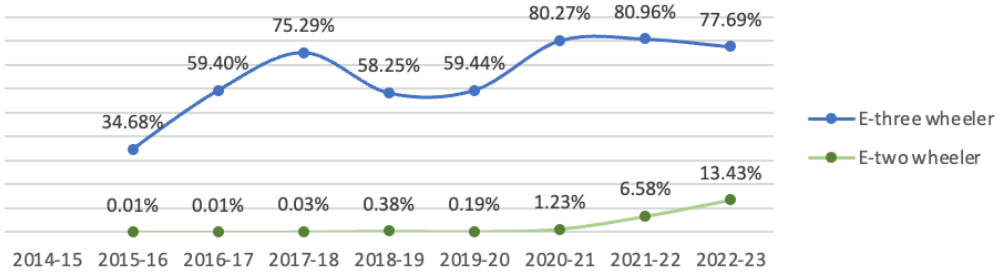
Rajasthan state electric vehicle policy 2022, provides vehicle category-wise electrification targets for new vehicle registration (i.e., 15 per cent for two-wheeler, 30 per cent of three-wheeler and 5 per cent for four-wheeler category vehicles). This clearly reflects the state's intent to rapidly electrify the diverse vehicle segments.

Graph 6: Electric three-wheeler category in Jaipur



Source: Vahan dashboard (Sep 2023)

Graph 7: Annual electrification rate of three-wheeler and two-wheeler segment in Jaipur



Source: Vahan dashboard (2014-2023)

In terms of EV penetration rate, only three-wheeler segment has shown consistent high penetration rate of 75 per cent or above over the past three years. But mush of this has happened in L3 segment. For transformative action, electrification of L5 is necessary. Recently, in FY 2022-23, two-wheeler segment has crossed 10 per cent penetration rate. For deeper penetration, it requires at least monthly 10 to 12 per cent electrification.

3. Connectivity and traffic pattern

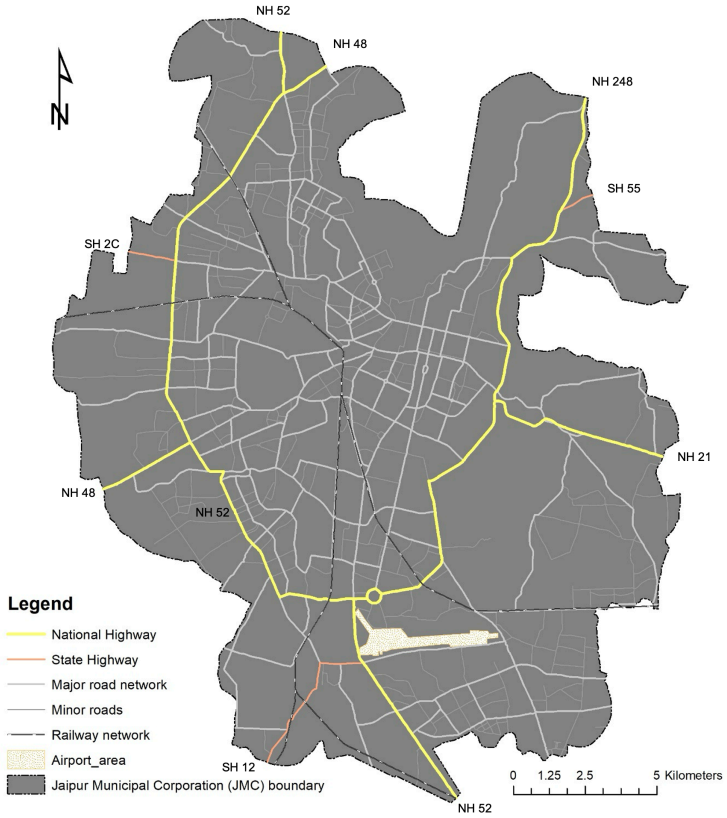
Mobility action requires deeper understanding of the urban form and connectivity pattern integrating land-use and transport. This determines the travel pattern and travel choices of the commuting masses and its bearing on emissions.

While the original Jaipur city reflects the advantages of compact urban form with high street density, small blocks, that walkable access, that makes neighbourhoods easily accessible, and travel distances short. This is the kind of urban form that keeps travel distances short and walkable and thus prevents lock in of pollution and carbon in the infrastructure.

However, the expansion of the city has created more sprawled development and has increased travel distances. The road network and connectivity has some distinct patterns.

Jaipur has around 1,782.5 km of road network of which 41 per cent is wider than 10 meters. The city is well connected with other urban centers in the region through a network of National and state highways and railways. Jaipur has around 325 km of major road network which primarily takes care of the intra-connectivity. Mirza Ismail Road (MI Road), Tonk Road, Jawahar Lal Nehru Marg (JLN Marg), and Gopalpura Bypass are considered as the major arteries of the city (see *Map 1: Jaipur road network).*

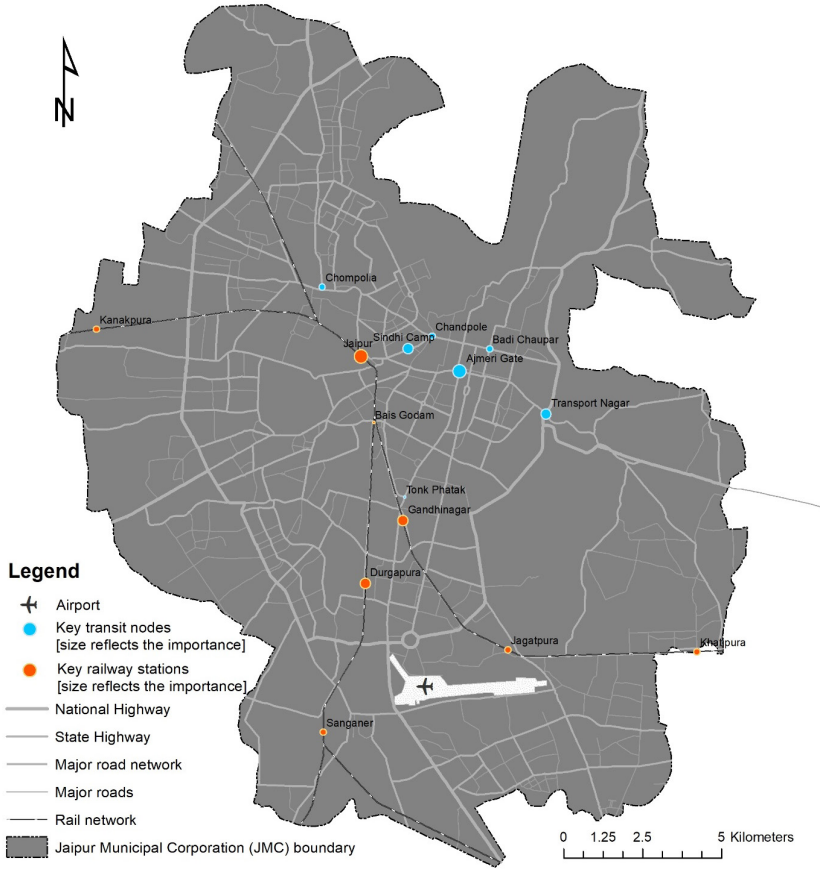
Map 1: Jaipur road network



Source: prepared by CSE

Overall, the city has a radial pattern of network distribution. The walled city has organized grid pattern. Tonk road and JLN Marg provide north-south connectivity. MI road provides east-west connectivity. Due to the presence of hills on the north-eastern side of the city, a bypass/ring road cannot be provided because of which regional traffic towards Delhi/Agra–Ajmer/Sikar enters the city and passes through MI road. In general, almost all the roads accommodate two-way traffic except some portion of MI road (Shaheed Smarak to Ajmeri gate), where traffic flows from west to east side of the city (towards Ajmeri gate). Parallel Ashok Marg has been used for opposite traffic flow. Around 47 per cent of the total road network doesn't have paved shoulders, resulting in an increase in road dust as well as PM10 concentration in the air. Sindhi camp, transport nagar, chompolia, chandpole etc. are some of the major transit hub in the city for both intra and inter-city bus connectivity. (See *map-2: Major transit nodes for regional connectivity in Jaipur*).

Map 2: Major transit nodes for regional connectivity in Jaipur



Source: prepared by CSE

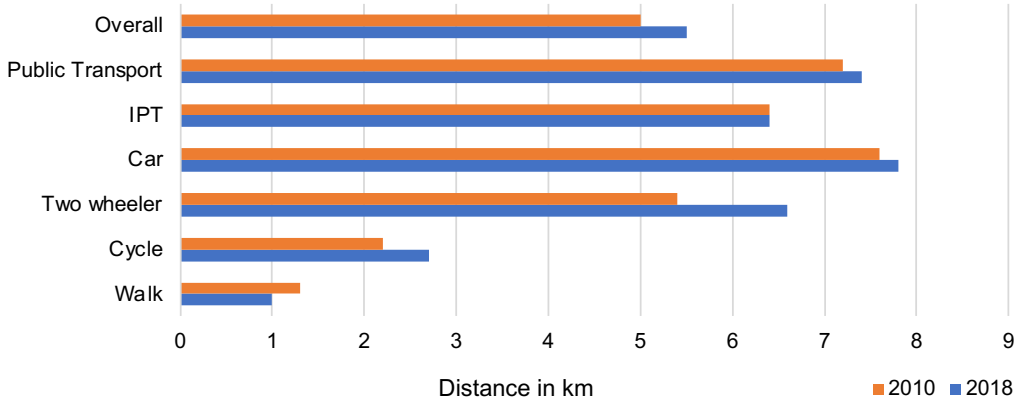
Other than extensive road network, for regional connectivity, Jaipur is also well connected through both railway and airways. Three major railway lines, i.e., Delhi-Ahmedabad, Sawai Madhopur and Jaipur-Sikar line passes through Jaipur Junction. Daily around 102 broad gauge trains arrives/ depart/ by pass Jaipur railway station which makes one of the busiest railway stations in Rajasthan[5]. Similarly, Jaipur international airport handles around 15,000 passengers with average 60 flights on daily basis[6].

This region is highly dependent on road transport for local and regional connectivity. That further induces heavy motorized traffic. On a daily basis, yet another humongous number of vehicles enter from outside Jaipur. This is further enhanced by the influx of tourists vehicles as this city is an important tourism destination.

4. Growing private transport demand

With growing urbanization and rising urban population, mobility demand is also increasing rapidly. According to Comprehensive traffic and transportation study (CTTS) 2018, per capita trip rate of Jaipur city is around 1.22 (including walk trip), which means on an average 5.1 million trips are being made on a daily basis. Vehicular trip rate of the city is around 0.84[7], -- this means around 3.5 million people use vehicles for their daily commuting. It is important to highlight that in between 2010 and 2018, the vehicular trip rate has increased by 15 per cent, from 0.73 to 0.84[8]. (see *Graph 8: Changing trip length).*

Graph 8: Changing trip length

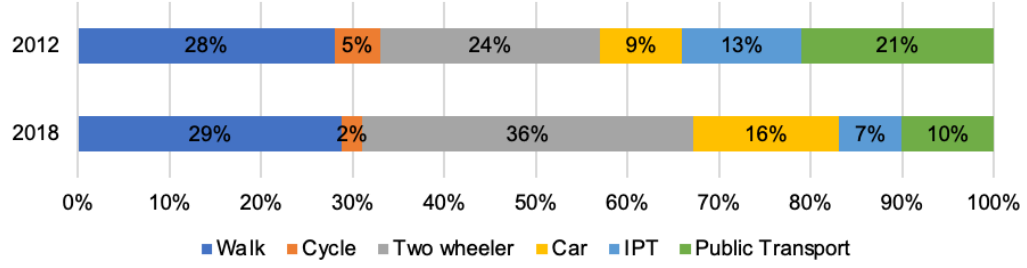


Source: Traffic and Transportation Study for Detailed Project Report for Proposed Jaipur Metro, 2010 and Comprehensive Traffic and Transportation Study for Jaipur Region, 2018

While trip rate has increased, the trip length has remained almost the same, except for two wheelers. This indicates that between 2010 and 2018, the city has densified, instead of spreading outwards, which is a good sign.

However, modal share exhibits a grim picture. Between 2012 and 2018, i.e., six years, private mode share has increased from 33 to 52 per cent. During the same period, the public transport share including intermediate public transport (IPT) like autos and taxis, have reduced to half, i.e., 34 to 17 per cent (see *Graph 9: change in mode share*). This is a serious loss.

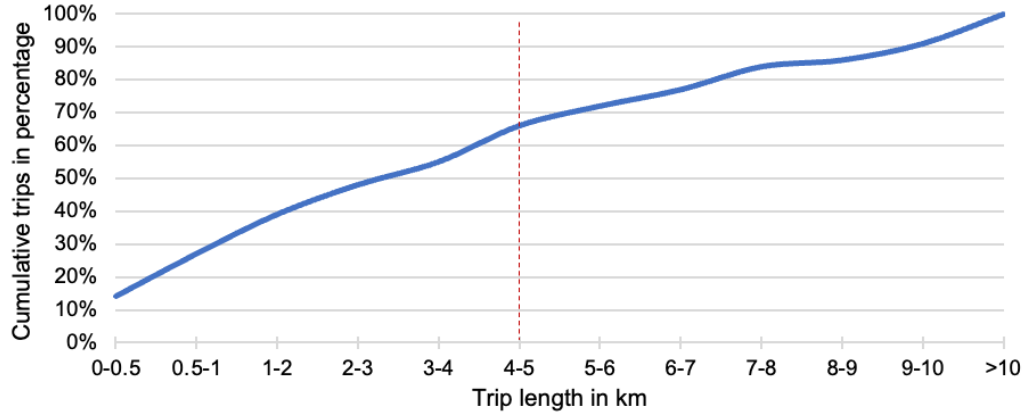
Graph 9: Change in mode share



Source: Detailed project report Jaipur metro (phase-1), 2012 and Comprehensive Traffic and Transportation Study for Jaipur Region, 2018

Trip length distribution curve clearly indicates that more than 65 per cent commuters make trips that are less than 5 km. This is easily accessed by IPT modes or electric cycles (see *Graph 10: Trip length distribution curve).*

Graph 10: Trip length distribution curve



Source: Comprehensive Traffic and Transportation Study for Jaipur Region, 2018

5. IPT – an opportunity – but unregulated service is a problem

According to CTTS 2018, Jaipur has around 15,725 autos of which 72 per cent autos (i.e., 11,595 autos) operate using LPG as fuel and rest are diesel operated. But around 26 per cent of the auto-rickshaws and 29 per cent of shared autos are more than 10 years old. This combination of diesel powered autos and ageing fleet is a source of high emissions and source of direct toxic exposures. A targeted scrappage policy and shifting to electric autos can ensure significant emissions reduction benefit.

Recently Jaipur has observed a sudden rise of L3 e-rickshaws in its roads. Presently, Jaipur has more than 32,000 electric passenger rickshaws covering the nook and corner of the city.

Even though the autos provide critical public transport services, its unregulated deployment is adding to the challenges of traffic chaos and congestion which is further aggravating pollution. Moreover, this is leading to poor auto services (see *Image 1: Clogged roads with IPT services*).

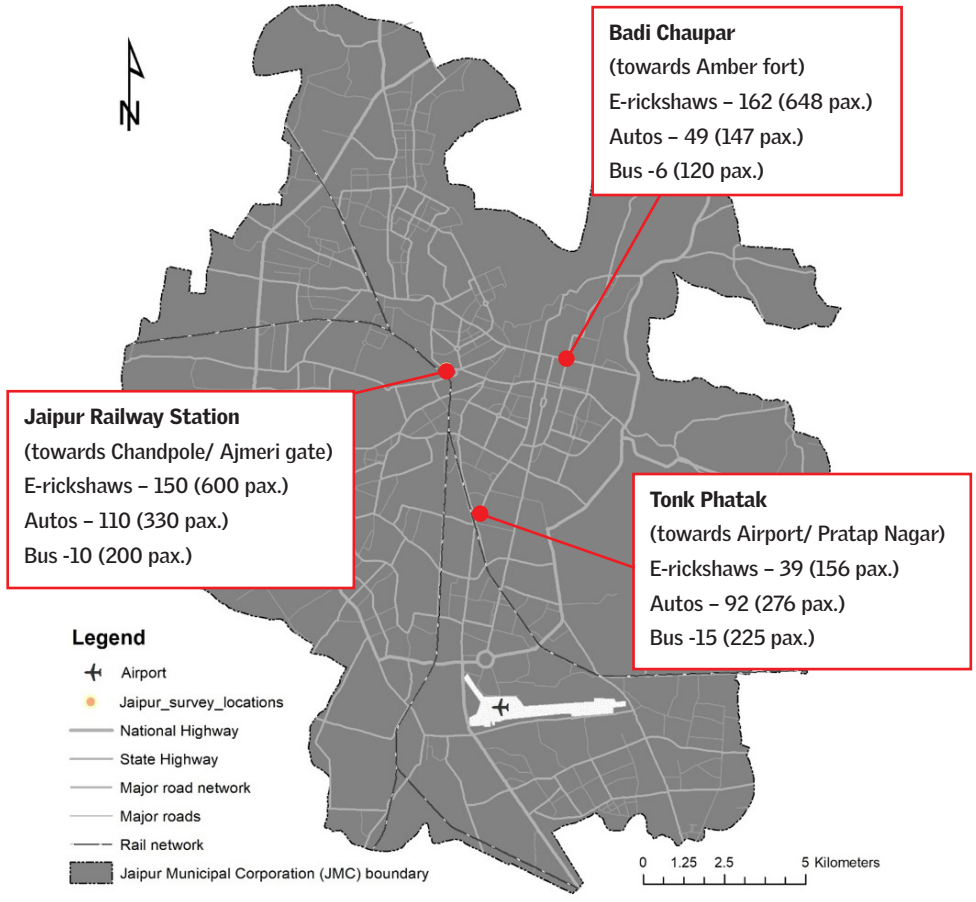
Almost all the major activity areas including Jaipur railway station, Sindhi camp, Chandpole, Badi Chauper, Transport Nagar etc., roads- junctions are completely choked with e-rickshaws (L3) and autos, making it difficult for normal traffic to flow smoothly.

Image 1: Clogged roads with IPT services

(left side – Badi Chaupar, Right side – Sindhi Camp)

Efforts have not been made to organise their deployment and integrate with other public transport systems. In some sections (e.g., tripolia market area), buses have stopped plying due to clogging of roads by these autos (see *Map 3: Dominance of IPT modes over city bus services)*

Map 3: Dominance of IPT modes over city bus services



Source: prepared by CSE

To understand the nature and quality pf service delivery offered by the IPT modes verses city buses, CSE team surveyed three key locations in the city. A 15 minutes survey at each locations revealed that IPT service capacity (supply-side) is almost 2 to 6 times higher than the bus service capacity. (See Map 3: Dominance of IPT modes over city bus services).

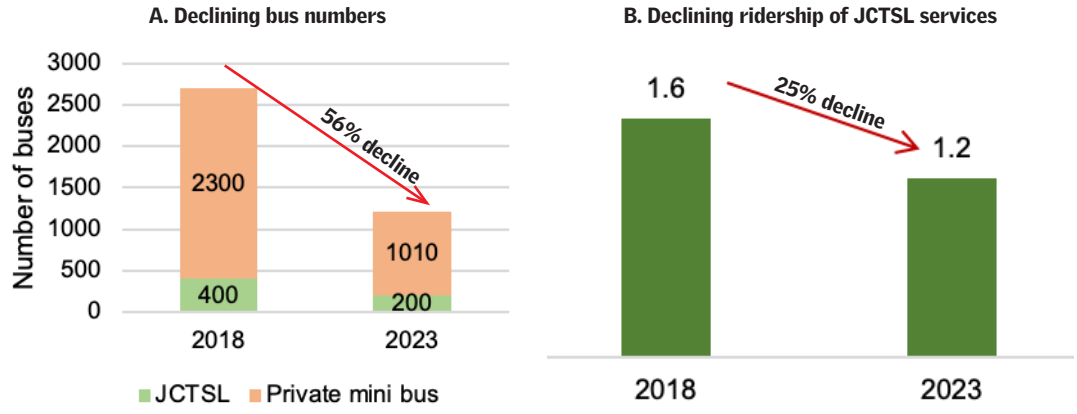
Additionally, due to lack or no halt and go points for IPT services, vehicle operators haphazardly stop or park vehicles on road sides and near junctions impeding both traffic and pedestrian flow. This is obstructing through traffic.

6. City bus services under stress

City bus service is expected to be the prime mover and the spine of the public transport systems. These are cost affective, affordable and can operated flexibly to penetrated deep into neighbourhoods to provide efficient services. This has to draw priority attention and policy support.

Jaipur has both public and private bus operations. Presently, around 1200 buses are plying to provide city bus services. Jaipur City Transport Services Ltd. (JCTSL) operates 200 buses and rest 1000 buses are private. The city bus service has declined by more than 50 per cent in last five years (see Graph 11: Declining bus and ridership numbers).

Graph 11: Declining bus and ridership numbers



Source: Comprehensive Traffic and Transportation Study for Jaipur Region, 2018 and primary data

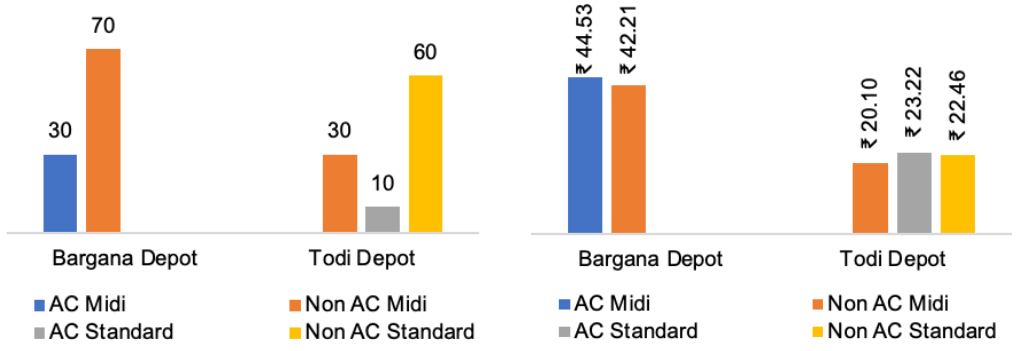
With the decline in bus numbers, the coverage of bus services has also reduced. In 2016-17, JCTSL used to operate buses in 29 routes. Now they are operating buses in 25 routes. Other than JCTSL buses, private mini bus operators have also stopped operating buses in some earlier operated routes.

Presently, all JCTSL buses are being operated by two private operators under gross cost contractual (GCC) framework with some differences. Both of them have a mandate to operate 100 buses each from two separate depots, namely, Todi and Bargana depot.

About 70 standard and 30 midi buses operate from Todi depot. These have been procured under JnNURM scheme in 2017. The bus operator, M/s Mateshwari Travels, is responsible for only providing drivers and take a good care of these buses to make them road worthy during the contractual period. But Bargana depot

operator, M/s Paras travels line, is responsible for taking entire responsibility of bus operations, from providing buses, drivers, fuels to maintaining these buses. Thus, operating cost of these services are also quite different. (see Graph 12: Details of JCTSL bus operations).

Graph 12: Details of JCTSL bus operations



Source: JCTSL

However, the involvement of private partners to operate buses has actually positively impacted the JCTSL service delivery. For e.g., some of the crucial parameters like, fleet utilization, bus utilization, ridership per bus per day and KMPL has improved in past couple of years. (see Table 1: Performance improvement in JCTSL services).

Table 1: Performance improvement in JCTSL services

Parameter	2020	2023
Fleet utilization (no. of buses operated / no. of buses held)	88%	95%
Ridership per bus per day	562	631
Bus productivity (operated km / no. of buses held per day)	190	254
KMPL of fuel	2.76	3.02

Source: Enhanced strategies for clean air action plan: Jaipur Division and JCTSL

All the buses operated by JCTSL are global positioning system (GPS) enabled and JCTSL has created a Jaipur bus app which provides real-time bus information for passenger's convenience. They have also digitized the fare collection through implementation of electronic ticketing machines (ETMs).

It is important to note that CTTS 2018 has highlighted that low frequency and overcrowding of city buses are the two most important criteria for not using buses by the non-bus commuters. This clearly indicates the need for augmentation of reliable, convenient and comfortable bus services to enable shift.

The city also needs to build adequate transit infrastructure with adequate and well-designed bus shelters for passenger convenience along with passenger information system, and ease of access. Presently, the city has around 400 bus stops of which only 146 have bus shelter facilities. A city where average temperature ranges between 30 degree and above for eight to nine months, a shelter is a necessity for the commuters. Encroachment around the bus shelters need to be removed to enable safe access and convenient boarding and alighting (see *Image 2: Encroached bus stops)*. However, encroached bus stops reduce the visibility of services and also create inconvenience to the commuters.

The system requires further upgrade with passenger information system with respect to the arrival time of buses etc and also operational efficiency needs to improve to frequency of bus service. This requires stringent monitoring and action. During the initial stages of the central government scheme to support electric bus programme, Jaipur did not initiate this programme. It is now expected that under the new PM e-bus Sewa Jaipur will seed and expand the electric bus programme. This is an opportunity to leverage zero emissions electric buses for mass commuting. This will therefore require modernization of the bus infrastructure, charging faciliies and protected right of way for buses to increase ridership.

Image 2: Encroached bus stops

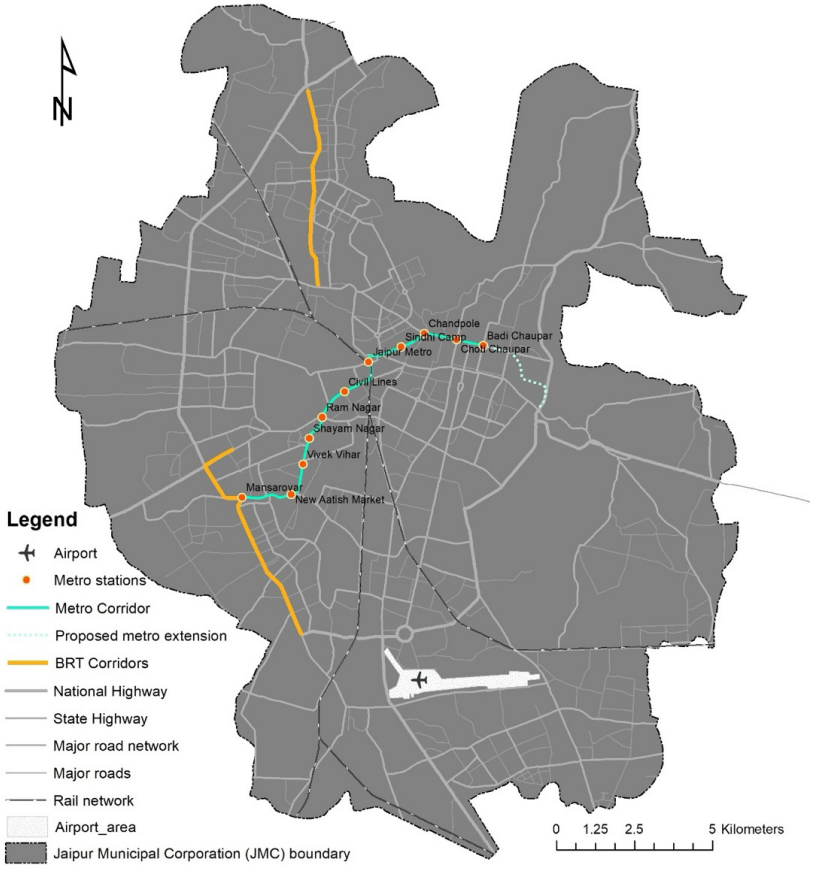
Source: CSE (left-side: near collectorate circle, right-side: near Malviya Nagar)

7. Inadequate mass-transit network

Even though Jaipur was one of the leading cities to have established two bus rapid transit (BRT) systems it could not hold on and sustain this strength. This has been virtually dismantled in the face of resistance from the car users. There is one metro corridor for mass movement which is poorly used.

It will be difficult to reduce vehicular emissions if these mass commuting systems are not upscaled.

Map 4: Limited mass-transit corridors in Jaipur (BRT and Metro)



Source: prepared by CSE

Jaipur bus rapid transit system (BRT): Both the BRT corridors (phase 1 and 3A) are no longer operating as dedicated bus corridors. These are being used by all kinds of vehicles including private cars, institutional buses, private mini buses, goods vehicles etc. This system of providing dedicated space to buses for efficient and free flow to improve commuting experience and speed of the public transport has been dismantled.

Currently, due to lack of attention and poor maintenance the condition of the BRT stations have deteriorated (see image 3: poor condition of BRT corridor, for details).

These abandoned corridors have become traffic nightmares as the vehicles are trying to utilise the corridors to evade traffic signals at junctions. (see Image 3: Poor condition of BRT corridor).

Both state and central investment to build this system has become wasteful while the objective of improving mass transport has not been met.

Image 3: Poor condition of BRT corridor

Source: CSE (left-side: BRT lane being used by private vehicles, right-side: poor BRT station)

Jaipur metro: Jaipur has one 12km long metro corridor with nine stations, from Mansarovar to Badi Chaupar. Presently. The metro corridor connects a few major transit nodes of the city, namely Jaipur railway station, Chandpole, Sindhi camp and Badi Chaupar.

It is planned to extend the corridor to Transport Nagar by 2027. Metro services are available in 10 minutes interval during peak hours. Daily total 101 trips from each side are made with 4 coaches with capacity to carry 200 passenger (seating) at one go. Around 55,000 passengers use metro services on daily basis.

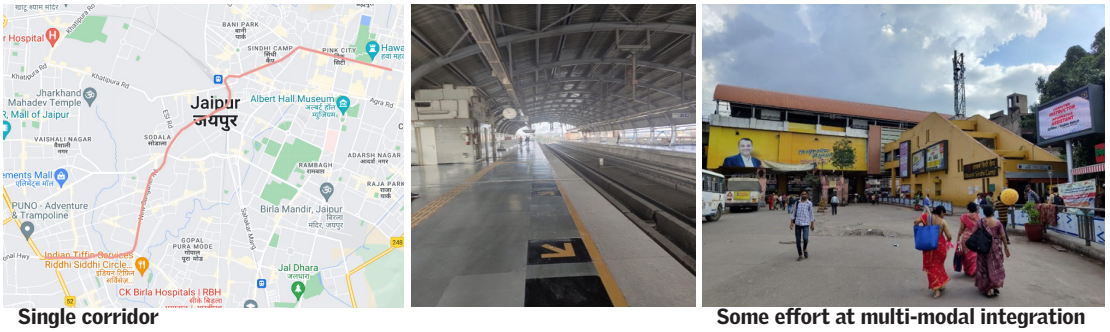
However, the current ridership trend is only 20 per cent of the projected figure forecasted in the detailed project report (DPR) of phase 1 metro corridor (Mansarovar to Badi Chaupar). It was estimated that the corridor would observe around 3 lakhs ridership on daily basis by 2021. This is yet to be achieved.

Currently, Jaipur metro is using token as fare medium. Use of information signage and directional marking and tiles makes it easier for commuters to use the system. Physical integration of metro and other transit nodes exists that can be better designed for easy of access.

As this is a single corridor, it requires interchanges to connect different origin and destinations in the city for most commuters. This increases the journey cost for commuters.

While the city has taken the initiative to build two mass transport systems – BRT and the Metro – it has not been able to leverage these systems for mobility transition. Upscaled action should have been initiated by now to integrate these two systems with enhanced last mile connectivity and feeder systems. This would have enhanced ridership of both the systems and prevent growing usage of personal vehicles that is locking in enormous pollution that will be difficult to undo.

Image 4: Metro infrastructure



Source: CSE (left-side: clean and well demarcated metro station, right-side: physical integration of metro and bus terminal at Sindhi camp)

8. Inadequate non-motorised infrastructure

According to CTTS 2018, around 81 per cent of the roads in the city do not have footpaths. And, the rest 19 per cent roads have some form of walkways. About 15 percent of these roads have footpaths on both sides and the rest four per cent roads have footpaths only on one side of the road.

However, the majority of these footpaths are either encroached by parking, vendors or some installations like traffic/ directional signages and electric boxes. This compromises walkability.

Some initiatives have been taken in the past to encourage cycling by demarcating cycle lanes in some stretches of the roads. Public bi-cycle sharing system was also introduced in the city. But those initiatives never got the right traction to have city-wide scale. (see Image 5: Encroached footpath).

Jaipur with its inherent advantage of small travel distances needs to prioritise active mobility – walking and cycling – that can decarbonize travel and convert a sizeable part of local transport to zero emissions. Even for public transport strategies to be successful, safe walking infrastructure is critical as each and every public transport begins and ends as a walk trip.

Yet, a lot of new investments into road network currently is focusing on car centric road design that includes road widening, removal of crossings, blocking of at grade crossings, one way traffic and pushing pedestrians to foot over bridges that are difficult to negotiate. Such interventions discourage walking, cycling and usage of public transport by design. It is necessary to repurpose spending to augment people friendly road infrastructure.

In the past, there have been efforts to pedestrianize the old city area especially Johri Bazaar that draws heavy footfall and also a lot of traffic. But this has not materialized.

The city micro action plans need to identify such areas and develop low emissions zones that will promote usage of public transport, walking and cycling and electric vehicles. High tourism footfall in Jaipur is an opportunity to develop such strategies.

Image 5: Encroached footpath

Source: CSE

9. Absence of vehicle restraint measures

One of the reasons for poor performance of the metro system and dismantling of the BRT system is the range of hidden subsidies that the personal vehicles enjoy with no restraint on their usage. As this incites usage of personal vehicles, the pressure builds up in the city to provide more road space for personal vehicles and

more land for their parking. This thus, compromises land allocation for public transport systems and the users.

Parking in most land uses are free. Parking pricing has been implemented in a few commercial areas but that is meagre. Parking pricing is not designed based on polluter pay principle or as demand management measure. On the contrary, parking intervention is seen as only supply side management i.e. to only find more space or make multi-level parking or provide more on-street and off-street parking to meet this insatiable parking demand. There are no additional strategies to impose congestion charges etc.

Around 62 per cent of the road network in Jaipur city is covered by on-street parked vehicles. Majority of these parked vehicle areas do not have any demarcation of legal parking areas which encourages private vehicle users to park freely everywhere. Places with such free parking are observed near Jaipur Railway Station, Sindhi Camp, Collectorate Circle, Lal Kothi, Sodala Junction, Madhyam Marg, Raja Park, MI Road, Sikar Road, Sawai Jai Singh Road, New Sanganer Road along the metro corridor, Diggi Malpura Road, Bharkat Nagar Road, Ashok Road, Gopalpura Bypass, among others.

Parking is regulated only in few areas including wall city area, where authorities have decided to limit maximum parking time to 3 hours for two-wheelers and cars. Parking rates are low. While official parking rates are low, due to high demand for parking, higher parking fees than the authorised rates are changed in some locations. (see Image 6: Parking *congestion)*

Image 6: Parking congestion

Source: CSE (left-side: near RTO office, Right-side: internal lane in market area)

It is evident that in 2012, the Rajasthan High Court had asked the state government to ensure availability of parking space before registering a new four-wheeler or three-wheeler or provide proof of parking. However, the enforcement of the rule has been quite poor because it appears that there is no clear system of verifying to confirm the proof of parking submitted by vehicle owners in their submission to the transport department. Registration is allowed based on submission.

Enforcement of such measures require adoption of city-wide parking policy and parking management area plans in each municipal ward to identify and demarcate legal parking areas to establish access to legal parking slot. In other cities like Gangtok in Sikkim or Shimla in Himachal Pradesh proof of parking is verified by either the police or local authorities. Only after that vehicle registration is allowed. An official from Jaipur Development Authority (JDA) informed on the conditions of anonymity that people show a public multi-level car parking facility as proof of available parking space and get their vehicle registered.

Recently, Jaipur Smart City Limited (JSCL) has proposed the development of smart Multi-Level Car Parking (MLCP) at Anaj Mandi and near Jaipuria Hospital at a combined cost of Rs 30.69 crores without considering the long-term sustainability of the project.

The thrust therefore continues to be on supplying more parking instead of restraining demand for parking that can reduce usage of personal vehicles and contribute towards reduce congestion and pollution.

It may be noted that already the Supreme Court of India that is hearing the ongoing public interest litigation case on air pollution in Delhi and the National Capital Region (NCR) has already directed in 2019 the adoption of parking policy and Parking Management Area Plans (PMAP) in municipal wards. Subsequently, the 2022 Clean Air Policy of the Air Commission for Delhi-NCR and beyond have incorporated this measure and in 2024 has asked for its implementation. The NCR segment of Rajasthan Alwar and Bhiwadi are already mandated to implement these measures. This framework needs to be adopted for Jaipur and other non-attainment cities of the state urgently.

The PMAPs as defined as part of the notified policy and rules of Delhi on parking and taken on board by the Supreme Court requires, municipal ward wise delineation of parking management areas, inventory of street activities and parking, identification of legal parking areas in the area and its physical demarcation, penalty on illegal parking, ban on parking in green areas, footpaths

and near traffic intersections. It requires enforcement of variable parking pricing for demand management.

It is designed to ensure that the on-street parking is more expensive so that people do not stay for too long and the turnover rate is high. For instance, a parking study conducted by the Town Planning Department, Rajasthan, indicates that on-street parking duration for about 50 per cent of the vehicles is only 30 minutes; 15–25 per cent of vehicles are parked for a one-hour duration and the rest of the vehicles for more than an hour. This indicates that if there is effective variable pricing linked to duration of parking, these vehicles will move out quicker and may even consider other options.

At the same time relatively cheaper rates inside multi-level car parks can have a high probability of people parking their vehicles inside MLCP to save time and money. This will reduce parking congestion on roads.

MLCP should not be planned in isolation for spot fixing. This needs to be part of the parking management area plans. MLCPs are capital-intensive project and their utilisation needs to be planned well. Mere construction of MLCP is not a sustainable solution in the long run as it does not guarantee an improvement in the parking space crisis. Parking policy is needed to mandate regulation of public land to deter people from parking their vehicles free of cost.

Public support for such strategies can be ensured if a part of the augmented parking revenue is earmarked for local area development. Such plans will also help to organise and identify parking solutions for commercial vehicles and taxis that require overnight parking.

Improving mobility in the city: Proposed framework

This overview of the status of transport and mobility in Jaipur brings out that the strategies for interventions need to be developed for each aspect of transport management – augmentation of public transport services, upscaling of integrated public transport system and ridership; expanding walking and cycling network city-wide, improve access to public transport and make journey cost affordable, enforcing vehicle restraint measures like parking policy among others.

As mentioned earlier, the CPCB has already provided detailed indicators for several of these aspects to reduce vehicular pollution (See Table 3: Mobility related action parameters *provided by CPCB for tracking progress in* micro-action plan*)*. These indicators encompass parking as a demand management measure, improving bus service and requisite technology upgradation, improvement in IPT, walking and cycling network and develop zonal plan for its implementation, and ensure compact city development.

Table 3: Mobility related action parameters provided by CPCB for tracking progress in micro-action plan

VE5	Parking Management
VE5.1	Prevent parking of vehicles in the non-designated areas -- No of challans issued and vehicles towed for parking in non-designated areas per month
VE5.2	Development of Multi-layer parking
VE5.3	Penalise parking of vehicles in non-designated areas - Amount of penalty collected per month
VE6	Strengthening of Public Transportation
VE6.1	Regulate the taxi industry - Steps taken
VE6.2	Assess and introduce a city bus system of appropriate fleet size of small buses and desirable bus type replete with GPS tracking, ETVMs for fare collection and Passenger Information Systems. - Steps taken
VE6.3	Develop route plan for bus operation; target trunk roads - Steps taken
VE6.4	Intermediate public transport (IPT) and bus system
VE6.5	Introduction of new electric buses (with proper infrastructure facilities such as charging stations) and CNG buses for public transport which will reduce plying of private vehicles on road and help to curb tail-pipe emissions.
VE6.6	CNG infrastructure for auto gas supply in the city and transition of public transport vehicles to CNG mode Introduction of e-buses for public transport in metro cities
VE6.7	Steps for promoting battery operated vehicles like E-rickshaw/ E-Cart - Steps taken
VE7.	Traffic Congestion

VE7.1	Conducting audit of traffic intersections and install functional traffic signals at all major intersections -- frequency of audit per annum, operational traffic signals/total traffic signals for major intersections
VE7.2	Synchronize traffic movements/Introduce intelligent traffic system for lane-driving - Steps taken
VE7.3	Prepare plan for construction of diversion ways/ bypasses to avoid congestion due to non-destined vehicles. - Number of bypasses created
VE8	Launch Public awareness campaign for air pollution control, vehicle maintenance, minimizing use of personal vehicle, lane discipline, etc. - Steps taken
VE9	Periodic calibration test of vehicular emission monitoring instrument. SOP for calibration of emission monitoring instrument prepared?
VE11	Phase out old vehicles and vehicle scrappage policy
VE12	NMT
VE12.1	Introducing cycle tracks along with the roads - x Kilometres of bicycle paths and lanes per kilometer of road
VE12.2	Prepare and implement zonal plans to develop an NMT network
VE13	Compact city development to reduce distances and improve access

These requirements of micro-action plans have not catalysed action adequately for upscaled implementation in the mobility sector of Jaipur. The action on vehicular pollution remains limited to strengthening pollution control programme, restricting, adoption of alternate fuel (including electric), phasing out and scraping of old vehicles.

The parameters related to public transport, non-motorised transport and parking as a restraint measure are not clearly defined in terms of the scope of action and the type of steps to be taken. As a result the interventions are either too little or not always in synch with the principles of sustainable mobility.

Thus, it becomes difficult for city authority to take any fruitful actions based on these action plans to ensure increase in public transport ridership and the service level, reduced dependence on personal vehicles, accelerated electrification, and effective operation of parking measures to reduce demand for parking and vehicle usage. Each of these intervention areas require a detailed strategy for effective implementation and to achieve increase in modal share of public transport, walking and cycling and fleet electrification to reduce vehicular emissions.

Need a framework for mobility interventions

To enable and accelerate appropriate mobility action in the city, it is necessary to adopt an assessment framework for defining the scope of action for implementation. CSE therefore proposes an assessment framework for developing strategies for implementation and grading of scope of action for more effective impact and

advancement. This grading of action for each sub segment of public transport, walking and cycling, and vehicle restraint measures reflects the service level benchmark and national habitat standards that have been developed by the Ministry of Housing and Urban Affairs (MoHUA) and are consistent with the provisions of the National Urban Transport Policy, Transit Oriented development Policy and other related policies.

For each parameter in different segments, the nature and scope of action is graded as follow:

- **Base action** is the common minimum that the city must implement right away.
- **Level -1 to Level-3** shows how a city should improve the level of services and the type of improvement needed. This need not be linear and can be combined in the early stages of planning for quicker uptake and impact.

The city administration may strive to achieve the Level 3 quicker in all or priority parameters for an effective impact. The graded action needs to be implemented cumulatively and within a stringent timeline. The timeline needs to be aligned with the NCAP target of reducing particulate pollution by 40 per cent by 2026.

Table 4: Defining the scope of action for each parameter according to the level of service

Thematic areas	Broad parameters	Base level	L-1	L-2	L-3
Bus	No. of buses per lakh population -as per the service level benchmark of MoHUA (as appropriate forJaipur's population) and track ridership	30 buses Report trend in ridership	40 buses Report trend in ridership	50 buses Report trend in ridership	more than 50 Report trend in ridership
	Percentage of buses fitted with ITS facilities, including AVLS, AFCS (ETVM, Smart card), PIS (on board) etc.	75% buses with AVLS and AFCS - ETVM, PIS (on board)	100% buses with AVLS and AFCS - ETVM, PIS (on board)	AFCS- Smart Card [closed loop],	AFCS- Smart Card [open loop], UPI/Debit/Credit/ NFC etc.
	Use of asset management system, Dynamic Scheduling (software based), ERP system, integrated ticketing system for better fleet management etc.	Asset management system	Asset management system and ERP system	Dynamic Scheduling (software based)	Integrated ticketing system

Thematic areas	Broad parameters	Base level	L-1	L-2	L-3
Bus	Percentage of demarcated stops (signage, shelter, PIS, announcement system etc.)	100% stops with Signage (name and post)	All the major bus stops should have bus shelter, basic PIS- QR reader	L-1, 50% of the all-major stops should have PIS display	All Key hubs (major terminals) should have announcement system. Protect right of way of buses
	Condition of Depot infrastructure	Should have basic depot facilities - inspection and repair bays, parking area, manoeuvring area, admin area, crew area, store, high mast etc.	Entire bus parking and manoeuvring area should be concretised, separate sections for tyres, battery and other equipment	Should have advanced equipment, including nitrogen inflator, wheel balancing machine etc.	Depots should be secured through CCTV, roof top solar etc.
Electric buses		Electrification of targeted depots	Depot electrification and charging strategy to maintain the desired schedule of buses	Depot electrification and charging strategy to maintain the desired schedule of buses	Opportunity charging for buses
Autos/ IPT services	Accessibility of IPT services	All the IPT stops on the major road network should be properly demarcated - signage/ colour/ shelter etc. Illegal pick up and drop off to be penalised.	All the IPT stops on PT network should be integrated with PT stops.	All the IPT vehicles should have AVLS facilities. Create association/ cooperative of auto operators for organised services	IPT services should be integrated with journey planner/ app-based platform to show the availability.
Walking	Effectiveness of walking infrastructure	50% of all the major road network (including arterial and sub-arterial, collector roads), should have encroachment free dedicated walkways as per the Urban Road Code/ complete street guidelines	All the major road network (including arterial and sub-arterial), should have encroachment free dedicated walkways as per the Urban Road Code/ complete street guidelines Develop multi-function zones for regulated vending activities	75% intersections located on the major road network should have special provision for pedestrian to cross the road (signalization/ pelican signal, table top crossings etc.)	All the intersection located on the major road network should have special provision for pedestrian to cross the road (signalization/ pelican signal etc.) and all the high footfall areas should have raised crossings High footfall areas, old city/Jauhri bazaar and tourism areas to be developed as low emissions zones.

Thematic areas	Broad parameters	Base level	L-1	L-2	L-3
Cycling	Effectiveness of cycling infrastructure	50% of all the major road network (including arterial and sub-arterial), should have encroached free dedicated cycle network as per the Urban Road Code/ complete street guidelines	All the major road network (including arterial and sub-arterial), should have encroached free dedicated cycle network as per the Urban Road Code/ complete street guidelines	75% intersections located on the major road network should have special provision for cyclist to cross the road (signalization/ pelican signal etc.)	All the intersection located on the major road network should have special provision for cyclist to cross the road (signalization/ pelican signal etc.)
Vehicle restraint	Adoption of vehicle restraint measures	Notifying the parking policy and rules (including parking management area plan-PMAP) for the city, Implement Parking Management Area Plan (PMAPs) by inventorising and demarcating legal parking areas in each municipal ward, penalise illegal parking, do not allow parking on footpaths, green areas and near traffic intersections and implement variable parking pricing. Proof of parking should be linked with PMAPs. MLCPs should be part of PMAPs and not isolated projects. Use part of augmented parking revenue for local area improvement.	Completion of 25% area identified for PMAP implementation, Implementation of dynamic pricing techniques, issuing residential parking permits. Planning to scale up additional 25% area under PMAP.	Completion of 50% area identified for PMAP implementation, planning to scale up rest 50% area under PMAP, Continuous monitoring of implemented PMAP area for further improvements or modification.	Completion of 100% of area as PMAP implementation zones in each municipal ward. Continuous monitoring of implemented PMAP area for further improvements or modification.

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