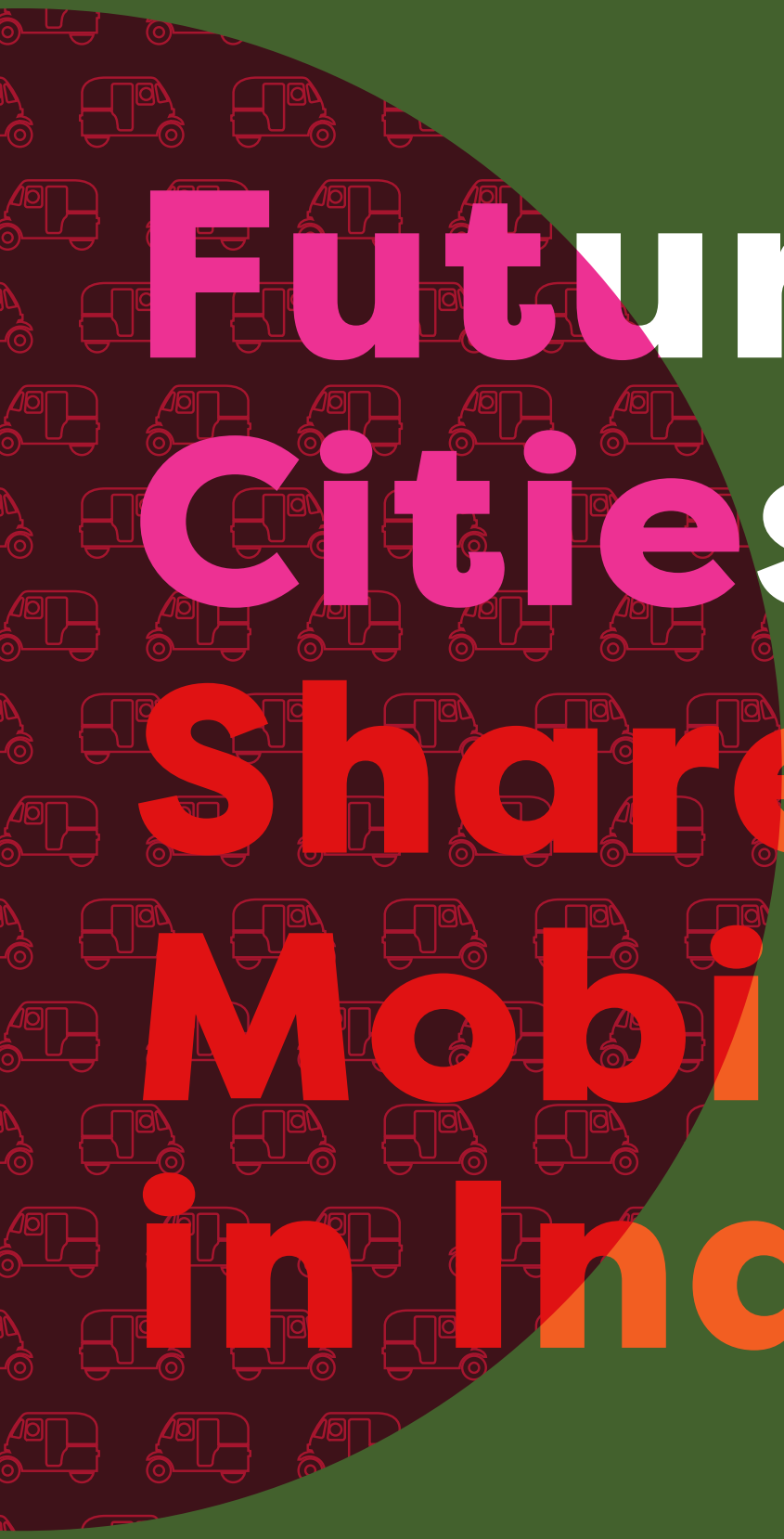
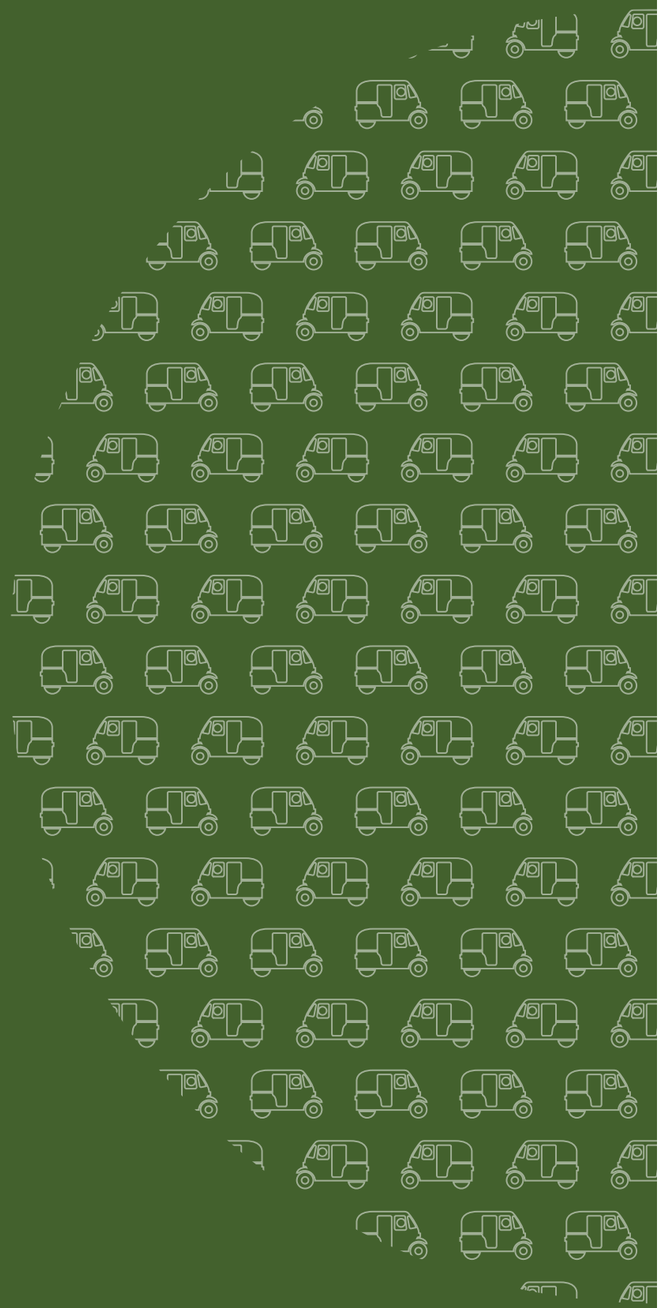


Future of Cities & Shared Mobility in India

How Emerging Mobility Paradigms Are Shaping Transportation Trends In Urban India

Uber WXY

2022



Acknowledgments

This report was produced by Uber and WXY in 2021-2022. Many individuals contributed to the development of this work and the overall findings set forth here.

Uber WXY

Table of Contents

Glossary

ACES	Autonomous driving, connectivity, electrification, and shared/smart mobility
BEST	Brihanmumbai Electricity Supply and Transport Undertaking
BMC	Brihanmumbai Municipal Corporation
BMRCL	Bengaluru Metro Rail Corporation Limited
BMTC	Bengaluru Metropolitan Transport Corporation
BRT	Bus rapid transport
CEEW	Council on Energy, Environment and Water
CESL	Convergence Energy Services Limited
CGM	Centre for Green Mobility
CNG	Compressed natural gas
CSMT	Chhatrapati Shivaji Maharaj Terminus
DDC	Development & Dialogue Commission
Delhi NCR	Delhi National Capital Region
EESL	Energy Efficiency Services Limited
EV	Electric vehicle
FAME	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles
GCC	Greater Chennai Corporation
GHG	Greenhouse gas
GMCBL	Gurugram Metropolitan City Bus Limited
GNCTD	Government of National Capital Territory of Delhi
GoI	Government of India
ICE	Internal combustion engine
IFMR	Institute for Financial Management and Research
IIT	Indian Institute of Technology
INR	Indian rupee
ITDP	Institute for Transportation and Development Policy
MaaS	Mobility as a service
MCGM	Municipal Corporate of Greater Mumbai
MHI	Ministry of Heavy Industries
MMRC	Mumbai Metro Rail Corporation
MMRDA	Mumbai Metropolitan Region Development Authority
MoHUA	Ministry of Housing and Urban Affairs
MPA	Mumbai Parking Authority
NEMMP	National Electric Mobility Mission Plan
NITI Aayog	National Institution for Transforming India
NIUA	National Institute of Urban Affairs
NMT	Non-motorised transport
NUTP	National Urban Transport Policy
OD	Origin-destination
RFP	Request for proposal
SaaS	Software as a service
SEV	Small electric vehicle
TERI	The Energy and Resources Institute
TOD	Transport-oriented development
UITP	International Association of Public Transport
ULB	Urban local bodies
UMMTA	Unified Mumbai Metropolitan Transport Authority
USD	United States dollar
UTB	Unified transport bodies
WRI	World Resources Institute

Executive Summary

India has an opportunity to leapfrog an era of auto dependency by fast-tracking innovative mobility-as-a-service (MaaS) solutions and emphasising mixed-use, walkable development. If India succeeds in improving mobility without proliferating the use of personal vehicles, it will establish a new paradigm for smart, equitable development in rapidly urbanising contexts.

Cities in multiple Asian countries, including India, are confronted with significant challenges in the transport sector due to accelerating economic growth, which has resulted in a substantial increase in motorisation over the past two decades, with about two billion motor vehicles projected on the roads worldwide by 2040 (Smith, 2016). The use of personal motorised vehicles, from two-wheelers to four-wheelers, imposes enormous economic, environmental and social costs, including stifling traffic congestion, deteriorating air quality, alarming crash rates and fragmented neighbourhoods. Nonetheless, owning a personal vehicle remains aspirational for many households in developing countries and, therefore, reducing the growth in personal vehicle ownership will remain hard to achieve. With the right strategic policy incentives, however, policymakers can limit the use of personal vehicles by adopting innovative and effective shared mobility solutions.

This report, commissioned by Uber and developed by WXY studio, contemplates the role of shared mobility in India's transport future. India's current modal share favors non-motorised transport (NMT), ride-hailing and public transport . However, a decline in overall ridership has been observed due to lack of safe pedestrian and bicycle infrastructure and dependable public transport. To address this twofold challenge of retaining and increasing public transport users while avoiding a future of auto dependency, India's policymakers must urgently implement integrated transport and land use policies.

Drawing on a combination of primary survey data, expert interviews and literature review, as well as an analysis of Uber's extensive geospatial data, this report synthesises insights into the effects of new policies, emerging technologies and shifting societal trends in urban travel to inform the future of shared mobility in urban India. The report sets forth four key findings and four strategic recommendations for India's shared mobility future.

Key Findings

1

Growth in personal vehicle ownership challenges India's sustainable mobility future

India's cities are at a critical crossroads in the development of their transport networks. As economic prosperity has become more widely shared, more households are purchasing personal vehicles. Public health and safety concerns during COVID-19 further accelerated an already growing appetite for personal vehicles. Though this tide is rising, India's vehicle ownership rates remain far below developed countries, including the United States. Cities have the opportunity to stem this tide, reduce pollution and implement integrated transport and land use policies based on a more sustainable mix of NMT, public transport, shared vehicle fleets and small electric vehicles.

2

Rethinking street design and parking policy is the key to improving NMT and achieving sustainability goals

India's urban roads are already stretched to their limits, balancing pedestrians, vendors, personal vehicles, public transport and freight delivery, among other uses. Due to limited planning capacity and the lack of influence of NMT among key decision makers, street redesigns in the previous few decades have often imposed order by restricting, rather than balancing space—fencing footpaths to pedestrians, and increasing the amount of roadway reserved for drivers at the expense of NMT.

Overcoming this challenge requires a holistic approach to street design that prioritises NMT, regulates the use of kerbside space and public sidewalks and manages parking to discourage personal vehicle use while generating consistent revenue for infrastructure projects. By reallocating space from private cars to public transport lanes, freight priority corridors, micromobility infrastructure and improved sidewalks, cities can improve transport access, expedite deliveries, encourage sustainable mode choices and avert extreme car dependency. Planned systematically in concert with smart land use policies, these shifts offer a path towards achieving India's smart mobility goals.

3

The shift from personal vehicles to sustainable transport options can improve mobility access for everyone

Shared mobility offers Indians a greater array of choices to meet their travel needs more flexibly. The expansion in access to walking, biking, reliable public transport, on-demand mobility and shared services would enable governments to successfully curb the growth of personal four-wheeled vehicles and improve personal mobility in profound ways. Access to these services does not depend on heavy infrastructure investments but can instead be accelerated through digital policy and regulatory changes to more efficiently allocate road space and vehicle fleets, while prioritising public services that most efficiently move people.

This shift has profound potential to improve mobility among Indians who do not own a vehicle. By making it safe and convenient to walk and bike, urban governments can help reduce overall transport costs at the household level. Once initiated, this new mobility paradigm will foster a positive feedback loop. As infrastructure improves to support transport, NMT and shared mobility, these sustainable transport options will move more people and build popular support for further investment.

4

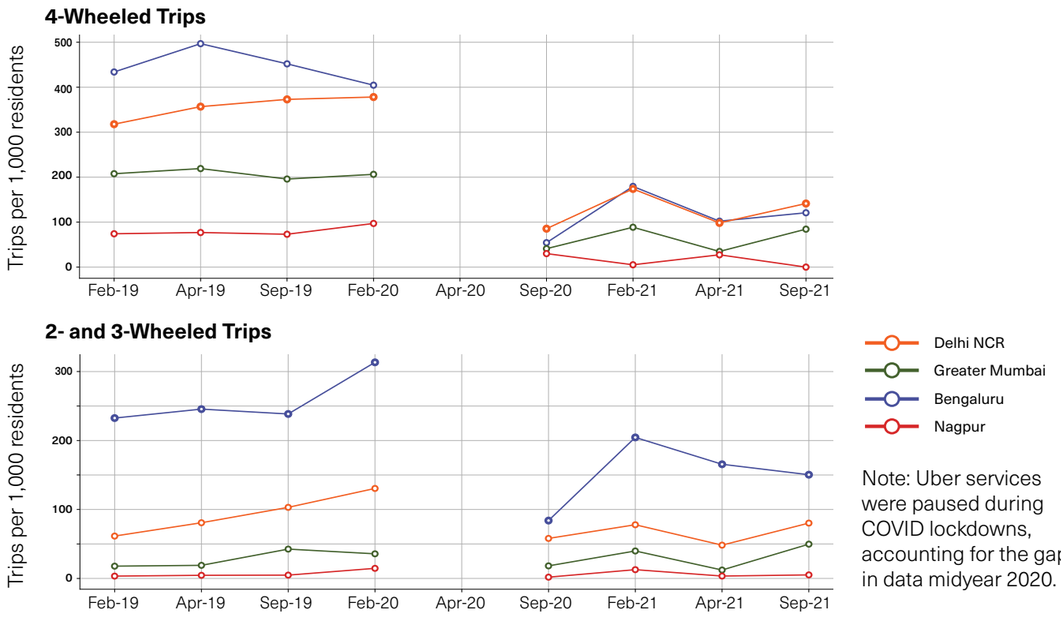
Public-private collaborations are paving the way for smart mobility

As cities expand, private transport operators are filling in gaps in public transport networks, providing first-/last-mile connections, goods delivery and on-demand services that supplement and augment traditional public transport options. The initial stages of this integration of public and private mobility services is well underway, as cities improve coordination across public agencies and develop stronger ties with private transport providers. Private companies expand their options to support sustainable travel through connections to transport, electric vehicles, and micromobility sharing programmes. To improve this collaboration, cities can serve as mobility managers and adopt a more robust geospatial data environment that enables data-informed planning decisions and facilitates real-time collaboration with private partners.

As a global leader in ride-hailing services, Uber ventured into India's growing and price-sensitive market in 2013. It currently offers services in over 100 cities, with over 600,000 drivers, across the country (Business Wire, 2022). To understand the role of shared mobility in the urban transport system, this study examined urban travel patterns in four cities—Delhi National Capital Region (NCR), Greater Mumbai, Bengaluru and Nagpur—of different types across India, using Uber data from February 2019 to September 2021. These four case study cities reflect a range of different urban typologies, from large, high-density, transport-rich cities to smaller, transport-poor areas.

Although the report found an overall steady utilisation trend in Uber usage, data analysis revealed significantly higher recovery rates in demand for two- and three-wheelers (Uber Moto and Uber Auto, respectively) than four-wheelers on Uber's platform after the April 2020 lockdown. This shift in travel pattern suggests an untapped market potential for two- and three-wheelers to supplant and/or complement four-wheeled trips. The COVID-19 lockdowns accelerated this change in Indian mobility, including investments in non-motorised transport, two- and three-wheelers, and walkable mixed-use neighbourhoods, that might otherwise have taken decades. Amidst a changing mobility landscape, Uber has endeavoured to generate new understandings of the future of mobility in India's cities. For example, Uber recently partnered with the Gurugram Metropolitan City Bus Limited (GMCBL) for a pilot focused on building a multimodal mobility system and enhancing commuter experience by allowing pre-booked seats in public transport buses in Gurugram, Delhi NCR using Uber's app (Abrar, 2022). In an effort to engage policymakers, planners, and transport professionals further in a constructive dialogue, the report sets forth four key recommendations that position urban transport systems to meet the future mobility demand of India's growing cities.

Trip Volume for the Four Case Study Cities (February 2019 to September 2021)



Note: Uber services were paused during COVID lockdowns, accounting for the gap in data midyear 2020.

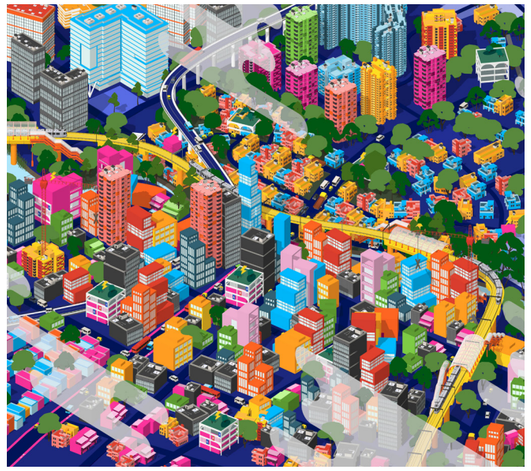
IFFCO Chowk Metro Station
Gurugram, India

Recommendations

Empower Multimodal Mobility Managers

To develop an integrated transport system, a facilitating body must convene both public and private actors around a shared set of objectives. While there is currently no entity fulfilling that role across sectors, multimodal nodal agencies similar to the unified transport bodies (UTB) that exist in many cities at the behest of Ministry of Housing and Urban Affairs' (MoHUA) National Urban Transport Policy (NUTP) can be adapted to fulfill this role and empowered with the regulatory tools required to manage transport initiatives across agencies effectively.

- Expand UTBs to include representatives of the shared mobility companies operating in each city to improve collaboration between and across the public and private sectors, and facilitate the creation of cross-sector partnerships (Deloitte, 2017).
- Empower UTBs to study and improve multimodal interchange points to facilitate connections between modes (NITI Aayog, 2018).



Adopt integrated approach for land use and transport planning

Planners must adopt an integrated approach to land use and transport planning in order to achieve ambitious safety and sustainable mobility goals (ITDP, 2019). Investments in NMT can go further by prioritising dense areas that are adjacent to public transport stations, in support of first-/last-mile connections.

- Lower parking requirements and require developers of new structures to make investments in the public spaces surrounding public transport stations/stops.
- Incentivise the presence of necessary neighbourhood amenities in and around transport stations by using land use regulations.

Use shared mobility to connect underserved areas

Dense housing and commercial space located outside of the urban core and far from access points to public transport require shared mobility options to connect residents and employees to other parts of the city, or to reach public transport lines (Mishra, 2019; WRI India, 2020). Data analysis revealed high travel demand for Uber's services in these areas.

- Partner with shared mobility companies to implement aggregator services and shuttle systems that serve disconnected, transport-poor areas.
- Mandate major new developments to create a transport demand management plan to connect with existing networks, set target mode shares, plan required transport infrastructure and measure carbon emissions (SFPC, 2021).
- Use city incentives to promote car-lite developments by building near transport or by establishing coordinated shared mobility services (ITDP, 2015).

Encourage transition to sustainable mobility

In addition to promoting the adoption of green fuel vehicles, including electric vehicles (EVs) and compressed natural gas (CNG) vehicles at national and state levels, India also seeks to bolster employment opportunities and industry for EV manufacturing.

- Extend subsidies to include electric micromobility vehicles like e-bikes, electric kick scooters and other new forms of micromobility (McKinsey, 2020).
- Shift to progressive subsidy models focused on benefitting lower-income households to ensure affordable access to a variety of EV types.
- Pair investments in energy grid with investments in EV infrastructure to ensure adequate generation capacity to support the additional system load.

Introduction

In a policy landscape that has increasingly embraced public transport and NMT as the future, shared mobility stands to play an integral role in filling first-/last-mile gaps and servicing growing urban areas in India.

Indian cities are among the most populous urban centres on the planet, and they are expanding at an astounding rate. In the last 30 years, India has added five megacities (Delhi, Mumbai, Kolkata, Chennai and Bengaluru) of over 10 million people each, with two more megacities (Ahmedabad and Hyderabad) expected by 2030 (Randhawa et al, 2017). At this critical inflection point, India's transport landscape is being shaped by ambitious policies and investments at the national, state and local levels. Major infrastructure projects across the subcontinent are stitching regional centres together for passenger and freight transport, while local investments in rail, road-based public transport and street design are transforming neighbourhoods and tying outlying areas into their cores through new connections (ITDP, 2015; WRI India, 2020).

Innovations in transport technology, mobility-as-a-service (MaaS) and renewable fuel sources represent the early hallmarks of a new age in transport that promises greater efficiency, lower emissions and more equitable access. Shared mobility, defined as any mode of transportation shared by users for movement of both people and goods on an as-needed basis such as carsharing or bicycle-sharing systems (NITI Aayog, 2018), is an integrated strategy towards a more sustainable development path economically and environmentally.

Policy Context

India's transport policy context is reflected by the National Urban Transport Policy (NUTP) published by the Ministry of Housing and Urban Affairs (MoHUA) of the Government of India (GoI). This policy provides a clear directive to states and urban local bodies (ULB) to control the growth of private automobile traffic and facilitate NMT and public transport. The NUTP set forth a clear vision "to recognise that people occupy center stage in our cities and all plans would be for their common benefit and well being," and "to make our cities the most livable in the world and enable them to become the 'engines of economic growth' that power India's development in the 21st century" (MoHUA, 2018).

States and municipalities have since answered this call with their own NMT and sustainable transport policies. The national Smart Cities Mission, an effort to enhance quality of life of people by enabling local governments to adopt smart technologies and smart city planning practices, has accelerated these efforts by establishing new funding mechanisms to support redesigned city streets with the integration of smart mobility and transport.

When the nation shuttered during its April 2020 lockdown, streets, railways and highways ground to a halt as residents isolated at home. COVID-19 gave the directives of the NUTP new urgency, as many Indians shifted away from public transport in favor of private modes and turned to NMT for shorter local trips. In this context, the MoHUA issued an advisory in June 2020 to help local governments accommodate new travel needs. The advisory directed cities to redouble their efforts to support NMT as a central tenet in urban transport planning, and to support the return to public transport by ensuring proper vehicle sanitisation along with new methods of cashless and contactless payment. As national initiatives of the Smart Cities Mission, MoHUA also launched the India Cycles4Change Challenge, the Streets4People Challenge, and the Transport4All Challenge in 2020 to inspire cities to develop solutions that create walking- and cycling-friendly streets and improve public transport in consultation with stakeholders and citizens.

Prior to April 2020, India's economy was growing at an average 5.8% per year, with a quickly expanding middle class (Nayak et al., eds. 2010). Researchers have identified a direct correlation between household income and transport expenditure among Indians (Ahmad et al, 2015), and as the country's middle and upper class has grown, so too has the aspiration to own a personal vehicle despite the number of vehicles on its already heavily congested roads. With just 22 cars per 1,000 citizens, (as compared to the United States' 816) (US Dept. of Energy, 2017), the nation now faces a critical challenge to improve the mobility of its citizens, who now rely heavily on NMT, while stemming the growth in personal vehicle usage that will worsen congestion and increase greenhouse gas (GHG) emissions and road fatalities (Singh et al, 2020).

An Environmental Cliff

India's transport future, while critical to its citizens' physical and economic mobility, will also have profound impacts on the planet's climate outlook. Based on the last recorded data from 2019, India emitted 2,300 megatons of CO_2, the third most of any nation, behind only China and the United States (International Energy Atlas, 2020). In 2020 and 2021, CO_2 emissions were expected to be lower due to multiple COVID-19 lockdowns. Transport is a major contributor, as the third most CO_2-emitting sector of India's economy (Singh et al, 2022).

Despite its already huge impact, Indian road transport emissions will have even more significant implications if the nation continues to see exponential growth in the use and therefore, ownership of personal vehicles. The current number of four-wheel cars in India is projected to multiply up to 6.6 times by 2050, to a projected 432 million vehicles (Singh et al, 2020). The tools to avoid an auto-dependent future are available, and the willingness exists among most urban Indians (Soman et al, 2019), but the solutions will require public-private coordination to execute. Initiatives for promoting a sustainable, shared mobility future include the continued expansion of public transport systems, promotion of non-motorised transport through investments in footpaths and cycle tracks, transport-oriented development (TOD) policies and the expanded use of EVs through strategic incentives and charging infrastructure investments.

Sustainable Transport

The sustainable transport strategies outlined in the NUTP can reduce the underlying demand for personal

HUDA City Centre Metro Station
Gurugram, India

vehicles, the major contributing factor to transport-based emissions. This work is already evident in metro expansion programmes in Mumbai, Bengaluru, Nagpur and other cities as well as in NMT initiatives in Delhi, Pune and Chennai.

Vehicle electrification represents another core component of India's sustainable transport platform. National policies like Faster Adoption and Manufacturing of Hybrid and Eelectric Vehicles (FAME) and vehicle electrification policies in more than 15 states are using regulatory and financial mechanisms to accelerate this shift. Indians are being nudged towards EVs with a mix of positive incentives that includes purchase subsidies, taxes and fee waivers and expanded charging infrastructure. Some state strategies and public transport improvements have also included retrofitting internal combustion engine (ICE) vehicles to operate using cleaner-burning fuels like compressed natural gas (CNG). Together, these strategies are building a new mobility future in India's cities.

India's urban transport systems are at the crossroads of a new era, pressured by expanding city populations, new technologies and novel policy approaches (Smith et al, 2019). This new matrix of mobility options will support economic growth, individual mobility and climate adaptation.

Research Methodology

In order to better understand the role of shared mobility in India's future, this report used multiple research methods, including literature review, a survey of transport professionals, geospatial data analysis and one-one-one interviews.

The research team built on existing research and literature by directly engaging subject matter experts in the field, including practitioners, transport system operators and researchers, through both a survey and a series of interviews conducted in fall and winter 2021. Additionally, the study drew insights using Uber's trip data, including trip volumes, distances and origin and destination wards, from February 2019 to September 2021 for the four Indian case study cities: Delhi NCR, Mumbai, Bengaluru, and Nagpur.

Literature Review

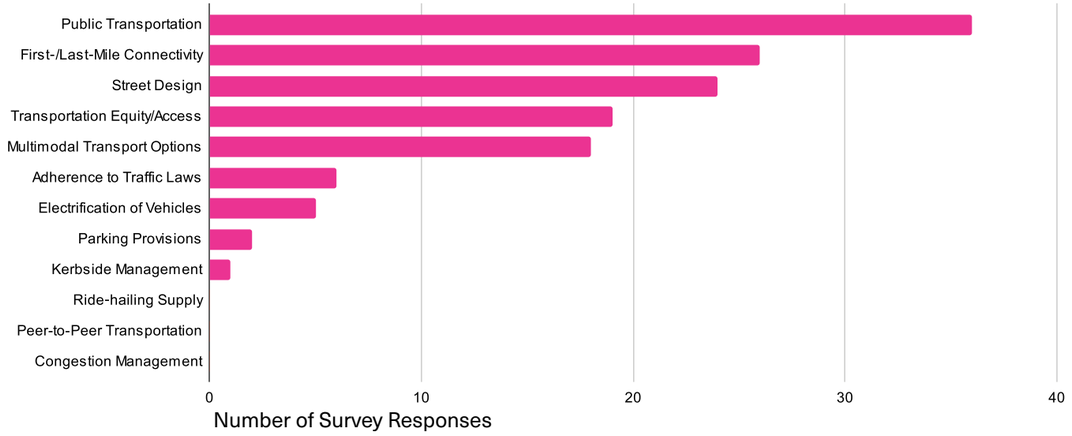
An initial literature review of current trends was conducted and drew upon official government releases, national and state policies, academic research articles and reports by major international development agencies.

Survey

As part of the research for this report, a survey was developed and shared with transport professionals, academics and policymakers. The survey was open for one month from September to October 2021 and collected quantitative and qualitative input. The survey consisted of five biographical questions, one ranked-choice response and four open responses. Questions covered mobility priority areas, the identification of challenges and opportunities, Uber's existing and potential role and changes witnessed as a result of COVID-19. A total of 31 responses were collected that helped to inform the contents of this report and serve as a basis for extended interviews with a selected subset of respondents.

Survey respondents represented 26 unique organisations that are shaping the transport space in India. Among those government, private and academic entities

Analysed Responses: Top Priority Areas in Transport Planning and Management



were major institutions like the Council on Energy, Environment and Water (CEEW), the Energy and Resources Institute, the Institute for Transportation and Development Policy (ITDP) India, the Mumbai Metro Rail Corporation (MMRC), the Mumbai Parking Authority (MPA), the National Institute of Urban Affairs (NIUA), the Shakti Sustainable Energy Foundation and others. Respondents were from Delhi, Mumbai, Bengaluru, Bhopal and Pune.

Among survey responses, certain themes arose consistently. Public transport was widely listed as the top priority area for transport planning and management among respondents. When asked about the greatest challenges facing urban mobility in India, respondents frequently listed:

- Rising vehicle ownership rates
- Lack of institutional coordination
- Poor integration of private-sector initiatives into overall planning efforts
- Lack of political will and citizen demand for transport investments

Respondents highlighted the creation of tech-enabled citizen-centric solutions, first-/last-mile connectivity, sustainability and smart ticketing among other items as critical areas of evolution in the shared mobility space.

When asked about Uber's role in particular, the most common responses centred around first-/last-mile connectivity and greater coordination with transport operators. Finally, when asked about the potential long-term impacts of COVID-19 on urban mobility, most professionals did not believe that it would have a long-lasting impact, but that in the short term it would drive more people towards personal transport options.

Interviews

In addition to the survey, seven interviews were conducted with decision makers and thought leaders throughout India. The set of interviewees included representatives of the Development & Dialogue Commission of Delhi (DDC), MMRC, MPA, Bengaluru Metro Rail Corporation Limited (BMRCL), CEPT University, the Centre for Green Mobility (CGM) and Sensing Local.

These semi-structured, hour-long interviews enabled the research team to dive deeper into topics of particular interest. Areas of focus included transport expansion, street design, sustainable mobility, parking policy and participatory planning practices. The key findings included:

- Parking management and charging infrastructure are essential to shift towards micromobility solutions
- Coordinated TOD can substaintially increase public transport mode share
- Unified transport bodies should be created inclusive of both public and private operators
- Poor availability and access to spatial data hinders integrated transportation planning efforts

Case Study Data Analysis

For the purpose of this study, four unique cities were selected as case studies to understand the role of shared mobility in the urban transport system. The four focus cities, Delhi NCR, Greater Mumbai, Bengaluru and Nagpur, each have different scale and character, as well as varying levels of transport infrastructure, distinct attitudes towards shared mobility and gradients of density.

The study bolstered publicly available geospatial data by cross-referencing it with Uber trip data. Through this time-based assessment of Uber origins and destinations, particular areas (broken down by wards) of interest arose based on significant trip volumes or changes therein. The study used available data to assess population density, built environment characteristics, road network density and public transport access, among other variables. Socioeconomic data was considered where available but was not readily accessible in all cities.

Uber trip data was aggregated and analysed at the ward level, with origin-destination trip pairs of 5 trips or less (per month) screened out for privacy purposes. Uber trips were also aggregated by trip type, with two- and three-wheeled trips analysed separately from four-wheeled trips.

Several key questions arose through the data analysis and investigation:

Trip geography and distribution: What is the overall spatial distribution of trips in the city? What parameters, including population density, business clusters or airports, drive trip distribution?

Trip time distribution: How are Uber trips distributed over the course of a day and a week?

Trip length and distance: How far do riders take two- and three-wheelers versus four-wheelers? How did trip distances shift during the pandemic, if at all?

Demographic-related travel patterns: What is the relationship between Uber ridership and population density? Are there clear patterns that emerge in terms of either origins or destinations? Are there clear patterns of usage based on land use or built characteristics?

To explore these questions, the team compared the trends observed in Uber travel data against each ward's physical characteristics, available socioeconomic data and the location of transport routes and stations. The correlations noted across these factors are explored in later sections of the report.

Emerging Mobility Trends

A new transport landscape is rising in India, characterised by expanding public transport options, increasing access to personal vehicles, competitive shared mobility platforms, electrification initiatives and a coordinated push towards NMT.

As India's cities expand at an incredible pace, its local, state and national governments have sought to guide their development under the principles of smart growth in an effort to support multiple goals:

- Facilitate economic growth
- Support human health and well-being
- Distribute resources fairly
- Control urban GHG emissions and improve urban air quality

Collectively these programmes seek to expand public transport, electrify vehicle fleets, encourage NMT and develop equitable access to mobility options. Several of the nation's planning initiatives are also informed by the national Smart Cities Mission, launched in 2015, which seeks to use innovation and technology to develop 100 cities and address urban challenges across India (Smith et al, 2019). With the Mission period ending in June 2023, seven cities from the states of Madhya Pradesh, Gujarat, Rajasthan, Odisha and Uttar Pradesh have taken a lead with most projects completed (Sharma, 2022).

Various urban policies, including NUTP and India's current Smart Cities policy, reflect a newfound emphasis on planning at the local level to achieve national policy objectives emphasising an approach that foregrounds collaboration between public and private actors and encourages private investments in infrastructure, including foreign direct investment.

The following section synthesises findings from the literature review, survey, and stakeholder interviews to assess the form of this emerging shared mobility future.

Public Transport

Takeaway: Public transport is expanding, transformative service improvements are enabling greater collaboration and integrated information technology to improve transport access while creating more accessible options.

1 Metro Expansion and Bus Rapid Transport

Multiple cities, including Mumbai, Bengaluru and Nagpur, are currently expanding or building out new metro systems for intracity travel. Although most major cities are well connected to their neighbors through suburban rail networks, the cities are additionally creating alternatives to using personal vehicles to improve mobility, reduce car dependency and increase urban land values. Portions of these light rail investments are being driven by foreign direct investment. According to a representative from the MMRC, Mumbai's new Metro line 3 has received 57% of its funding from the Japan International Cooperation Agency (Interview, MMRC, 2021).

Many Indian cities have made, or are planning to make, substantial increases in bus service, including new bus rapid transport (BRT) lines. This is possibly because shared bus network is a high frequency transport system with costs much lower than metro. After Pune launched the nation's first BRT line in 2006, its success led to the implementation of compressed natural gas (CNG) buses in 2009, and the eventual creation of the Rainbow Line in 2015, with the first electric buses rolled out in 2019 (Pune Smart City Development Corp. and ITDP, 2021).

2 Mobility as a Service

Mobility as a service (MaaS) has the potential to vastly expand the return on investment for India's rail- and bus-based mass transport systems. MaaS offers more travellers the ability to access first- and last-mile mobility options to connect with transport, effectively expanding the area around each station that is served by mass transport by several kilometres (Deloitte, 2017). A representative of the BMRCL said in an interview that the agency is optimistic about the potential of shared mobility services, such as for-hire two- and three-wheelers, to extend access to light rail lines, particularly through initiatives like unified payment integration. As MaaS expands, mobility will be increasingly defined by access to services, rather than asset ownership. According to a 2020 Deloitte survey, 56% of Indians were travelling more "because of readily available ridesharing services," and 60% now question the need to own a vehicle in the future (Deloitte, 2020).

3 Smart Transport

As the data environment in India's cities continues to improve and more devices, urban infrastructure and vehicles become digitally connected, public and private transport operators are increasingly shifting to smart transport models (McKinsey, 2020). Smart transport uses real-time data to improve the efficiency of mass mobility through more efficient routing, appropriate demand matching with right-sized vehicles, and tech-enabled interventions that prioritise mass transport. Telematic technologies, which monitor vehicles using GPS and on-board diagnostics, enable vehicles in a network to communicate and serve as the first step towards more widespread automation. In the 2019 ACES Consumer Survey conducted by McKinsey, the proportion of Indian respondents who said they would be willing to own a connected car jumped from 20% in 2014 to 54% in 2019.

Public-Private Partnerships

Public-private partnerships are critical to the future of India's transport systems. By deepening coordination across public- and private-sector actors, Indian cities can improve mobility options in new and creative ways, while more effectively responding to shifts in transport demand. Private companies are well equipped to meet rapidly shifting mobility priorities, while government investments in road and transport systems create a framework for investments in sustainable transport (Canales et al, 2017). Although they are mutually reliant, public and private actors often lack coordinated operations, creating friction across mobility networks.

Despite the benefits that can emerge from the integration of public and private transport systems, there are significant challenges of coordination across public agencies and with the private sector. The 2006 NUTP recommended the creation of a Unified Metropolitan Transport Authority to coordinate disjointed transport operators in every city larger than one million residents (Desai, 2022). In 2008, Mumbai formed the Unified Mumbai Metropolitan Transport Authority (UMMTA) in response to this policy (MMRDA, 2021), however the body has struggled to fulfill its full potential to date due to its lack of statutory power (Desai, 2022). During an interview in November 2021, a representative of the MMRC reported that they are coordinating with Mumbai's suburban rail operators and the Brihanmumbai Electricity Supply and Transport Undertaking (BEST) to refocus the work of the UMMTA in concert with Mumbai Metro Line 3 from Cuffe Parade to Aarey Depot with a likely extension from Cuffe Parade to Navy Nagar in the far-south of Mumbai. Although the body currently consists of only public operators, MMRC was hopeful that future iterations would coordinate with, or directly incorporate, representatives from Mumbai's private transport and mobility operators. Direct public-private coordination through the UMMTA would enable transport agencies to take a network approach to mobility planning and implement features to improve travellers' experience, like fare integration across services, contactless digital payments and coordinated scheduling. Such bodies may also enable transport agencies to shift into the role of mobility managers, going beyond fixed-route operations to coordinate the activity of shared mobility companies and aggregator services.

In the absence of a dedicated body to coordinate public-private mobility partnerships, private operators have sought to fill existing gaps in the mass transport networks through a combination of private for-hire vehicles and aggregator services (WRI India, 2020). Private aggregator services approach the environmental and spatial efficiency of public transport by serving groups of people in larger vehicles with each trip. These companies typically cater to younger workers commuting more than 30km. Although typically perceived as disruptive to public transport, Shuttl, a Gurugram-based company that provides app-based buses for office commuters, reported that 6% of its users switched from car-based modes, and only 2% of users shifted from public buses to private aggregators (WRI India, 2020). By the way of a more recent example from 2022, Uber partnered with the Gurugram Metropolitan City Bus Limited (GMCBL) for a pilot focused on enhancing commuter experience by allowing pre-booked seats in public transport buses in Gurugram using Uber's app (Abrar, 2022). Consequently, companies offering private aggregation services, like OLA, Rapido, Shuttl and Uber, can form a key leg in urban strategies to combat car dependence, particularly in outlying office or industrial parks that are not well served by mass transport.

Parking and Kerbsides

Takeaway: Stronger parking regulations and enforcement can help create streets and public spaces that centre people, disincentivise car ownership and generate revenue to fund sustainable mobility projects. Cities and consumers must overcome the expectation that parking is free and fill data gaps to establish parking strategies tailored to neighbourhoods.

1 Existing Parking Trends

Parking a four-wheeled vehicle will become increasingly difficult as the number of cars on the road increases. Many cities across the country have adapted parking policy, but its implementation and enforcement remains a challenge. Government agencies are leaning into this strategy and utilising street redesign programmes to reallocate road space from auto parking to non-motorised users and public space (ITDP, 2015).

2 Variable Parking Pricing

Cities are experimenting with programmes to vary parking fees based on location, vehicle type, time of day and surrounding land use. Becoming one of the pioneering cities in on-street parking management in the country, Ranchi implemented variable pricing on its busiest thoroughfare, Mahatma Gandhi Marg, with a twelve-fold increase in revenue (ITDP, 2019). According to a recent interview, the MPA will soon differentiate parking zones as commercial, semi-residential and residential with accompanying fee structures. The representative from MPA suggested to initially start with flat, reduced pricing for residential zones to accustom people to pay instead of free parking and then slowly move towards variable parking pricing as per timings or land use. These pilots have the potential to support more progressive and equitable parking policies that account for the negative externalities associated with motorised and four-wheeled vehicle use.

3 Parking and Complete Streets

As cities continue to redesign streets to centre people, demand for personal vehicle parking represents a potential hurdle in public adoption. In 2014, Chennai became the first Indian city to adopt an NMT Policy, and the Greater Chennai Corporation (GCC) and Chennai Smart City have since embarked on complete street redesigns for 75km of roadway (MoHUA and ITDP, 2019). GCC planners have cited encroachment by personal vehicle parking and vendors as key obstacles to implement complete street programmes (MoHUA and ITDP, 2019).

Reallocating Space

Many cities have made reallocating parking and kerbsides a key strategy to support the shift to non-motorised transport. Although often contentious, parking reallocation can attain broad public support. According to a 2019 survey conducted by the CEEW and the Shakti Sustainable Energy Foundation that surveyed 3,682 urban citizens across India, 90% of city residents support creating dedicated parking areas and parking fees to free up space and raise funds to build cycle lanes and footpaths, and 86% support policies to make transport more sustainable, including fuel-efficiency standards, cleaner fuels, more walkable communities and reduced subsidies for petrol (Soman et al, 2019).

More cities are taking this mandate to heart as they work to redesign their streets to support NMT and sustainable mobility options. In October 2021, the Union Ministry of Housing and Urban Development of the GoI honored Delhi with its Best Non-Motorised Transport award for the 1.4km redesign of Chandni Chowk, which reserves the busy commercial corridor for pedestrian-only use during the day (MoHUA, 2021). Additionally, Pune has set a goal to reach 90% NMT by 2031, by redesigning 100km of streets in the Pune Streets Programme, as well as creating 400km of cycle infrastructure under its Comprehensive Bicycle Plan (Pune Smart City Development Corp. and ITDP, 2021).

Smart Kerbside Management

Providing a visual and physical delineation, kerbside is the edge of a footpath where it drops to the level of the road (WSP and Uber, 2020). Indian local and state governments are working to implement smart kerbside management programmes that combine new technology-enabled tools with traditional policy and regulatory practices to improve access to and utility of the kerb (Randhawa et al, 2017). In addition to traditional regulatory interventions such as designated parking and loading areas, some governments in other countries are now using real-time data to implement dynamic parking fees that vary by vehicle size and time of day (ITDP, 2015). These services allow drivers to see parking availability before their arrival and reserve spots. Combined, smart kerbside management practices help to match parking supply with demand, reducing overall trip time, fuel usage, congestion and air pollution that results from drivers looking for parking. Smart kerbside management also has the potential to generate dedicated revenue for mobility projects and will be required to make room for charging locations to facilitate the shift to electric vehicles.

Hauz Khas Metro Station
Delhi, India

The MPA is working to improve its kerbside management, however, the authority faces the challenge of pervasive culture of free parking and a lack of detailed data. Authority representatives stated that before they can implement smart kerbside management techniques, they will need to solidify a move from free parking to regulated parking areas that promote pedestrian access. To reach that state, MPA is moving in multiple phases to regulate parking as stated above. The second phase will incorporate fee differentials to account for peak time usage and land value (Interview, MPA, 2021).

Some Indian cities, including Mumbai and Chennai, are piloting more traditional regulatory interventions, which rely upon manual kerbside data collection (Interview, MPA, 2021). Many cities lack access to real-time and precise geospatial data, which presents a significant hindrance towards the implementation of tech-enabled kerbside strategies. Despite this data gap, MPA is working to assemble baseline kerbside capacity data through manual surveys, to support app-based and data-reliant strategies in the future (Interview, MPA, 2021). Shifting to less labor-intensive data collection methods can be expedited through closer public-private partnerships with mobility companies that collect travel data in Indian cities. Similarly, research universities and institutions can be important partners in advancing data-enabled kerbside management strategies and data sharing agreements.

CURRENT

FUTURE

Managing the Kerb

Updates to the kerb such as new parking policies, dedicated loading and unloading zones and the addition of more street furniture and greenery can further promote NMT (ITDP, 2015). Paired with street design that creates more dedicated space for pedestrians, bicyclists and vendors, streets can meet the needs of more people while ensuring a clear hierarchy that prioritises more vulnerable users and transport over personal vehicles.

Green Fuel and Electrification

Takeaway: Public policies and investments supporting EV charging infrastructure and domestic EV manufacturing are laying the groundwork for the shift toward electrification, while user incentives seek to lower the cost of EV purchase.

1 EV Manufacturing

While 16 states in India have EV policies, most of these include incentives and direct subsidies to encourage the development of electric vehicle manufacturing facilities and battery recycling programmes. These incentives include set-asides of industrial land for EV manufacturing, the creation of factory sheds ready for EV production, the construction of dedicated EV testing tracks and the development of training programmes to grow a skilled local labour force.

State policies in Karnataka and Tamil Nadu give particular emphasis to manufacturing programmes given the states' existing high capacities for research and development and auto manufacturing, respectively. It should be noted that, while these policies are important steps, to date EV manufacturing in India has been geared toward privately owned vehicles. Increasing manufacturing capacity to include commercial vehicles can dramatically multiply the positive environmental impacts of vehicle electrification.

2 Electric Vehicle Charging Infrastructure

Private and public investments in EV charging infrastructure will change the streetscape and make the option to use an electric vehicle viable for more households. State EV policies seek to provide charging stations throughout their cities and highway networks. State policies also use requirements for new development and incentives for existing buildings to incorporate EV-ready parking spots in off-street parking facilities.

3 Incentives

National, state and city governments are all providing incentives for citizens and institutions to make the switch to EVs. As more Indian households seek to purchase a vehicle, policymakers hope to avoid the emissions associated with internal combustion engine (ICE) vehicles by providing direct subsidies and waiving registration fees, road taxes and tolls for EVs. Nearly all state policies reserve special incentives for electrified two-wheelers, autorickshaws and public and private buses. Investments in EV programmes will be funded through additional tax on petrol, higher road taxes on ICE vehicles and congestion pricing fees.

Going beyond incentives, Delhi is now considering a mandate that certain proportions of shared mobility provider fleets be EVs. Policy requirements for two- and three-wheelers are for 10% within six months, 25% within one year, 50% within two years, 75% within three years and 100% electrification within four years. The proportions for four-wheeled vehicles are lower, requiring 5% within six months, 15% within one year, 25% within two years, 50% within three years, 75% within four years, and 100% within five years (GNCTD, 2022). However, drivers' ability to comply with these targets will be contingent on the pace of vehicle manufacturing and charger installation, as well as the cost of EVs, which are not aligned with these ambitious mandates. Policies with more achievable targets, and those that apply to a broader cross-section of vehicle owners, not just a small subset, will ultimately have a greater impact.

4 Public Transport Electrification

Multiple cities have electrified their bus fleets or shifted to compressed natural gas (CNG) fuel to reduce air emissions from public transport. The addition of 150 new electric buses in May 2022 increased the total number of buses in Delhi to 7,205, with 2,000 electric buses and 600-700 CNG buses further anticipated by 2023 (*New Indian Express*, 2022). Assisting in the work to electrify transport, Convergence Energy Services Limited (CESL)—a subsidiary of Energy Efficiency Services Limited (EESL) operated by the Ministry of Power, GoI—released an RFP in January 2022 to procure 5,580 electric buses with the intention to bolster public transport fleets in Bengaluru, Delhi, Surat, Hyderabad and Kolkata (*Financial Express*, 2022).

Major Investments in Charging Infrastructure

National and state governments have announced multiple programmes to increase the amount of electric vehicle charging points accessible to the public in an effort to catalyse faster EV adoption. A more comprehensive network of charging stations will be especially critical for enabling EV adoption for commercial vehicles, which drive more miles than private cars and thus will need to charge more frequently. The Ministry of Heavy Industries (MHI) shortlisted 11 cities for rapid EV introduction under FAME, with 10,383 crore INR earmarked for FAME II in FY2020-22 (Verma, 2020). The National Electric Mobility Mission Plan (NEMMP) aims to invest 13,894 crore INR (1.7B USD) over eight years to develop electric infrastructure (Verma, 2020).

In addition to national investments, state EV policies have set ambitious goals for the creation of charging stations throughout their cities and highway networks. Both Delhi and Maharashtra have set goals to install public electric charging facilities every 3km throughout urban areas, and Maharashtra will additionally install EV chargers every 25km along highway networks. State policies also lean on private developers to augment public charging networks. Delhi's policy requires at least 20% of all parking spots in new developments to be EV-ready and sets aside monetary incentives for existing buildings to retrofit parking facilities to accommodate electric vehicle chargers.

Alektrify Charging Station
Gurugram, India

Alektrify Charging Station
Gurugram, India

Two- and Three-Wheelers

Takeaway: Two- and three-wheeler registrations will continue to grow as an affordable option for personal vehicle ownership, and an increasing number of these small vehicles will be electric.

1 Two- and Three-Wheeler Electrification

Vehicle electrification policies in multiple states include additional incentives and mandates for two- and three-wheeled vehicles. For example, Delhi's policy includes subsidies of 30,000 INR for new electric two and three-wheeled vehicle purchases, and an additional 7,500 INR incentive to scrap old ICE autorickshaws. Maharashtra's policy sets a high goal for 30% of new three-wheeler registrations to be electric by 2025, in comparison to just 10% of all vehicles in the same period. Over the next several years, last-mile delivery for food, grocery and e-commerce is expected to be a central driver of electric two-wheeled vehicle uptake, as well as ride-hailing and self-driving rentals (McKinsey, 2020). Projections suggest that a combination of technological improvement and incentives can achieve 100% market penetration of two-wheeled e-vehicles by 2031. While a penetration level of 71.54% can be achieved if incentives are withdrawn after 2024, only 21.86% peneration can be achieved with no technological improvement even if incentives are continued until 2031 (NITI Aayog, 2022).

On-Street Two-Wheeler Parking in Unitech Cyber Park
Gurugram, India

2 Pandemic Ridership Preference

Two- and three-wheelers emerged as preferred vehicles for Indians during the pandemic (TERI, 2020). Although two-wheeler travel already represented a majority of trips in some cities, with mode share rates across urban India around 51%, the perceived safety benefits of riding open-air vehicles may have bolstered their growth during the pandemic, based on Uber data analysed over the study period (Soman et al, 2019).

3 Expected Transition

Indian cities have seen explosive growth in two-wheeler use in the previous decade, as their approximate market penetration rose from 39% in 2010 to 60% in 2019 (KPMG, 2020). Although conservative projections by researchers at the Indian Institute of Technology (IIT) in Bombay show the number of two-wheeled vehicles on Indian roads will double by 2050 (to 420 million), their growth rate in comparison to four-wheelers will decrease as the number of cars is expected to multiply four to six times in the same time period (Singh et al, 2020). This shift is largely driven by India's growing middle class, who can increasingly afford to access private four-wheeled vehicles (Singh et al, 2020).

MG Road Metro Station
Gurugram, India

Streets and Land Use

Takeaway: Integrated transport and land use planning, transport-oriented development and redesigned streets are key to expanding accessibility, reducing trip demand and moving more people while using less space.

1 Dislocated Edge Cities

Data from India's 2011 census showed that India added 2,774 new towns in the preceding decade (IFMR, 2017). Ninety percent of these new cities were mid- to high-density "census towns," areas that are not statutorily designated as a town but have urban characteristics, and a third formed within 50km of an existing city centre (IFMR, 2017). This rapid outward urban expansion has spurred the development of new planned communities, informal residences and residential complexes without access to existing transport networks. These new edge cities are far more reliant on auto-based transport, creating a challenge for urban sustainability goals and NMT mode share (WRI India, 2020).

2 Smart Cities Have Complete Streets

In an effort to promote the creation of complete streets, the national Smart Cities Mission published "The Complete Streets Framework Toolkit" in 2019, encouraging India's first 100 smart cities to redesign their roadways for all users. Couched within the Smart Cities Mission, MoHUA also launched the Cycles4Change and Streets4People challenges during the COVID-19 pandemic to address increased demand for quality NMT facilities (MoHUA, 2022).

Cities like Chennai and Pune have used Smart Cities Mission funds within that directive to promote non-motorised transport modes. These cities are leading street redesign investments with municipal initiatives like Walk Smart, Urban Street Design Guidelines, Pune's Comprehensive Bicycle Plan and Chennai's commitment to devote 60% of transport funding to its Non-Motorised Transport Policy programme (Singh, 2021). In May 2017, Haryana became the first Indian state to officially adopt a Vision Zero policy to eliminate 100% of traffic fatalities (UITP, 2020).

3 Harmonised Public Agencies for Smart Growth

Almost every metropolitan city in India, along with the Tier-2 cities moving towards their smart, technology-enabled development missions, have multiple transport agencies. Generally, most transport agencies are supervised by overarching Transport Departments, Urban Development Departments or Municipal Corporations. The goal of all such supervisory authorities is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology. However, challenges in communication and coordination across government agencies have potentially prevented implementation of integrated land use and transport planning processes. As the cities are working towards attaining their sustainable development goals, coordinated decision making about land use, density and urban form, transport networks and street design will be essential. Since dense residential and commercial areas have sprung up in places without convenient connections to transport, alignment between transport planners, urban designers and parking departments is more important than ever for seamless connectivity.

Transport-Oriented Development

Transport-oriented development (TOD) is a strategy to develop homes and employment opportunities around transport to enable car-free lifestyles. TOD is widely recognised as an international best practice strategy to reduce car dependency, lower road-based emissions and encourage active lifestyles by increasing transport access. A representative from Namma Metro believes that as more TOD projects are realised in Bengaluru, there is potential for the city's transport mode share to rise from its current 45% to 70-75% (Interview, BMRCL, 2021).

In 2016, the Ministry of Housing and Urban Affairs released a TOD Guidance Document for India, followed in 2017 by the National TOD Policy. With support from publications from the Institute for Transport and Development Policy (ITDP) and the Shakti Sustainable Energy Foundation, more cities are beginning to adopt TOD practices. Bengaluru and Jaipur are among the first to intentionally pilot TOD principles in select developments. In the "TOD Standard," ITDP lays out eight principles by which to assess TOD success, which includes the promotion of NMT, co-location with quality transport and mixed-use development. And the Institue highlights the Janmarg BRTS for connecting these types of neighbourhoods in Ahmedabad (ITDP, 2017).

Hauz Khas Metro Station
Delhi, India

Green Park Metro Station
Delhi, India

Sustainable Growth

As cities continue to adopt the sustainable mobility goals of the MoHUA's National Urban Transport Policy, their coordination with land use projects and policies will be a key factor in their success. In line with MoHUA's 2016 Transport-Oriented Development (TOD) guidance, planning for density near transport, walkable mixed-use neighbourhoods and a variety of transport alternatives will enable cities to meet their goals. According to the Centre for Green Mobility, this is best achieved in the Indian context through a return to traditional mixed-use neighbourhood typologies rather than importing new analogous derivatives from the Global North like the "15-minute city."

Case Studies

Using Uber trip data from February 2019 to September 2021, this report developed a critical understanding of the way that people use Uber in four different urban contexts.

For the purpose of this study, four unique cities across India, namely Delhi NCR, Greater Mumbai, Bengaluru and Nagpur, were selected as case studies. Each city has different scale and character, as well as varying levels of transport infrastructure, distinct attitudes towards shared mobility and gradients of density.

Uber's trip data, including trip volumes, distances and origin and destination wards, from Feburary 2019 to September 2021 was analysed for the four case studies. The trips were aggregated by trip type, with two- and three-wheeled trips analysed separately from four-wheeled trips. The detailed data analysis specific to the case studies and focus wards is included as the Appendix. The four key trends revealed by the analysis are detailed in this section.

On-Street Parking Near Galleria Market
Gurugram, India

Case Studies

1 Delhi, Delhi NCR

India's capital, its most populous city, and the second largest city in the world, Delhi is India's commercial and economic powerhouse. Delhi is connected as a hub in national road and rail networks, with the highest number of registered personal vehicles in the country (more than 10 million) (DDC, 2020). The metro region is well served by suburban rail, metro and bus services.

Population (2011): **20,290,010**
Land area: **2,104 km²**
Daily public transport ridership: **10.17M**
Number of metro and train stations: **297**
Bus fleet size: **6,672**
Car ownership rate: **643/1000 people**

(Census, 2011; GNCTD, 2021)

2 Greater Mumbai, Maharashtra

The nation's second largest metro area, Mumbai is a cultural and financial centre around the bay. Most residents commute via Mumbai's extensive public transport system, which includes three suburban rail networks, an extensive public bus system operated by BEST and an expanding urban metro.

Population (2011): **16,651,735**
Land area: **899.9 km²**
Daily public transport ridership: **12.74M**
Number of metro and train stations: **83**
Bus fleet size: **4,336**
Car ownership rate: **178/1000 people**

(Census, 2011; MCGM, 2016)

3 Bengaluru, Karnataka

The capital of its state and India's third largest city, Bengaluru is known as the Indian Silicon Valley, with the headquarters of many technology firms. The city's many universities support a thriving research and development economy that employs a young and highly educated population. Bengaluru's transport system relies on regional heavy rail and its public bus system, while the city is currently constructing the new Namma Metro light rail system.

Population (2011): **8,443,675**
Land area: **738 km²**
Daily public transport ridership: **3.31M**
Number of metro and train stations: **106**
Bus fleet size: **6,515**
Car ownership rate: **243/1000 people**

(BMTC, 2021; Census, 2011)

4 Nagpur, Maharashtra

Nagpur is projected to be the fifth-fastest-growing city in the world and has had a high level of investment as part of India's Smart Cities Mission. The city has the highest rate of car ownership among these peers and is expanding a new metro system first opened in 2019 that currently connects the city centre to its southwest.

Population (2011): **2,405,665**
Land area: **217 km²**
Daily public transport ridership: **166K**
Number of metro and train stations: **25**
Bus fleet size: **441**
Car ownership rate: **737/1000 people**

(Census, 2011; Chakraborty, 2021)

Case Studies

1 Two- and Three-Wheeler Ridership Growth

Although four- as well as two- and three-wheelers maintained steady utilisation before the April 2020 lockdown, data illustrates that the demand for two- and three-wheelers (Uber Moto and Uber Auto, respectively) on Uber's platform recovered significantly faster after the lockdown. This finding, which was more pronounced in some markets than others, suggests that there may be untapped market potential for these options to supplant and/or complement what would otherwise be four-wheeled trips. Since data was analysed between February 2019 and September 2021, the growth in two- and three-wheelers may be due to a variety of factors, which were observed globally. This includes a heightened preference for socially distant personal mobility (as opposed to public transport), affordability, a desire for open-air mobility services and lower overall trip volumes, which may skew data in some geographies.

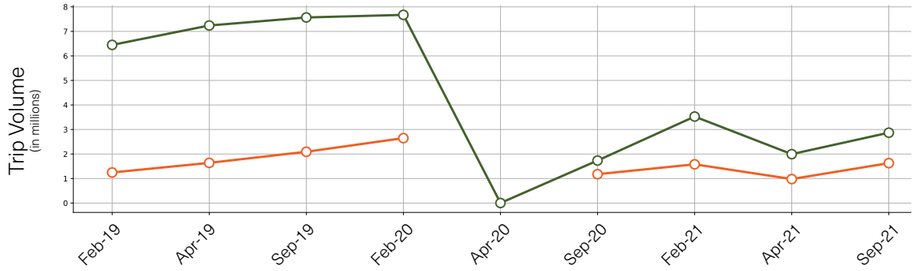
More space-efficient than four-wheelers, increased adoption of two- and three-wheelers could ultimately provide greater access to existing transport infrastructure by facilitating more first-/last-mile trips. A shift from four-wheeled vehicles to lighter-weight two- and three-wheeled vehicles could represent a positive trend for urban transport planners, as these vehicles:

- Consume less space
- Reduce congestion and parking demands
- More fuel-efficient per passenger-kilometre

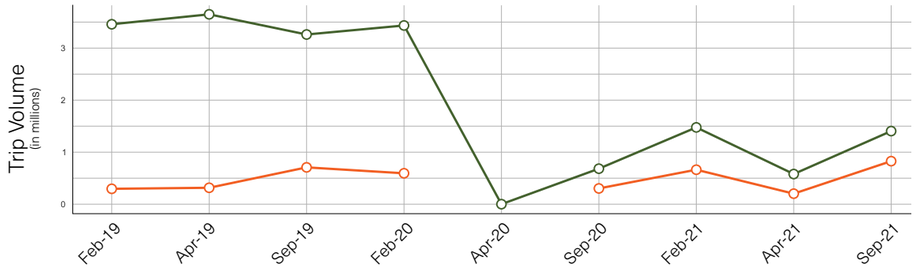
To bolster this effect, transport planners should consider the specific infrastructure, parking and dropoff needs of this vehicle type, as well as strategies to shift as many small, lightweight vehicles as possible to electric power.

On-Street Two-Wheeler Parking Near Green Park Metro Station
Delhi, India

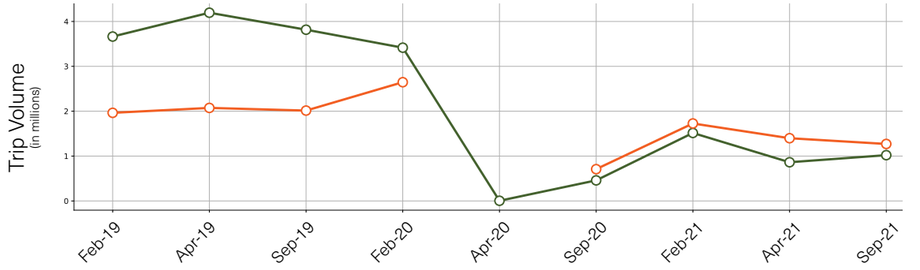
Delhi NCR



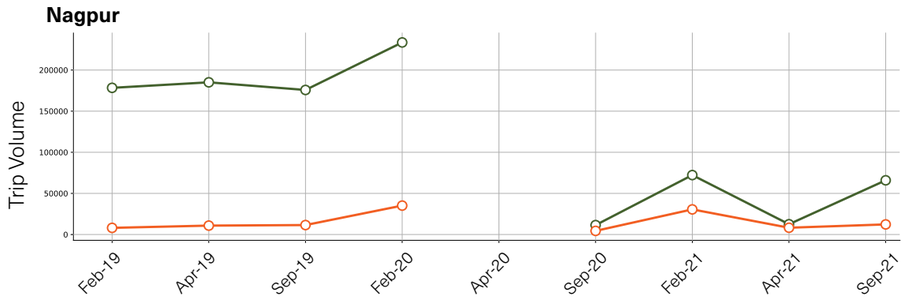
Greater Mumbai



Bengaluru



Nagpur



4-wheeled trips 2- and 3-wheeled trips

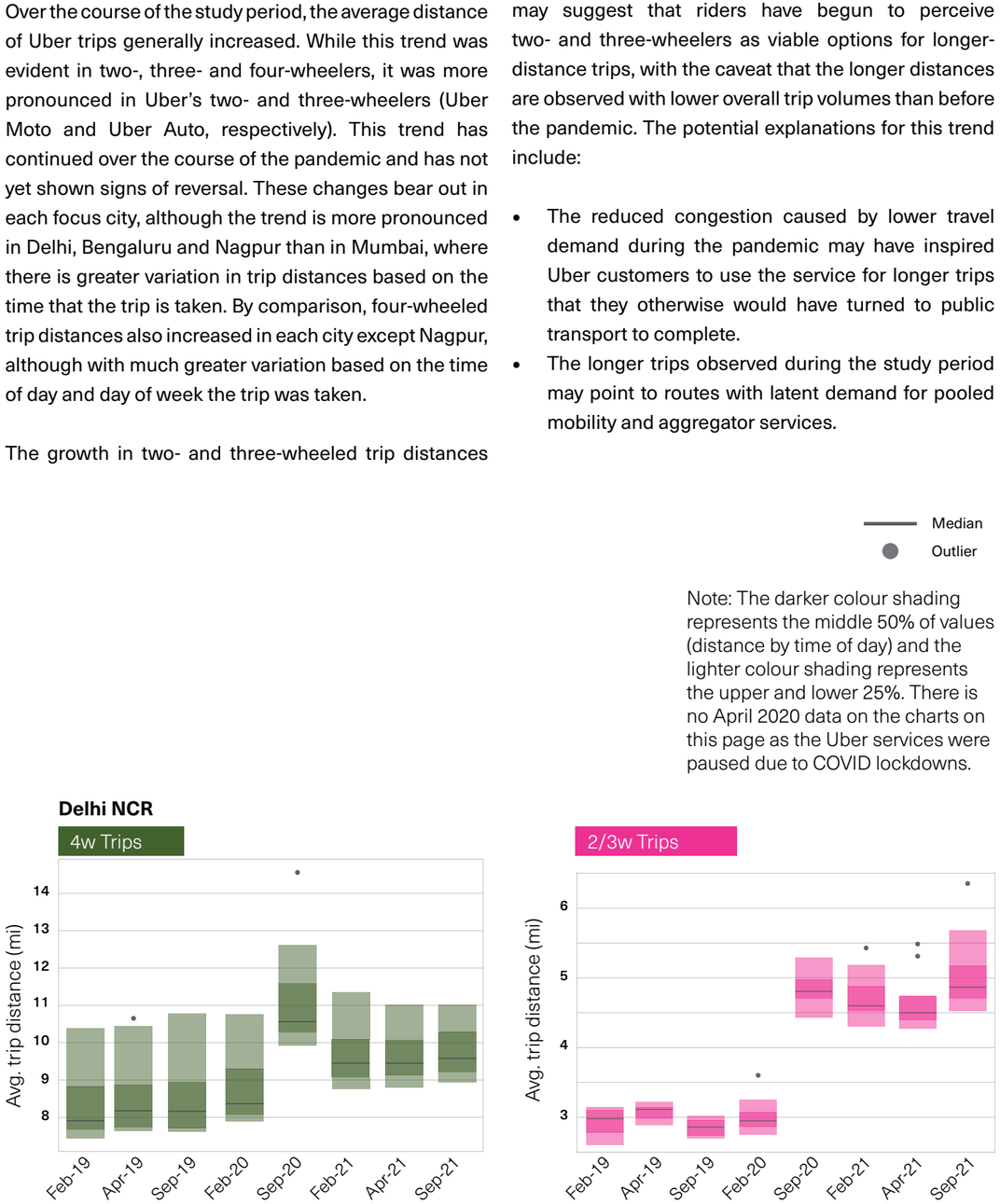
Note: Uber services were paused during COVID lockdowns, accounting for the gap in data midyear 2020.

2 Increased Travel Distances

Over the course of the study period, the average distance of Uber trips generally increased. While this trend was evident in two-, three- and four-wheelers, it was more pronounced in Uber's two- and three-wheelers (Uber Moto and Uber Auto, respectively). This trend has continued over the course of the pandemic and has not yet shown signs of reversal. These changes bear out in each focus city, although the trend is more pronounced in Delhi, Bengaluru and Nagpur than in Mumbai, where there is greater variation in trip distances based on the time that the trip is taken. By comparison, four-wheeled trip distances also increased in each city except Nagpur, although with much greater variation based on the time of day and day of week the trip was taken.

The growth in two- and three-wheeled trip distances may suggest that riders have begun to perceive two- and three-wheelers as viable options for longer-distance trips, with the caveat that the longer distances are observed with lower overall trip volumes than before the pandemic. The potential explanations for this trend include:

- The reduced congestion caused by lower travel demand during the pandemic may have inspired Uber customers to use the service for longer trips that they otherwise would have turned to public transport to complete.
- The longer trips observed during the study period may point to routes with latent demand for pooled mobility and aggregator services.



3 Fraction of Pooled Trips

The proportion of riders who chose to pool rides across cities showed distinct differences. Bengaluru observed far higher rates of pooling. This high frequency of shared trips may be indicative of a variety of phenomena, including latent demand for public transport in the region and the presence of more tech-savvy and younger demographics such as young IT professionals and students, who may be more willing to pool due to cultural norms and price sensitivity. It is also worthy to note that IT firms are co-located around the outer periphery, especially the northeast quadrant, in Bengaluru. Therefore, the probability of a group of individuals having the same destination is high, which is likely to lead to pooled trips.

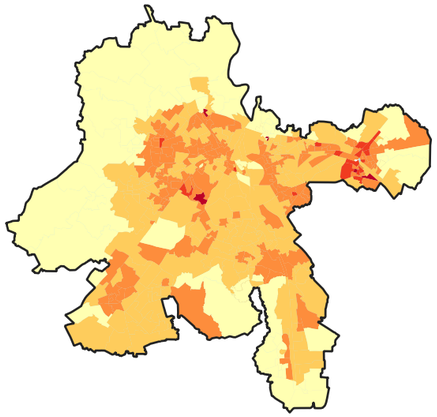
MG Road Metro Station
Gurugram, India

Percentage of Pooled 4w Rides pre-COVID-19*

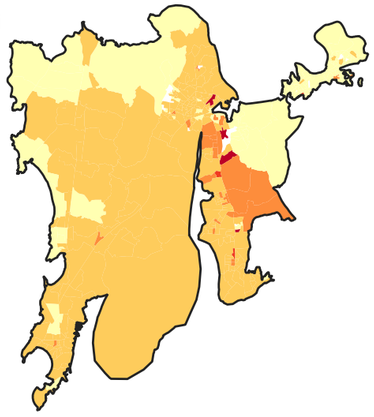
- 0 - 5%
- 5 - 10%
- 10 - 15%
- 15 - 20%
- 20 - 37%

*Data aggregated by origins and destinations.

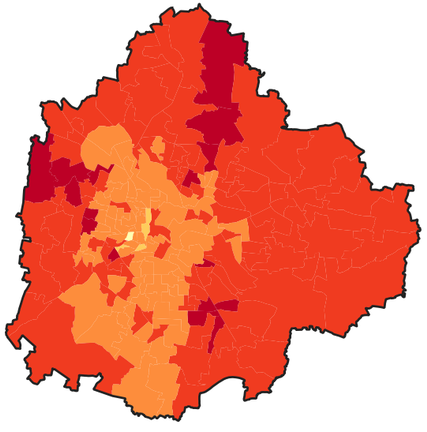
Delhi NCR



Greater Mumbai



Bengaluru



Note: Ride pooling was not available in Nagpur during the study period.

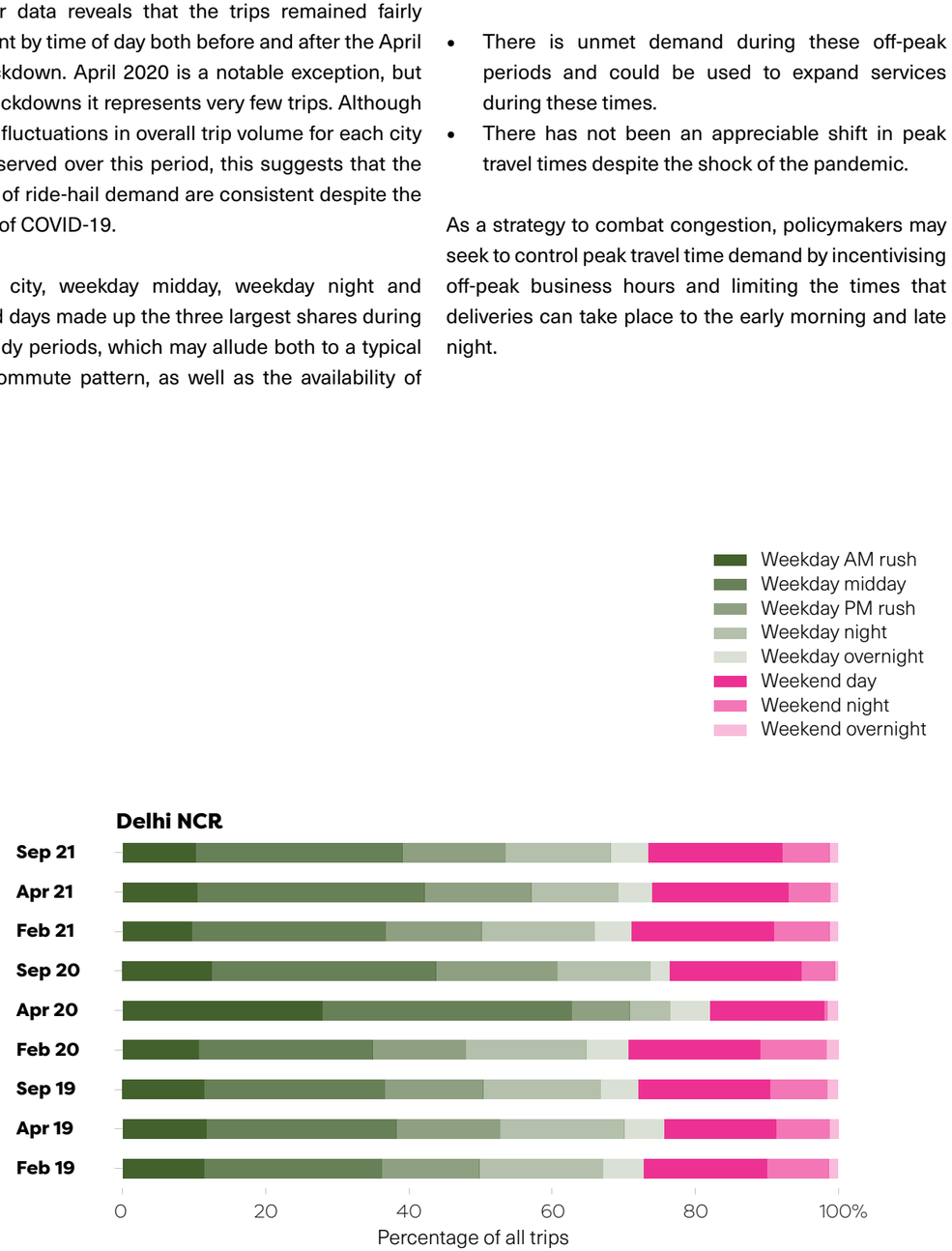
4 Trip Time Distribution

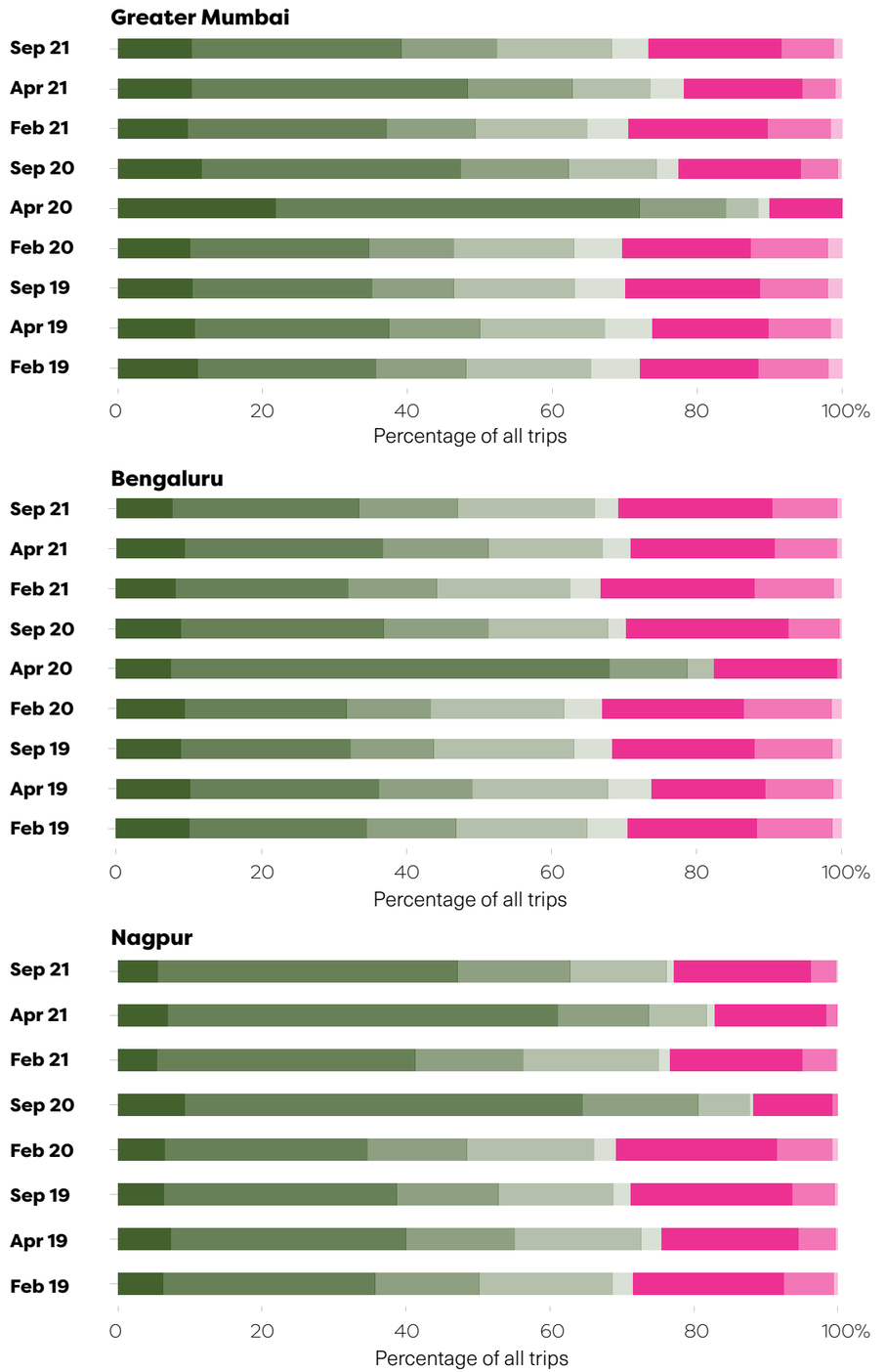
Despite general perception about higher demand for all modes during the morning and evening rush hour, the Uber data reveals that the trips remained fairly consistent by time of day both before and after the April 2020 lockdown. April 2020 is a notable exception, but due to lockdowns it represents very few trips. Although extreme fluctuations in overall trip volume for each city were observed over this period, this suggests that the patterns of ride-hail demand are consistent despite the impacts of COVID-19.

In each city, weekday midday, weekday night and weekend days made up the three largest shares during most study periods, which may allude both to a typical user's commute pattern, as well as the availability of other transport modes. This insight might signal to transport planners that:

- There is unmet demand during these off-peak periods and could be used to expand services during these times.
- There has not been an appreciable shift in peak travel times despite the shock of the pandemic.

As a strategy to combat congestion, policymakers may seek to control peak travel time demand by incentivising off-peak business hours and limiting the times that deliveries can take place to the early morning and late night.





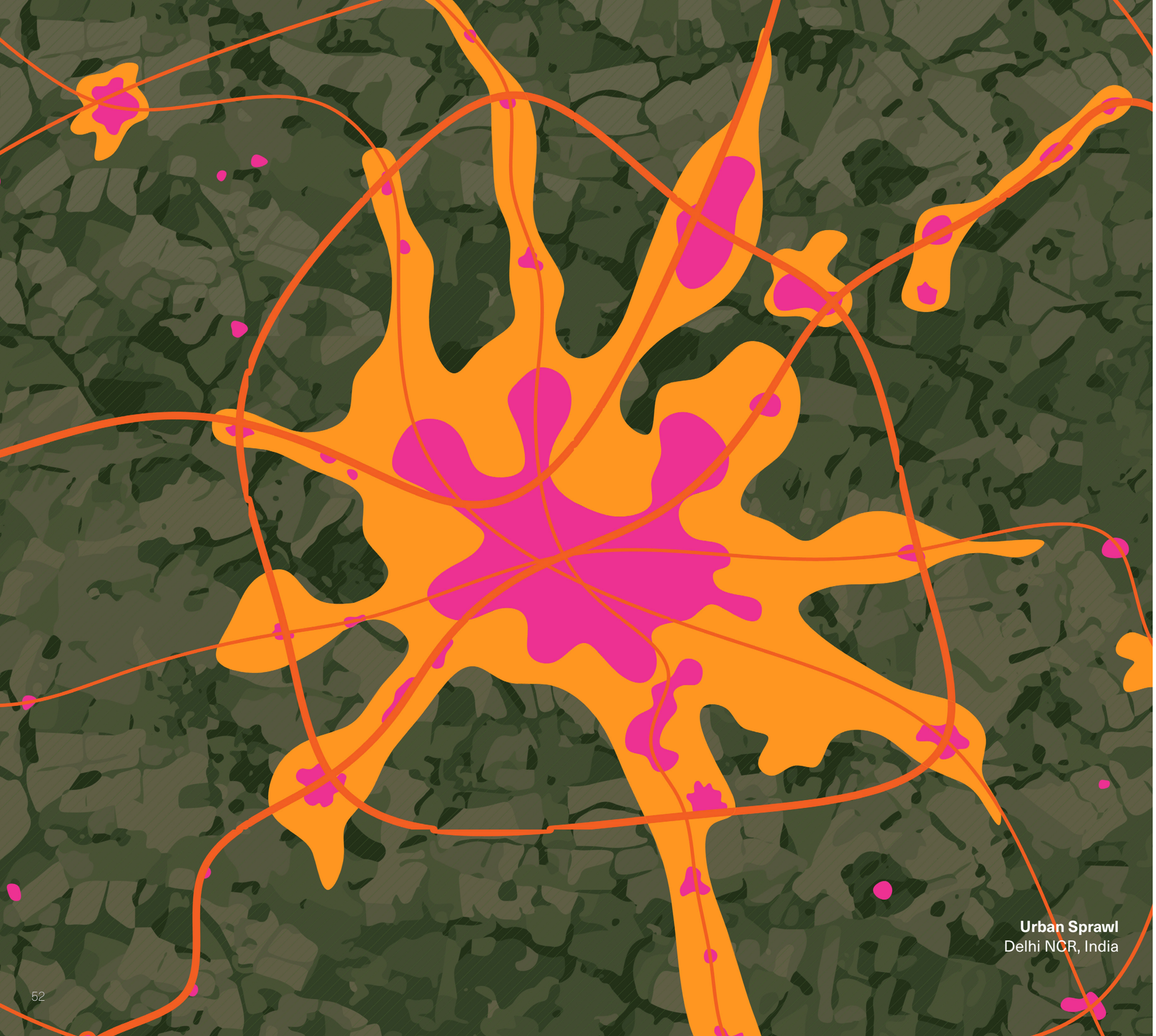
Future of Shared Mobility

Shared mobility has taken on an increasingly important role in urban transport networks within India, helping to fulfill first-/last-mile needs and expand the array of options available to travellers.

Shared mobility companies in India are working to improve accessibility and serve more people. Homegrown companies like Ola and Rapido, both from Bengaluru, share the ecosystem with international entrants. Uber, once new to the Indian transport landscape, has now established its presence as a core operator that helps people connect to work, school, friends and family on a daily basis. Launched in 2010, Uber entered the Indian market in 2013, just a few years after its global start. Since its arrival, the company has sought to tailor its products to more effectively serve the Indian market, whether through country-specific services like Uber Auto or by expanding into additional services first tested in other locations, like last-mile delivery and logistics. India is now Uber's third-largest market in the world, and ride-hailing by auto, moto and car is embedded in the transport landscape in cities across the country.

Shared mobility plays a unique role in India's rapidly evolving mobility ecosystem. Although India is among the world's largest markets, low rates of car ownership and high public transport and NMT use set it apart from more developed nations that are struggling to reduce the environmental burdens and infrastructural demands of widespread car ownership (Singh et al, 2020). On the average day, most residents in India's cities do not use a private motor vehicle, and those who do are far more likely to use a two-wheeler than a traditional four-wheeled vehicle, which offers an affordable and space-efficient alternative that can avoid some of the worst congestion. Four-wheeled shared mobility services have been most successful in serving high earners, tech workers and young professionals (WRI India, 2020).

While businesses may prefer to use four-wheeled on-demand services, two- and three-wheeled services offer an affordable and accessible entry point and can avert shared mobility's high-end connotation due to their familiarity in the Indian market. Shared mobility companies can add value to what are now street-hail trips in the form of convenience, reliability and transparency. Ride-hailing can serve customers at their



Urban Sprawl
Delhi NCR, India

doorstep at the requested time, saving them a walk to the taxi stand and an unpredictable wait. Similarly, presenting a set cost in advance saves customers the hassle of negotiating a fare with a street-hail driver.

As Mumbai, Bengaluru and other cities expand their metro systems, and others add new Bus Rapid Transport (BRT) lines, shared mobility companies can work in proactive partnership with transport agencies to serve travellers' first-/last-mile trips (UITP, 2019). Trips of just a few kilometres can be well served by small two- and three-wheeled vehicles and are well positioned for micromobility pilots with bicycle, e-bike and e-scooter share. Alternatively, companies can use their existing data to understand where trips between residences or offices and adjacent transport hubs are high and charter regular routes using vans or small buses that can aggregate several trips and lead to more spatially and environmentally efficient travel.

The recommendations that follow offer a collection of policies, strategic approaches and pilot programmes that can help policymakers, planners and transport professionals serve more people, fill existing gaps in the transport landscape and position urban transport systems to meet the future mobility demand of India's growing cities.

1 Empower Multimodal Mobility Managers

To develop an integrated transport system, there must be a facilitating body in place whose responsibility it is to convene public and private actors around a shared set of objectives. Although there is no entity currently fulfilling that role across sectors, multimodal nodal agencies similar to the unified transport bodies (UTB) that exist in many cities (including Bhopal, Delhi, Hyderabad, Jaipur, Kochi, Lucknow, Mumbai, Tiruchirappalli and Vijayawada) at the behest of MoHUA's NUTP can be adapted to fulfill this role and empowered with the regulatory tools required to manage transport initiatives across agencies. Understanding that UTBs didn't effectively work earlier majorly due to inadequate authority, it's recommended that UTBs coordinate decision making across bodies to eliminate redundancies and ensure that private providers augment rather than compete with existing systems.

Key Takeaways:

- Expand UTBs to include representatives of the shared mobility companies operating in each city to improve collaboration between and across the public and private sectors, and facilitate the creation of cross-sector partnerships (Deloitte, 2017).
- UTBs should study and improve multimodal interchange points to facilitate connections between modes (NITI Aayog, 2018). This includes improvements to street design at transport stations and programmes to designate pickup/dropoff zones for shared mobility companies in busy areas.

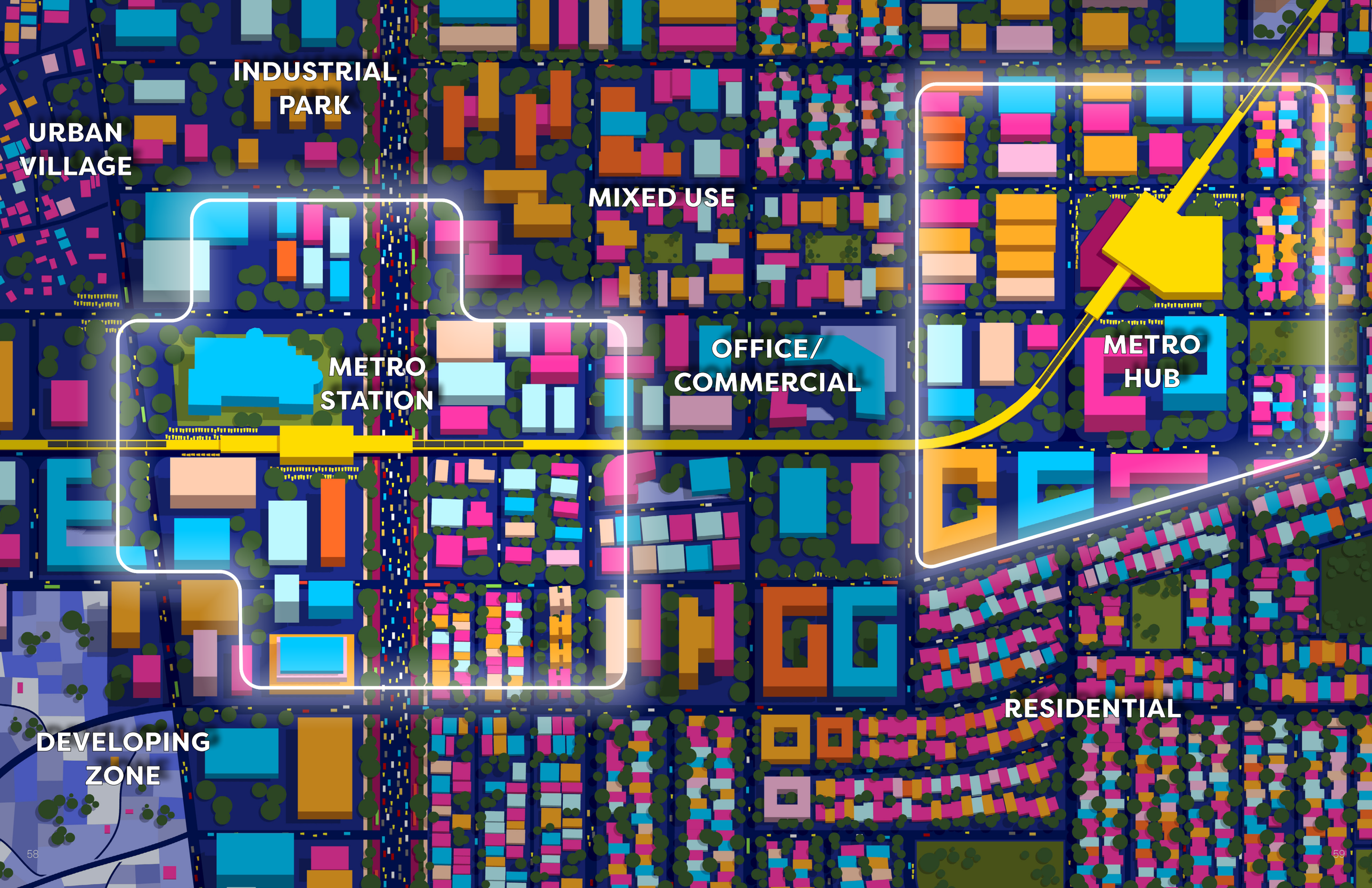
2 Adopt integrated approach for land use and transport planning

To achieve ambitious safety and sustainable mobility goals, planners will need to take an integrated approach to land use and transport planning (ITDP, 2019). Although NMT improvements are important everywhere, the urgency with which they are needed to lower carbon emissions and protect vulnerable road users calls for a clear strategic implementation plan. Investments in NMT will go further by prioritising dense areas that are adjacent to public transport stations, in support of first-/last-mile connections. Consequently, travellers in these areas will be better connected to transport in addition to enhanced walkability in communities where trips are short due to the nature of its existing urban form.

In line with conversations with the Centre for Green Mobility (CGM) , this strategy represents a return to more traditional models of Indian urban design that celebrates walkable, mixed-use urbanism. To realise this strategy, urban local authorities should consider regulatory measures for new developments, adjustments to parking mandates and revisions to land use planning practices.

Key Takeaways:

- Public-sector investments in road and transport systems, including safe cycling and pedestrian infrastructure, can create a framework for investments in sustainable transport that encourages shared mobility trips.
- Require the developers of new structures to make investments in the public spaces surrounding public transport stations/stops, including improvements to footpaths and cycle tracks, public restrooms, lighting and street furniture. This mirrors the “betterment” fee currently levied (as 1% stamp duty on property registrations) on developments adjacent to Mumbai’s new light rail lines to support the Metro (Interview, MMRC, 2021).
- In areas adjacent to public transport stations, drop parking requirements for new developments to reduce construction costs and encourage car-free transport habits (ITDP, 2015).
- Utilise land use regulations in and around transport stations to incentivise the presence of necessary neighbourhood amenities like grocery stores, pharmacies and banks, to enable transport users to conveniently chain their trips together (ITDP, 2017). This strategy is being employed by Namma Metro in Bengaluru as it incorporates commercial spaces into its new stations (Interview, BMRCL, 2021).


INDUSTRIAL PARK
URBAN VILLAGE
MIXED USE
METRO STATION
OFFICE/ COMMERCIAL
METRO HUB
RESIDENTIAL
DEVELOPING ZONE

3 Use shared mobility to connect underserved areas

New residential and office developments along the outer extents of cities pose a significant challenge to existing transport networks. Adding dense housing and commercial space outside of the urban core and far from access points to public transport requires automotive transport options to connect residents and employees to other parts of the city, or to reach public transport lines (Mishra, 2019; WRI India, 2020). Data analysis revealed high travel demand for Uber's services in these areas. If left unchecked, this type of development will perpetuate an auto-dependent future that is not aligned with the sustainable mobility goals of India's cities. Shared mobility can play a critical role in connecting new urban areas to existing urban transport networks.

Key Takeaways:

- Shared mobility companies can help connect these edge developments to public transport and urban centres (ITDP, 2015). By partnering directly with MaaS providers, cities can quickly implement aggregator services and shuttle systems that serve disconnected, transport-poor areas.
- Mandate major new developments to create a transport demand management plan that details how new projects will connect to existing networks, set target mode shares, plan required transport infrastructure, and measure carbon emissions (SFPC, 2021).
- City policymakers should require developments to mitigate their negative transport externalities. This may include steps to offset transport-based emissions through on-site renewable energy generation or investments in new public transport infrastructure.
- Where possible, city incentives should promote car-lite developments by building near transport or by establishing coordinated shared mobility services (ITDP, 2015).

4 Encourage transition to sustainable mobility

India has taken strong steps at the national and state levels to promote the adoption of green-fuel vehicles, including electric vehicles (EVs) and compressed natural gas (CNG) vehicles (UITP and Shakti Sustainable Energy Foundation, 2020). However, these policies can do more to ensure widespread and affordable adoption. By broadening the conversation around electrification to include support for all new types of electric micromobility and CNGs, policies can usher in an era when electric vehicles are available at every price point (Singh et al, 2020). As state EV policies seek to bolster the employment opportunities and industry for EV manufacturing, extending benefits to cover more types of electric mobility supports new forms of entrepreneurship.

Key Takeaways:

- Extend subsidies to include electric micromobility vehicles like e-bikes, electric kick scooters and other new forms of micromobility. Small vehicles with removable electric batteries are less dependent on charging infrastructure, save parking space, reduce congestion and enhance safety of other road users (McKinsey, 2020).
- Shift to progressive subsidy models focused on benefitting lower-income households to ensure affordable access to a variety of EV types.
- Prioritise subsidies for shared vehicle fleets that transport both passengers and goods, as well as subsidies for cheaper two- and three-wheeled vehicles to support broad access, in line with Delhi's vehicle electrification policy of 2020.
- Aid green vehicle-only lanes on congested roadways as adoption levels increase to further incentivise the switch away from ICE vehicles. In June 2021, the West Bengal state government proposed a designated inter-city corridor for electric vehicles, with charging stations every 25 kilometres, to phase out fossil-fuel vehicles and encourage people to use battery-driven cars (Bandyopadhyay, 2021).
- Pair investments in the energy grid with investments in EV infrastructure to ensure that there is adequate generation capacity to support the additional system load and that increased charging demand is met with renewable energy alternatives that will not simply transplant polluting vehicle emissions in urban areas to energy plant emissions in industrial areas.

Alektrify Charging Station
Gurugram, India

Conclusion

India has the potential to become a leader in clean, sustainable transport by combining the public sector's expertise in planning and management with the private sector's capacity to access financing and introduce innovation and cost-effectiveness into operations and maintenance.

Over the past several decades, the global transport sector has continued to grow as a major contributor to GHG emissions, adversely affecting air quality, road safety and equitable access. These impacts have been felt disproportionately in the developing world and in India in particular. For a rapidly urbanising country, India's private vehicle ownership rates remain fairly low. This presents a unique opportunity to chart a radically different course for the future–one focused on moving people efficiently rather than moving traffic.

The recommendations contained in this report combine a mix of innovative policy solutions, new approaches to street design and engineering, and larger-scale changes in the way that cities balance land use policy with transport planning. While these ideas collectively point towards a more sustainable urban transport future, their implementation has historically been frustrated by a lack of government coordination, a failure to scale public-private partnerships, and an ever-growing appetite for private vehicles that is unlikely to abate as Indians gain more global wealth. Despite these challenges, India's aggressive stance towards public transport expansion, combined with its leadership in the electrification of public and private vehicles, position its cities as testbeds for a shared and sustainable mobility future.

With the right framework for investment and experimentation, the government can foster ongoing collaboration and innovation in shared mobility with private-sector service providers. Given appropriate regulations, and the right mix of incentives to meet specific public policy goals, public-private partnerships can both facilitate and accelerate the growth of urban transport systems that improve accessibility and sustainability for all Indians over the coming decades.

References

Abrar, Peerzada. “Now, book a bus ride in Gurugram on Uber; service in other cities soon.” *Business Standard.* 8 September 2022. business-standard.com/article/companies/uber-starts-bus-service-in-india-targets-next-100-million-customers-122090801094_1.html. Accessed 2022.

Baliga, Linah. “Times Square makeover for CSMT intersection.” *Mumbai Mirror.* 23 October 2019. mumbaimirror.indiatimes.com/mumbai/civic/times-square-makeover-for-csmt-intersection/articleshow/71713842.cms. Accessed 2021.

Bandyopadhyay, Krishnendu. “West Bengal government proposes green lanes for e-vehicles.” *The Times of India.* 5 June 2021. timesofindia.indiatimes.com/city/kolkata/state-proposes-green-lanes-for-e-vehicles/articleshow/83244631.cms. Accessed 2022.

Bengaluru Metro Rail Corporation Limited (BMRCL). Interview. 28 October 2021.

Bengaluru Metropolitan Transport Corporation (BMTC). *2019-20 Annual Administration Report.* 2021. kla.kar.nic.in/council/house/Paperlaid/144/38.pdf. Accessed 2022.

Business Wire. “Moove partners with Uber to launch mega fleet for ride-hailing in India.“ *Business Wire.* 25 July 2022. businesswire.com/news/home/20220724005010/en/Moove-partners-with-Uber-to-launch-mega-fleet-for-ride-hailing-in-India. Accessed 2022.

Canales, Diego, Shannon Bouton, Elaine Trimble, Julia Thayne, Larissa Da Silva, Srikanth Shastry, Stefan Knupfer and Martin Powell. “Connected Urban Growth: Public-Private Collaborations for Transforming Urban Mobility.” Coalition for Urban Transitions. London and Washington, DC. 2017. newclimateeconomy.report/workingpapers/workingpaper/connected-urban-growth-public-private-collaborations-for-transforming-urban-mobility/. Accessed 2022.

Chadha, Jyot, Ojas Shetty, and Srikanth Shastry. “Understanding the Impact of Bus Aggregators on Urban Mobility in India’s National Capital Region.” World Resources Institute (WRI): India. 7 February 2020. wri.org/research/understanding-impact-bus-aggregators-urban-mobility-indias-national-capital-region. Accessed 2022.

Chakraborty, Proshun. “Aapli Bus daily ridership past 1L for 1st time in 21 months.” *The Times of India.* 24 November 2021. timesofindia.indiatimes.com/city/nagpur/aapli-bus-daily-ridership-past-1l-for-1st-time-in-21-months/articleshow/87876454.cms. Accessed 2022.

Dialogue and Development Commission (DDC). *Accelerating Delhi’s Mobility Transition: Insights from the Delhi Urban Mobility Lab.* 2020. rmi.org/wp-content/uploads/2019/08/rmi_report_uml_dehli.pdf. Accessed 2022.

Deloitte/Confederation of Indian Industry (CII). “Future of mobility in India: Envisioning the future of the Indian mobility ecosystem.” Confederation of Indian Industry (CII). Fenruary 2020. deloitte.com/content/dam/Deloitte/in/Documents/consumer-business/in-consumer-future-of-mobility-noexp.pdf. Accessed 2022.

Department of Planning, Government of National Capital Territory of Delhi (GNCTD). *Economic Survey of Delhi 2020-21.* 2021. delhiplanning.nic.in/sites/default/files/12.%20Transport.pdf. Accessed 2022.

Desai, Dhaval. "Lost in transit: Unified Metropolitan Transport Authority (UMTA)." Observer Research Foundation. 8 January 2022. orfonline.org/expert-speak/lost-in-transit-unified-metropolitan-transport-authority-umta/. Accessed 2022.

Express Drives Desk. "CESL launches tender for 5,580 electric buses to be deployed in five major cities." *The Financial Express.* 20 January 2022. financialexpress.com/auto/electric-vehicles/cesl-launches-tender-for-5450-electric-buses-to-be-deployed-in-five-major-cities/2411383/. Accessed 2022.

Fishman, Tiffany. "The rise of mobility as a service: Reshaping how urbanites get around." Deloitte Review: Issue 20. 3 January 2017. deloitte.com/us/en/insights/deloitte-review/issue-20/smart-transportation-technology-mobility-as-a-service.html. Accessed 2022.

Government of National Capital Territory of Delhi (GNCTD). "Delhi Motor Vehicle Aggregators Scheme, 2022." 5 July 2022. ev.delhi.gov.in/files/Aggregator%20Scheme_July_2022ae3b2a.pdf. Accessed 2022.

International Association of Public Transport (UITP) and Shakti Sustainable Energy Foundation. *Electric Bus Procurement under FAME-II: Lessons Learnt and Recommendations.* February 2020. cms.uitp.org/wp/wp-content/uploads/2020/07/200207-BrochureSSMobility_v4-web1.pdf. Accessed 2022.

International Association of Public Transport (UITP). *Promoting Safe and Sustainable Cities with Public Transport for the SDGs.* February 2020. cms.uitp.org/wp/wp-content/uploads/2020/07/200207-BrochureSSMobility_v4-web1.pdf. Accessed 2022.

International Association of Public Transport (UITP). *Transforming Cities with Bus Rapid Transit (BRT) Systems.* May 2019. uitp.org/publications/transforming-cities-with-bus-rapid-transit-brt-systems/. Accessed 2022.

International Energy Agency. *IEA Atlas of Energy*. 2020. energyatlas.iea.org. Accessed 2022.

Institute for Transportation and Development Policy (ITDP). *Harnessing Shared Mobility for Compact, Sustainable Cities*. 6 August 2015. itdp.org/2015/08/06/harnessing-shared-mobility-for-compact-sustainable-cities/. Accessed 2022.

Institute for Transportation and Development Policy (ITDP). *Parking Basics*. 26 October 2015. itdp.org/2015/10/26/parking-basics/. Accessed 2022.

Institute for Transportation and Development Policy (ITDP). People Near Transit, Transit Near People. May 2019. itdp.in/wp-content/uploads/2019/05/People-Near-Transit-Transit-Near-People.pdf. Accessed 2022.

Institute for Transportation and Development Policy (ITDP). "Ranchi Walks Ahead: The Overnight Transformation of M.G.Road." 17 September 2019. itdp.in/tag/ranchi/. Accessed 2022.

Institute for Transportation and Development Policy (ITDP). *TOD Standard*. 23 June 2017. itdp.org/2017/06/23/tod-standard/. Accessed 2022.

KPMG. *The Future of Mobility in post-COVID-19 India.* September 2020. assets.kpmg/content/dam/kpmg/in/pdf/2020/09/the-future-of-mobility-in-post-covid-19-india.pdf. Accessed 2022.

McKinsey & Company: Center for Future Mobility. "The unexpected trip: The future of mobility in India beyond COVID-19." McKinsey & Company. 17 July 2020. mckinsey.com/industries/automotive-and-assembly/our-insights/the-unexpected-trip-the-future-of-mobility-in-india-beyond-covid-19. Accessed 2022.

Ministry of Housing and Urban Affairs (MoHUA). *National Urban Transport Policy.* MoHUA, Government of India (GoI). 2018. mohua.gov.in/upload/uploadfiles/files/TransportPolicy.pdf. Accessed 2022.

Ministry of Housing and Urban Affairs (MoHUA). "MoHUA announces winners of Streets for People and Nurturing Neighbourhoods Challenge." 18 January 2022. pib.gov.in/PressReleaseIframePage.aspx?PRID=1790637. Accessed 2022.

Ministry of Housing and Urban Affairs (MoHUA) and Institute for Transport and Development Policy (ITDP) India. *Complete Streets Policy Workbook.* April 2019. itdp.in/wp-content/uploads/2019/05/CS-Policy-Workbook_Web-Version-compressed.pdf. Accessed 2022.

Mishra, Alok Kumar. "Cities, transport and agglomeration: Addressing the urban mobility challenges in India." *Growth and Change.* 2019. onlinelibrary.wiley.com/doi/10.1111/grow.12321. Accessed 2022.

Mumbai Metro Rail Corporation (MMRC). Interview. 19 November 2021.

Mumbai Metropolitan Region Development Authority (MMRDA). "Unified Mumbai Metropolitan Transport Authority." MMRDA. 2013. mmrda.maharashtra.gov.in/ummta. Accessed 2021.

Mumbai Parking Authority (MPA). Interview. 27 October 2021.

Municipal Corporate of Greater Mumbai (MCGM). *Comprehensive Mobility Plan (CMP) for Greater Mumbai.* April 2016. portal.mcgm.gov.in/irj/go/km/docs/documents/MCGM%20Department%20List/Roads%20and%20Traffic/Docs/CMP%20for%20Greater%20Mumbai/Executive%20Summary/Executive%20Summary.pdf. Accesssed 2022.

Nayak, Pulin B., Bishwanath Goldar, and Pradeep Agrawal, eds. *India's economy and growth: Essays in honour of VKRV Rao.* SAGE Publications India, 2010.

NITI Aayog. *Forecasting Penetration of Electric Two-Wheelers in India. 28* June 2022. niti.gov.in/sites/default/files/2022-06/ForecastingPenetration-ofElectric2W_28-06.pdf. Accessed 2022.

NITI Aayog. *Moving Forward Together: Enabling Shared Mobility in India.* 2018.

NITI Aayog. *Smart and Sustainable Urban Transport Planning: Toolkit I Strategic Mobility Planning.* 2018. itdp.org/download/attachments/65968367/1804_SMP%20Toolkit_ITDP_Draft.pdf?api=v2. Accessed 2022.

Prasad, Vishnu. IFMR. "India's Suburban Sprawl Is Stifling City Centers." *Smart Cities Dive.* 2017. smartcitiesdive.com/ex/sustainablecitiescollective/india-s-suburban-transformation/208606. Accessed 2022.

Pune Smart City Development Corporation and Institute for Transport and Development Policy (ITDP) India. *Pune's Sustainable Transport Journey.* February 2021. itdp.in/wp-content/uploads/2021/02/Punes-Sustainable-Transport-Journey.pdf. Accessed 2022.

Randhawa, Aman, and Ashwani Kumar. "Exploring sustainability of smart development initiatives in India." International Journal of Sustainable Built Environment 6.2. 2017.

San Francisco Planning Commission (SFPC). *Standards for the Transportation Demand Management Program.* 11 March 2021. sfplanning.org/transportation/tdm/TDM_Program_Standards.pdf. Accessed 2022.

Shah, Sonal, Kalpana Viswanath, Sonali Vyas, and Shreya Gadepalli. "Women and transport in Indian cities." New Delhi, India: ITDP India. December 2017. itdp.in/wp-content/uploads/2018/01/181202_Women-and-Transport-in-Indian-Cities.pdf. Accessed 2022.

Sharma, Nidhi. "Bhopal, Surat, Udaipur to be India's first smart cities." *Economic Times Bureau.* 4 May 2022. economictimes.indiatimes.com/news/india/bhopal-surat-udaipur-to-be-in-list-of-7-smart-cities/articleshow/91295388.cms. Accessed 2022.

Singh, A. "How the growing last-mile delivery space rides on the Indian e-commerce boom." *The Week.* 26 August 2021. theweek.in/news/biz-tech/2021/08/26/how-the-growing-last-mile-delivery-space-rides-on-the-indian-e-commerce-boom. Accessed 2022.

Singh, Namita, Trupti Mishra, and Rangan Banerjee. "Emission inventory for road transport in India in 2020: Framework and post facto policy impact assessment." Environmental Science and Pollution Research 29.14: 20844-20863. 2022.

Singh, Namita, Trupti Mishra, and Rangan Banerjee. "Projection of private vehicle stock in India up to 2050." Transportation Research Procedia 48: 3380-3389. 2020.

Smith, Mathew. "The number of cars worldwide is set to double by 2040." World Economic Forum. 22 April 2016. weforum.org/agenda/2016/04/the-number-of-cars-worldwide-is-set-to-double-by-2040. Accessed 2022.

Smith, Russell M., Prasad Avinash Pathak, and Girish Agrawal. "India's 'smart' cities mission: A preliminary examination into India's newest urban development policy." Journal of Urban Affairs, 41:4, 518-534. 2019.

Soman, Abhinav, Harsimran Kaur, and Karthik Ganesan.

"How Urban India Moves: Sustainable Mobility and Citizen Preferences." Council on Energy, Environment and Water: New Delhi. 2019.

Sustainable Urban Transport Project (SUTP). *Mobility as a Service.* 2018. sutp.org/publications/mobility-as-a-service-maas-inua-7/. Accessed 2022.

Swerts, Elfie, Denise Pumain, and Eric Denis. "The future of India's urbanization." Futures 56 (2014): 43-52.

The Energy and Resources Institute (TERI). *Impact of COVID-19 on Urban Mobility in India: Evidence from a Perception Study.* New Delhi: TERI. 2020.

The New Indian Express. "CM Arvind Kejriwal launches 150 electric buses, Delhi's fleet crosses 7,200 mark". *The New Indian Express.* 25 May 2022. newindianexpress.com/cities/delhi/2022/may/25/cm-arvind-kejriwal-launches-150-electric-buses-delhis-fleet-crosses-7200-mark-2457709. Accessed 2022.

Vehicle Technologies Office, US Department of Energy: Office of Energy Efficiency & Renewable Energy. "Fact #962: January 30, 2017 Vehicles per Capita: Other Regions/Countries Compared to the United States." US Department of Energy. 30 January 2017.

Verma, K. *The Future of Mobility in India.* Strategic Investment Research Unit (SIRU). 3 January 2020. investindia.gov.in/team-india-blogs/future-mobility-india. Accessed 2022.

World Economic Forum. "The Future of Urban Development & Services: Urban Development Recommendations for the Government of India." World Economic Forum. April 2015. weforum.org/docs/WEF_IU_FUDS_Urban_Development_Recommendations_Government_India_Report_2015.pdf. Accessed 2022.

WSP and Uber. *Place and Mobility: Future Ready Kerbside.* 2 December 2020. wsp.com/en-us/insights/future-ready-kerbside-creating-places-that-put-people-first. Accessed 2022.

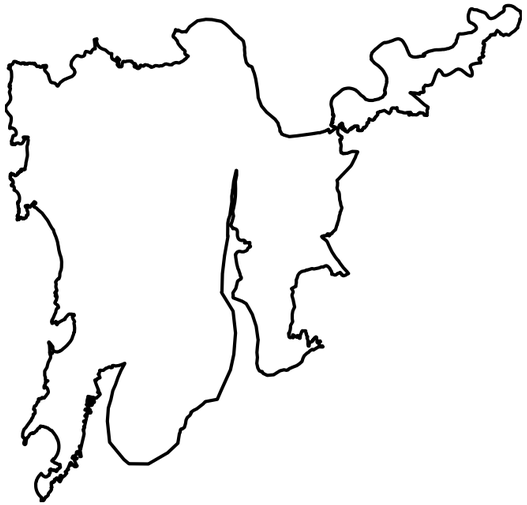
Green Park Metro Station
Delhi, India

Appendix

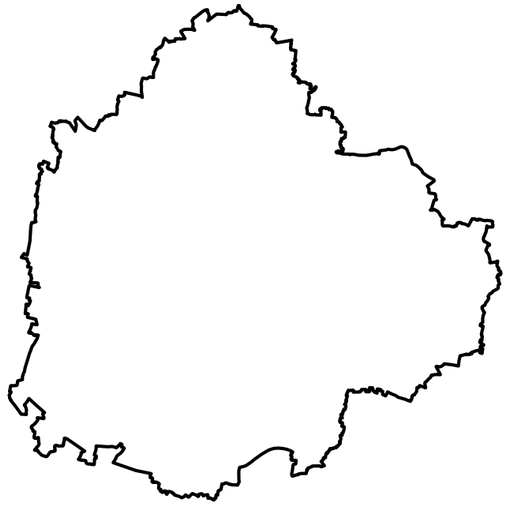
IFFCO Chowk Metro Station
Gurugram, India

City Profiles | Case Studies

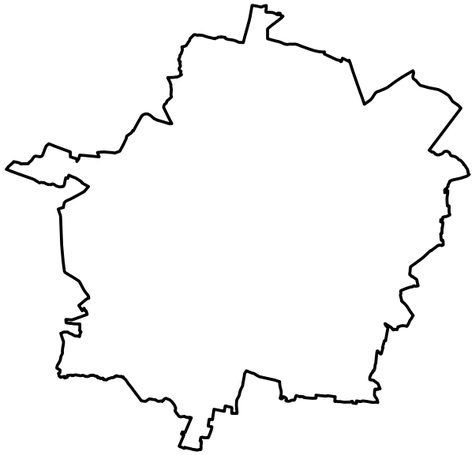
Delhi NCR



Greater Mumbai



Bengaluru



Nagpur

Appendix

CITY PROFILE

Delhi NCR

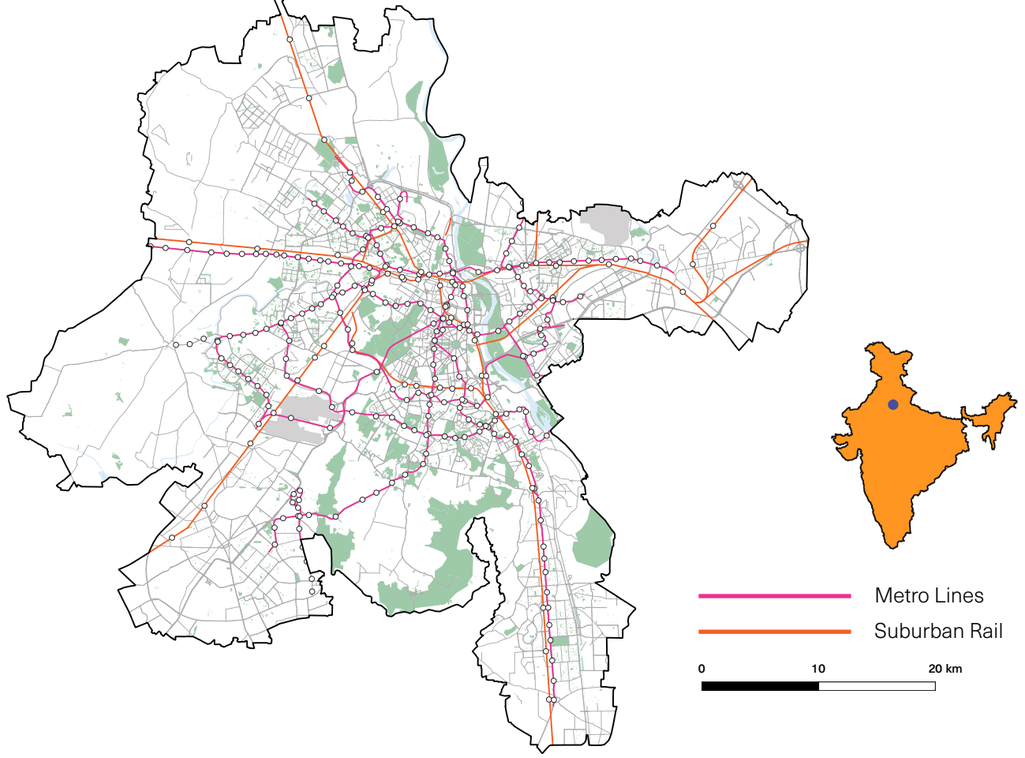
Delhi is the largest and most dispersed city studied and the most well served by transport. Uber trips in Delhi NCR were most highly concentrated in the city of Gurugram to the southwest of central Delhi.

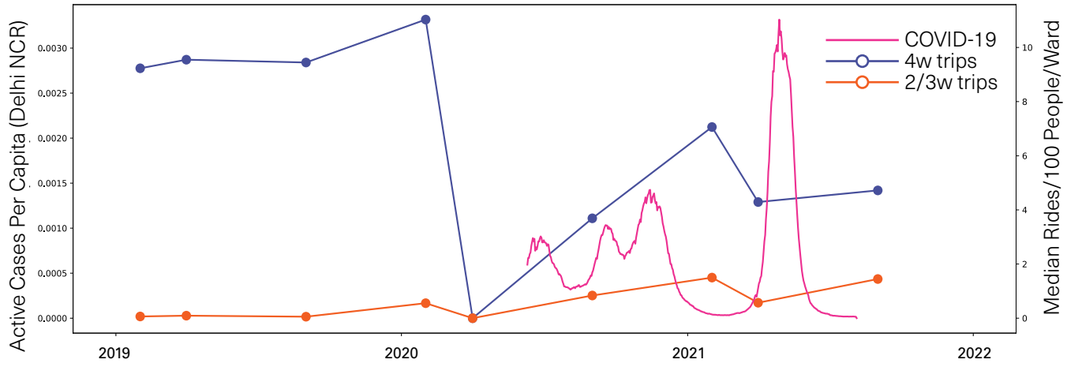
Key Stats

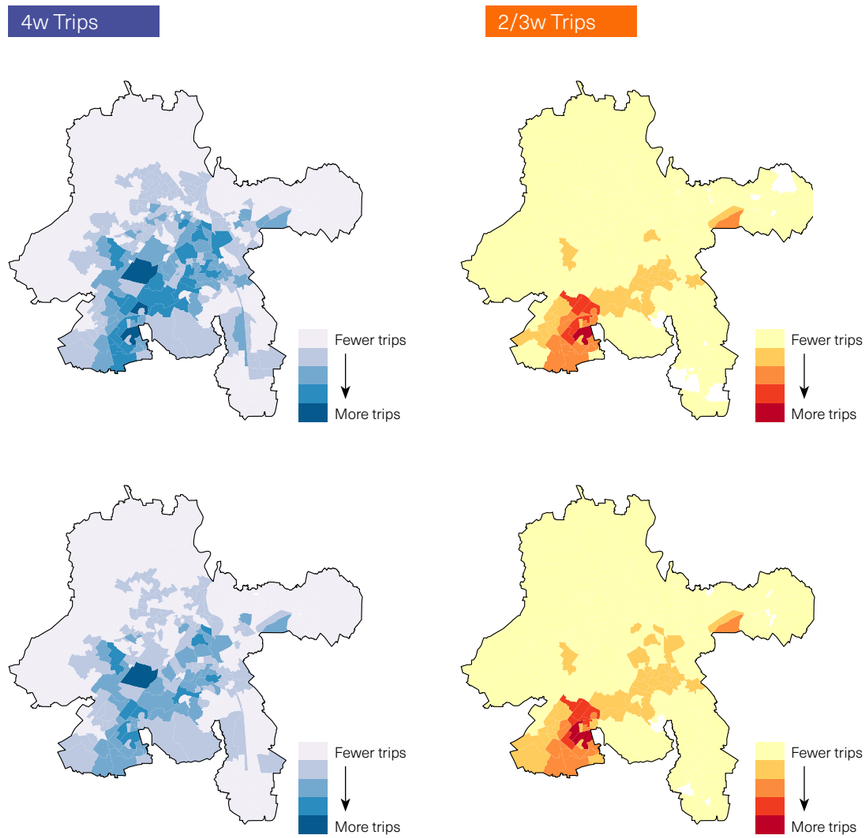
Population: 20,290,010 (2011)
Population density: 9,653 people/km^2
Land area: 2,104 km^2
Daily public transport ridership: 10.17M
Number of metro and train stations: 297
Bus fleet size: 6,672
Car ownership rate: 643/1000 people
Proportion of pooled trips pre-COVID-19*: 8.7%
Monthly 4w trips: 54.74 trips/100 people
Monthly 2/3w trips: 19.76 trips/100 people

*Data aggregated by origins and destinations.

(Census, 2011; Department of Planning, GNCTD, 2021; Uber, 2022)







FOCUS WARDS

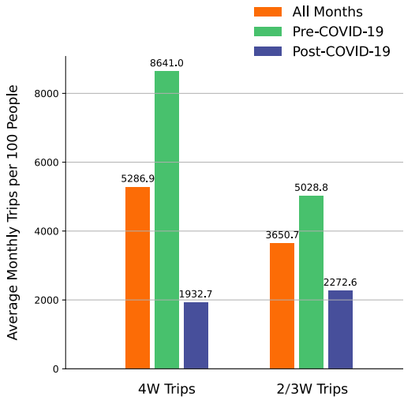
Delhi NCR

Gurugram, Sectors 48, 69, 70, 71, 73, 75

Naya Behram Pur Ward 0036

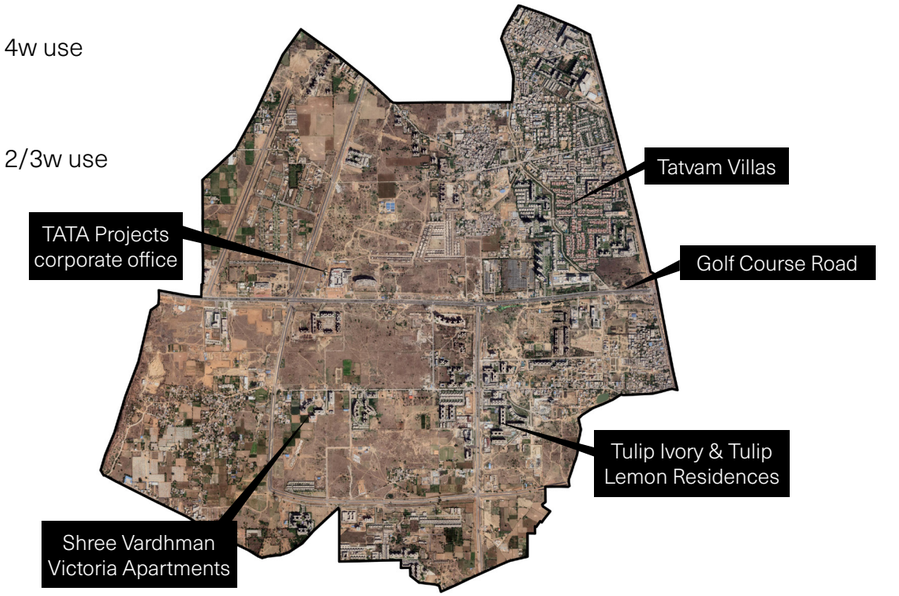
Population density:	119 people/km²
Intersection density:	16.3 int./road km
Fraction pooled:	6.3%
OD ratio:	1.00

This outlying ward in the south of Gurugram saw high trips per person for four- and two-/three-wheeled products. The Golf Course Road Metro Station is an 11-minute drive west of Ward 36, where Uber likely connects new office and residential developments at the city's periphery to Delhi's larger transport network.



High 4w use

High 2/3w use

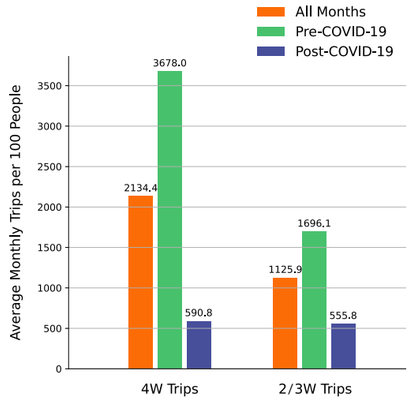


Gurugram, Sectors 24, 25, 25A

Gurugram Ward 0027

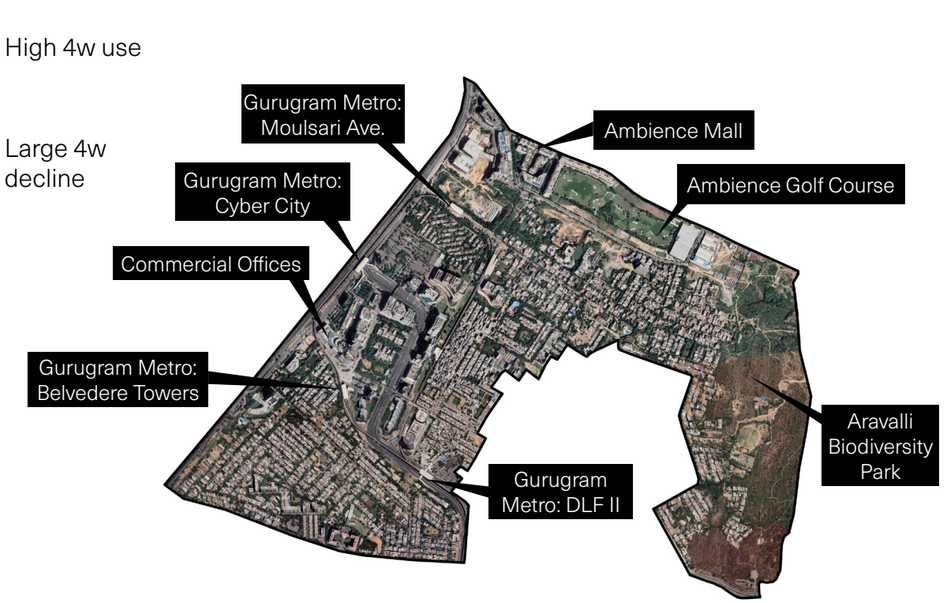
Population density:	3,134 p/km²
Intersection density:	21.0 int./road km
Fraction pooled:	7.1%
OD ratio:	0.07

This posh residential and commercial area had high four-wheeled trip volumes, but saw a huge drop during the pandemic as tech professionals switched to work from home. Gurugram's new Metro, opened in 2018, also loops the area and connects residents to Delhi's Yellow line at Sikanderpur Station.



High 4w use

Large 4w decline



CITY PROFILE

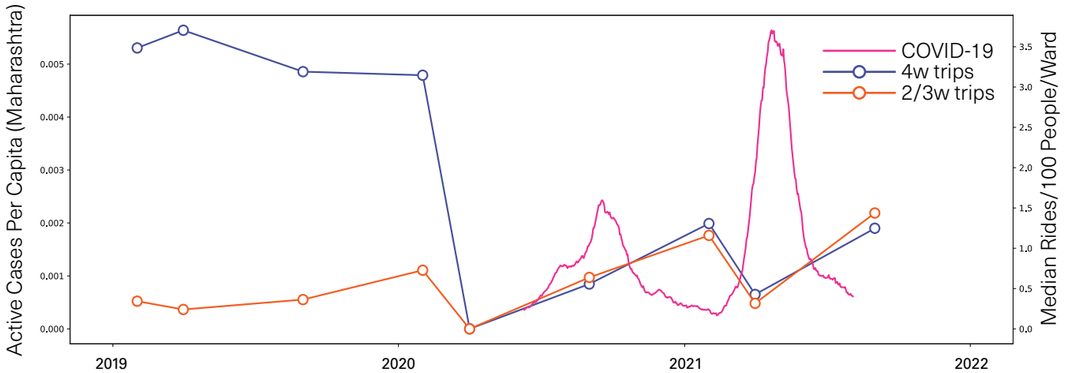
Greater Mumbai

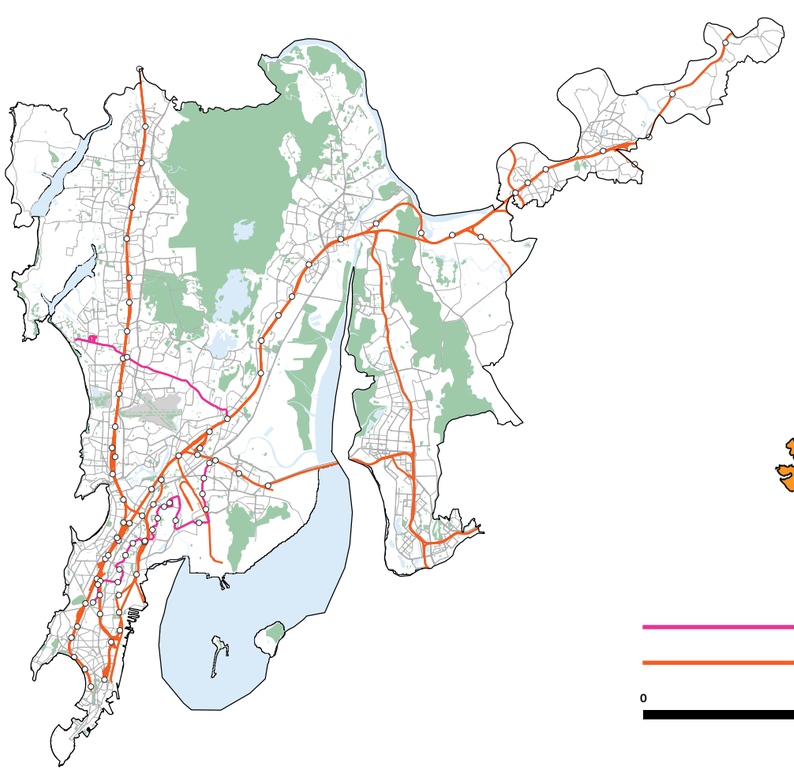
Mumbai is the most densely populated case study city and is well served by transport. Uber trips in the city were concentrated around Bandra East, a district that includes several large office parks. Since the pandemic, two- and three-wheeled trips per capita have exceeded four-wheeled trips.

Key Stats

Population: 16,651,735 (Census 2011)
Population density: 18,503 people/km²
Land area: 899.9 km²
Daily public transport ridership: 12.74M
Number of metro and train stations: 83
Bus fleet size: 4,336
Car ownership rate: 178/1000 people
Proportion of pooled trips pre-COVID-19*: 6.8%
Monthly 4w trips: 11.89 trips/100 people
Monthly 2/3w trips: 3.88 trips/100 people

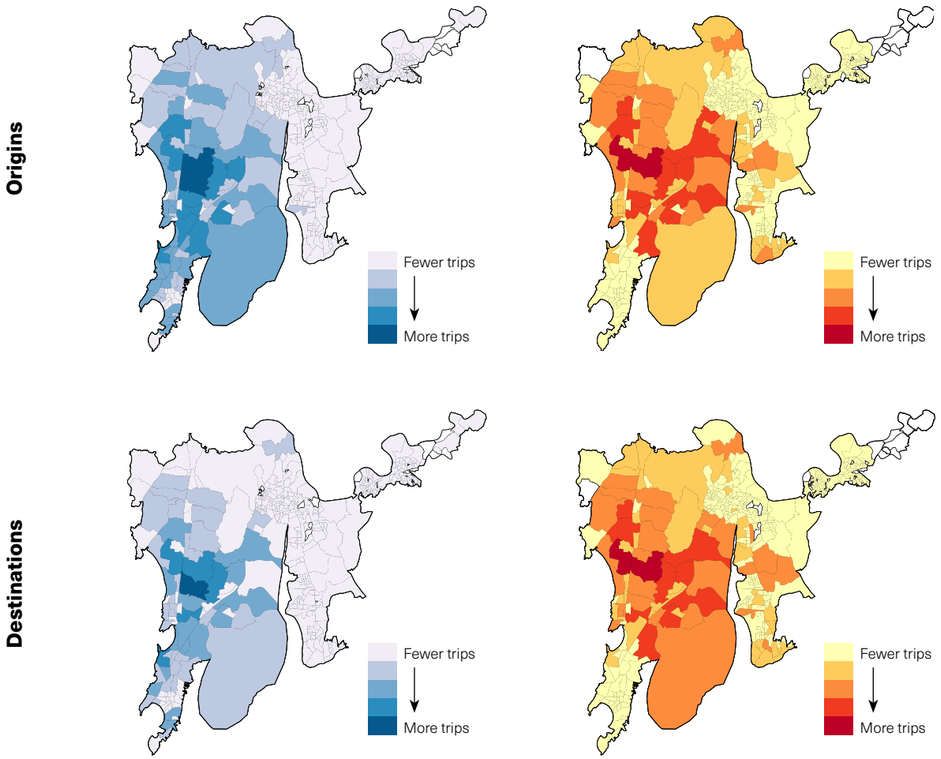
*Data aggregated by origins and destinations.
(Census, 2011; MCGM, 2016; Uber, 2022)





4w Trips

2/3w Trips



FOCUS WARDS

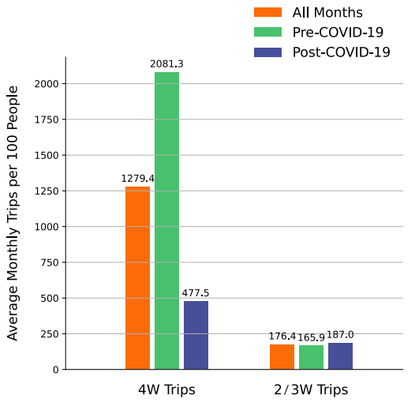
Greater Mumbai

Bandra East, Bandra Kurla Complex

Mumbai Ward 1145

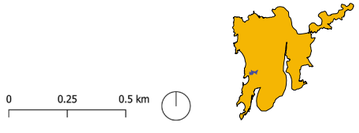
Population density:	2,900 p/km²
Intersection density:	19.3 int./road km
Fraction pooled:	5.9%
OD ratio:	0.93

Bandra East houses a mix of large commercial complexes near central Mumbai, as well as the Bandra Terminus. The employment centres in this district drove high four-wheeled trip volumes, as well as two- and three-wheeled trips that were high for the city.



High 4w use

High 2/3w use

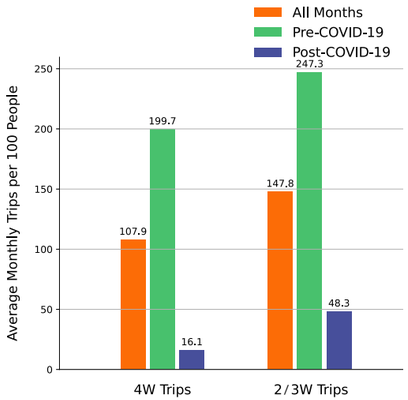


Rabale, Ghansoli, TTC Industrial Area

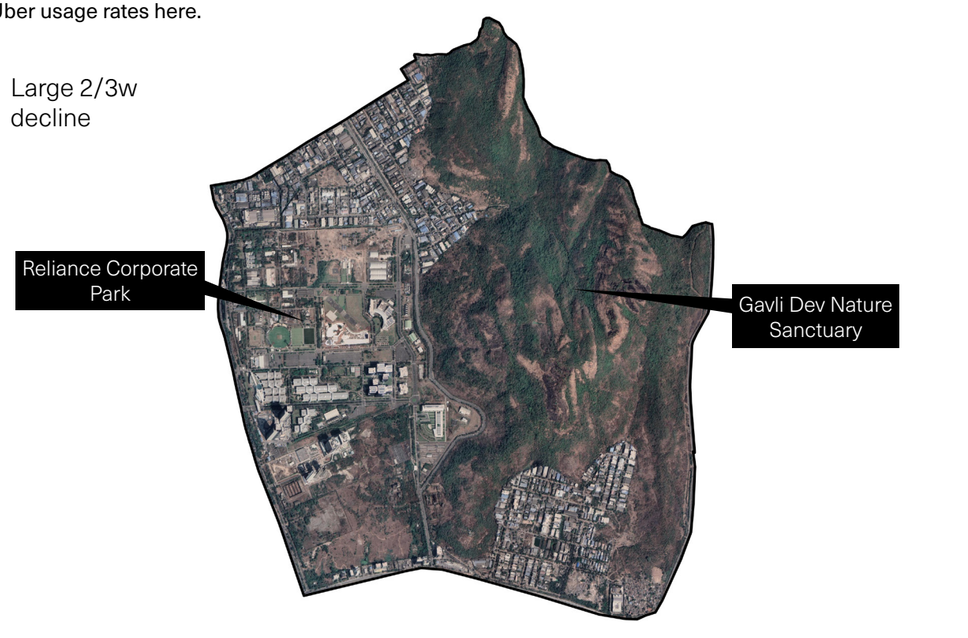
Navi Mumbai Ward 0022

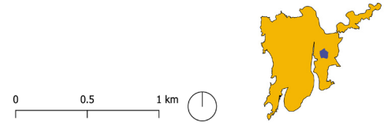
Population density:	897 p/km²
Intersection density:	14.6 int./road km
Fraction pooled:	10.7%
OD ratio:	0.77

This Navi Mumbai ward saw high two- and three-wheeled trip use that completely fell off during COVID-19. The ward houses Reliance Corporate Park, which includes the headquarters of India's largest company by market cap. Its employees and visitors drive the high Uber usage rates here.



Large 2/3w decline





CITY PROFILE

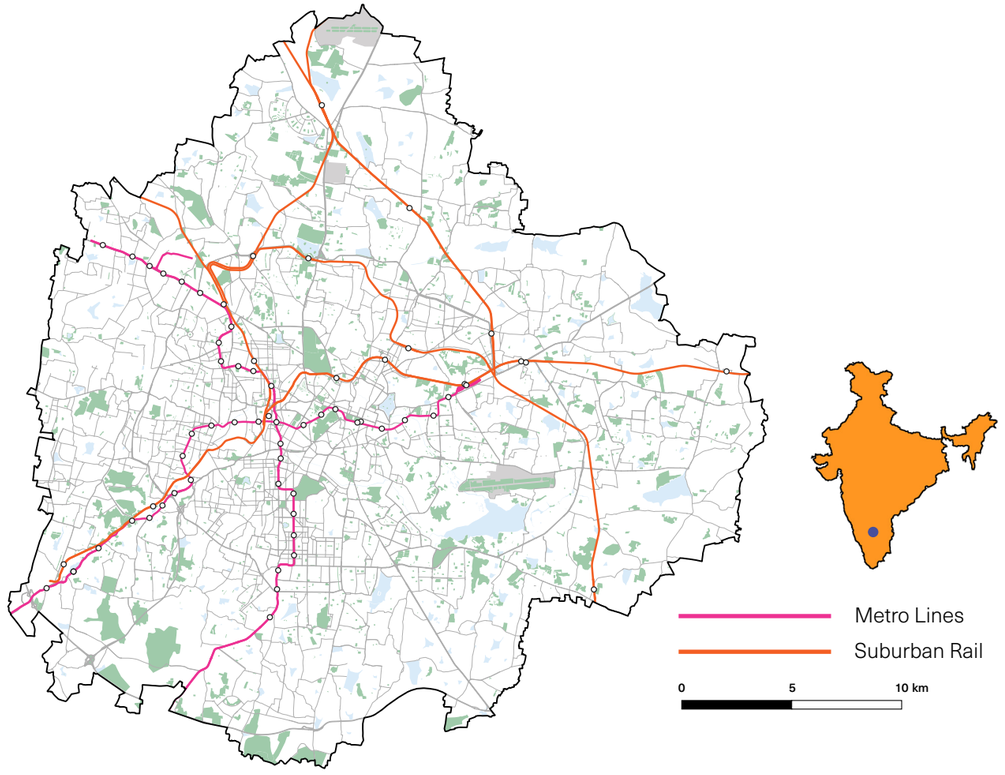
Bengaluru

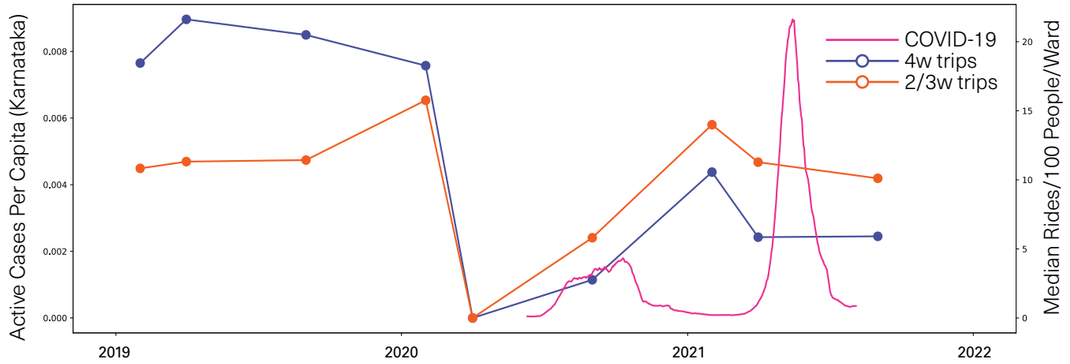
Bengaluru has the highest proportion of two- and three-wheeled trips when compared to four-wheeled trips of any case study. After the April 2020 lockdown, two- and three-wheeled trips exceeded four-wheeled trips. Bengaluru also had the highest rate of pooled trips.

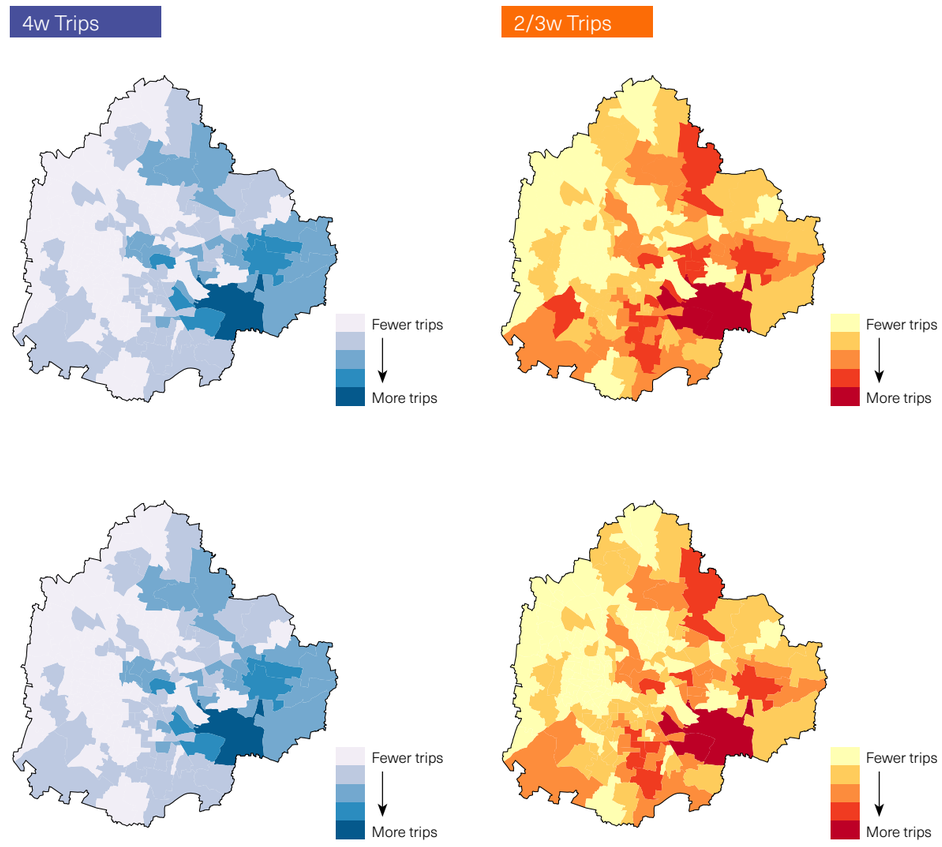
Key Stats

Population: 8,443,675 (Census 2011)
Population density: 11,440 people/km^2
Land area: 738 km^2
Daily public transport ridership: 3.31M
Number of metro and train stations: 106
Bus fleet size: 6,515
Car ownership rate: 243/1000 people
Proportion of pooled trips pre-COVID-19*: 15.7%
Monthly 4w trips: 27.82 trips/100 people
Monthly 2/3w trips: 20.73 trips/100 people

*Data aggregated by origins and destinations.
(BMTC, 2021; Census, 2011; Uber, 2022)







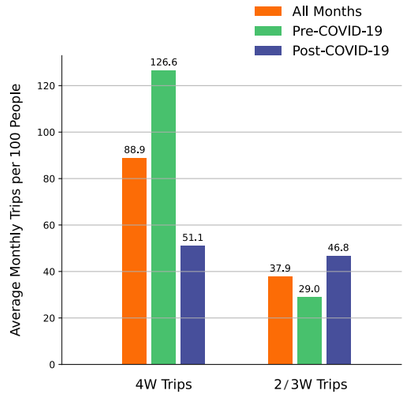
FOCUS WARDS

Bengaluru

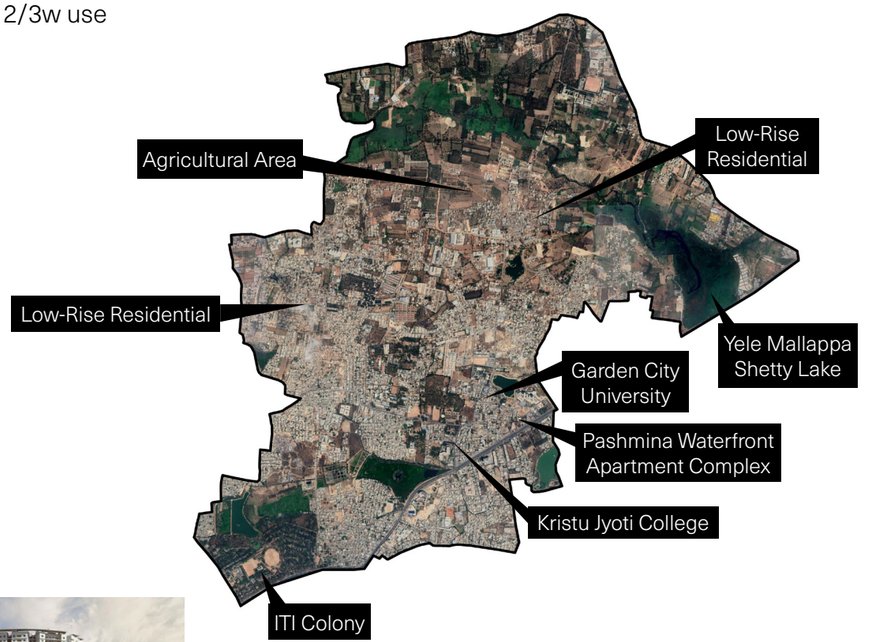
Kithiganur
Bengaluru Ward 0052

Population density:	2,043 p/km^2
Intersection density:	21.7 int./road km
Fraction pooled:	17.5%
OD ratio:	0.88

This very large outlying district in northeast Bengaluru is home to a few colleges and vocational schools, but mostly comprises primarily low-rise residential areas. The high two-/three-wheeler and Uber Pool use here exemplifies a trend of peri-urban wards turning to Uber's affordable options outside of urban centres.



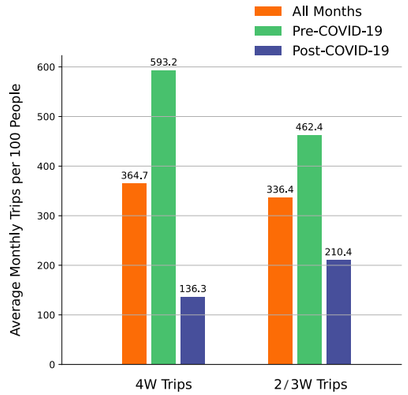
High 2/3w use



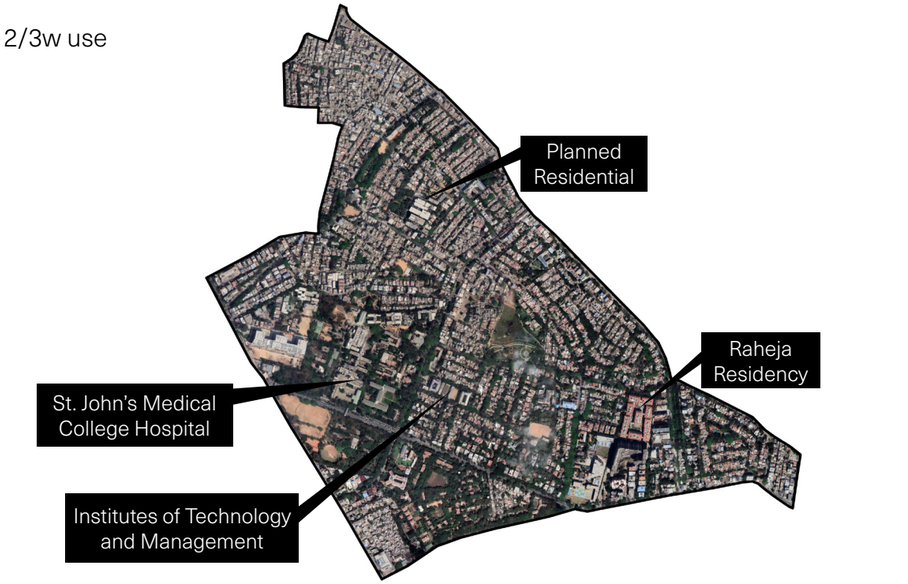
Koramangala
Bengaluru Ward 0151

Population density:	10,695 p/km^2
Intersection density:	19.8 int./road km
Fraction pooled:	16.7%
OD ratio:	0.99

Koramangala is an active district near the city centre, with a young and professional demographic living in planned residential complexes/communities. High two- and three-wheeler use and pooled trips suggest that younger people may be drawn to the products' lower price points and less beholden to cultural norms that stigmatise ride-hailing.



High 2/3w use



CITY PROFILE

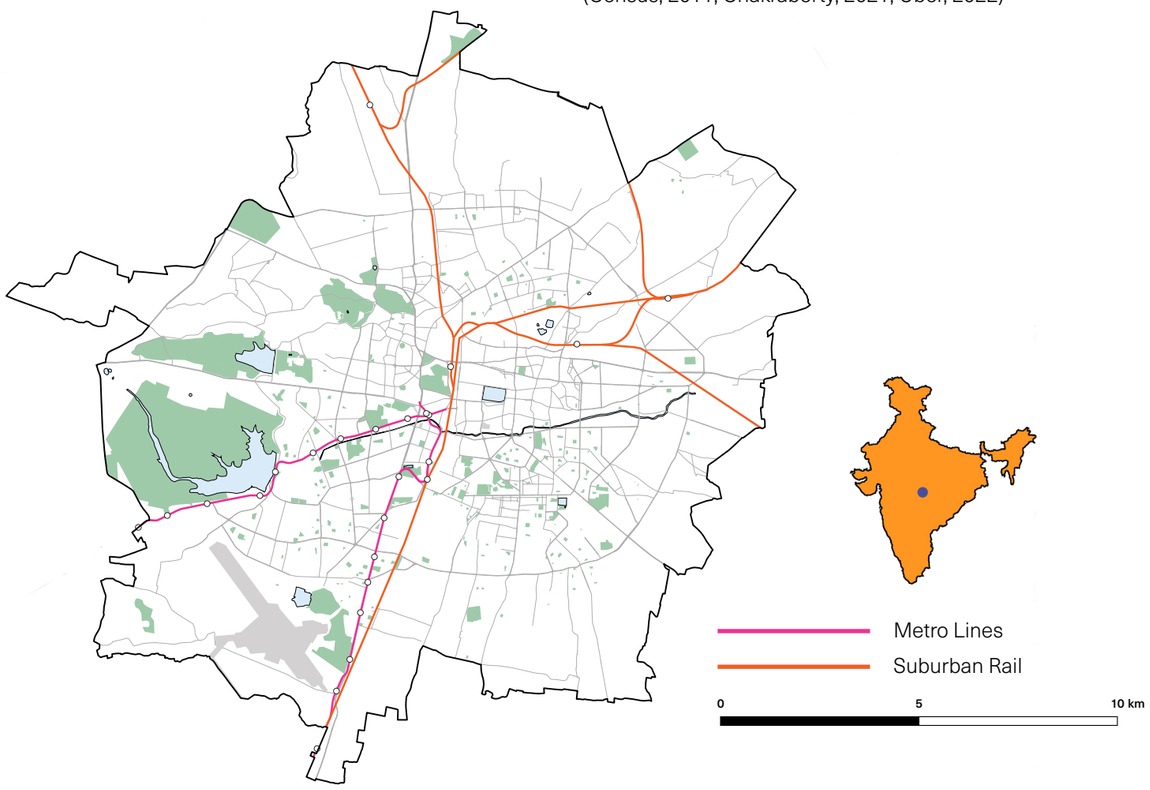
Nagpur

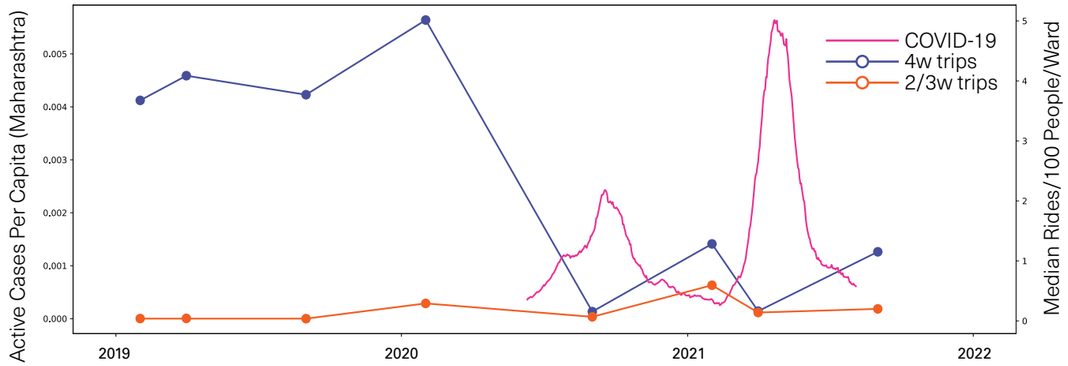
Nagpur is the smallest case study city in both population and area and the least well served by public transport. Trip rates are higher in western Nagpur. Two- and three-wheeler service launched in Nagpur in late 2019.

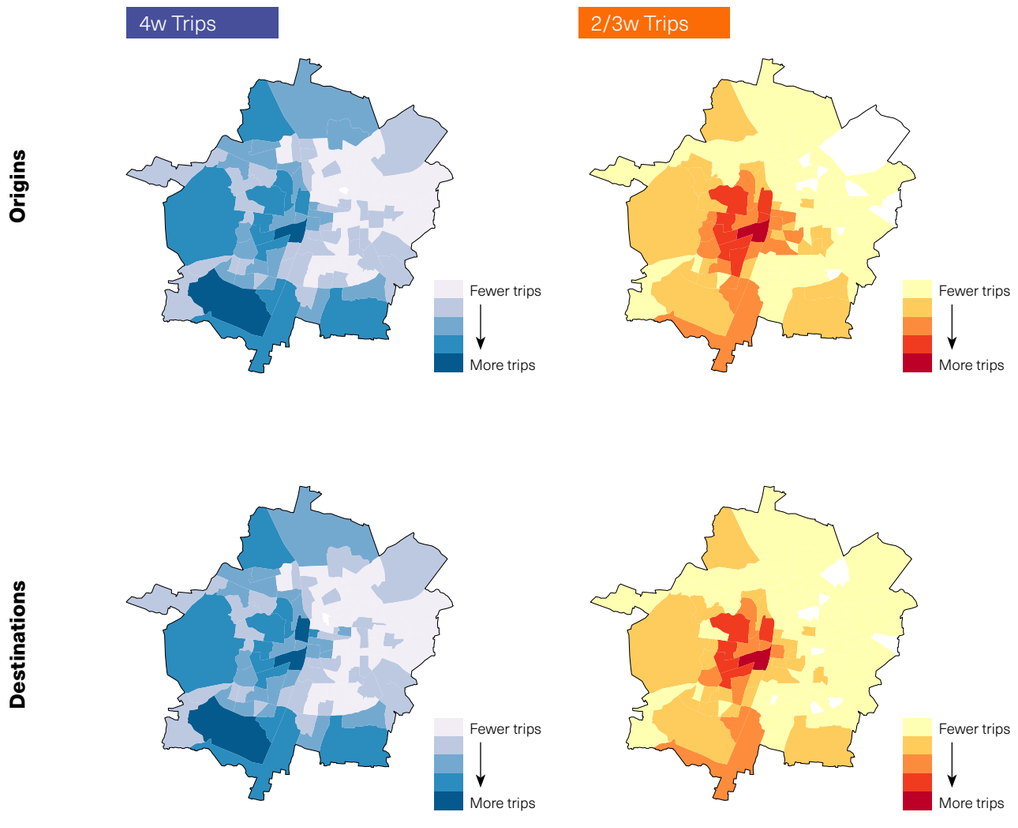
Key Stats

Population: 2,405,665 (Census 2011)
Population density: 11,077 people/km^2
Land area: 217 km^2
Daily public transport ridership: 166,187
Number of metro and train stations: 25
Bus fleet size: 441
Car ownership rate: 737/1000 people
Proportion of pooled trips pre-COVID-19*: N/A
Monthly 4w trips: 5.27 trips/100 people
Monthly 2/3w trips: 0.87 trips/100 people

*Data aggregated by origins and destinations.
(Census, 2011; Chakraborty, 2021; Uber, 2022)







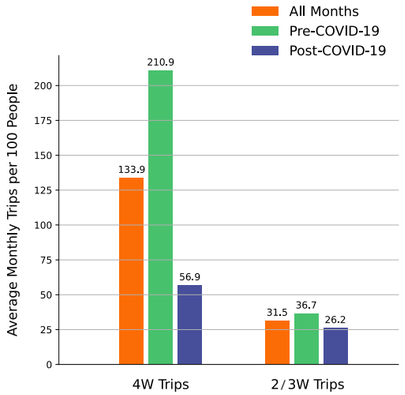
FOCUS WARDS

Nagpur

Ramdaspeth and Dhantoli
Nagpur Ward 0081

Population density:	7,262 p/km²
Intersection density:	15.9 int./road km
Fraction pooled:	0%
OD ratio:	1.03

Dhantoli in central Nagpur ranked among the highest ridership for four-wheeler and two- and three-wheeler products. It also saw a major fall in trips during the pandemic. This core, walkable, mixed-use district represents a typical central business district use case in a mid-sized city.

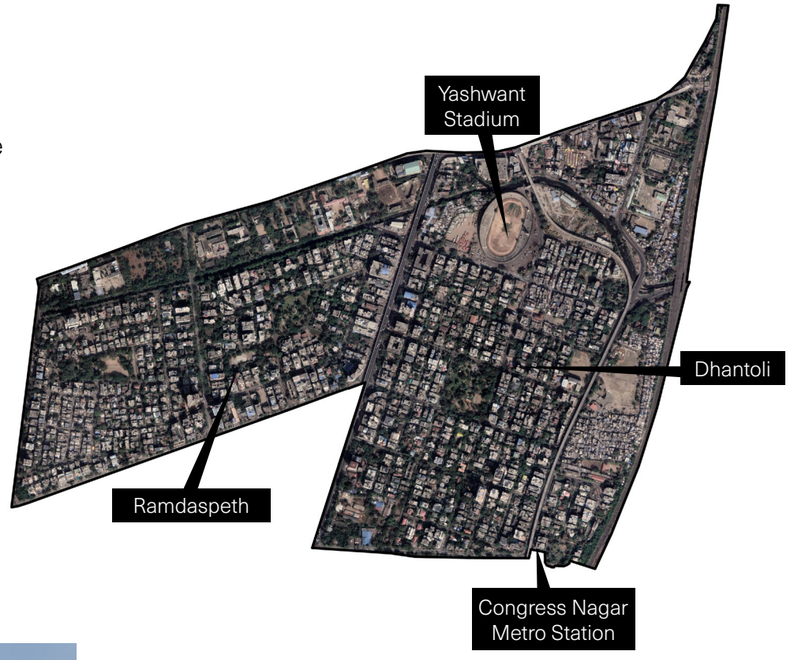


High 4w use

High 2/3w use

Large 4w decline

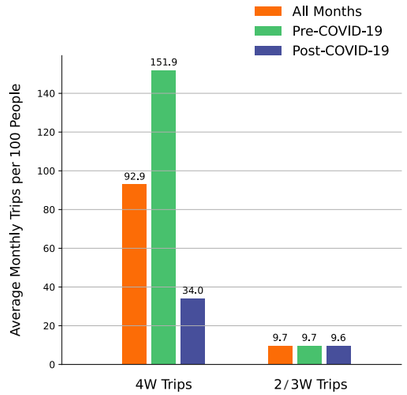
Large 2/3w decline



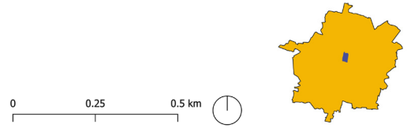
Nagpur Junction Station and Mohan Nagar
Nagpur Ward 0050

Population density:	12,166 p/km²
Intersection density:	13.2 int./road km
Fraction pooled:	0%
OD ratio:	0.57

This small ward, also in central Nagpur, saw a lot of Uber activity as home to Nagpur Junction, the main rail station in the city. The low origin-destination ratio shows that people rely on Uber to reach the station as the first leg of their journey on the regional train network.



High 2/3w use



Survey Questions

The survey that follows was open from September 21, 2021, to October 22, 2021, and distributed to policymakers, urban transport operators and related professionals by email as part of the research for this project.

Email:
Name:
Organisation:
Role:
City:

Please choose (in ranked order) your top 3 priority areas in transport planning and management from the following (please limit to 3 choices):

- Ridesharing supply caps/procedural constraints
- Parking provisions
- Electrification of vehicles
- Multimodal transport options
- Public transport expansion (bus/metro/suburban rail)
- Street design
- Peer-to-peer transport
- Kerbside management
- Congestion management
- Transport equity/access
- Adherence to traffic laws (including signals, CCTV, etc.)
- First-mile/last-mile connectivity

[Limited to 3 selections, in rank choice order: 1, 2, 3.]

What do you see as the challenges in the top priority area selected above?
[Open answer]

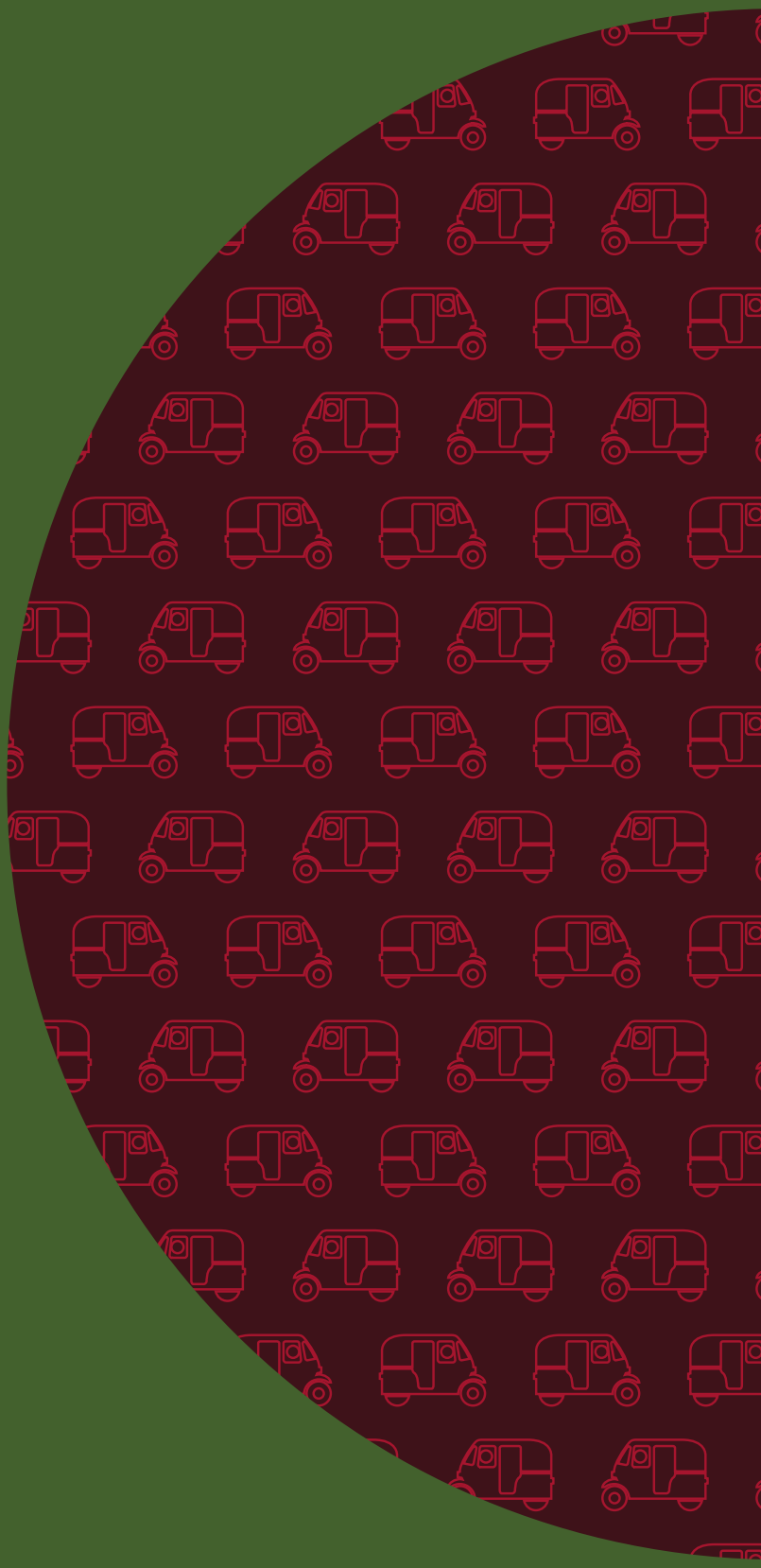
What do you see as the opportunities in top priority areas selected above?
[Open answer]

As Uber endeavours to enhance mobility in the cities, what do you think should be Uber's focus areas in the future?

- Congestion and parking management (aggregated data insights)
- Public transport planning
- Public transport route expansion
- Software as a service (SaaS)/mobility as a service (MaaS)
- First-mile/last-mile connectivity
- Other: _____

[Option to select multiple]

How do you foresee transport and mobility reacting to COVID long-term, if at all?
[Open answer]



Uber WXY