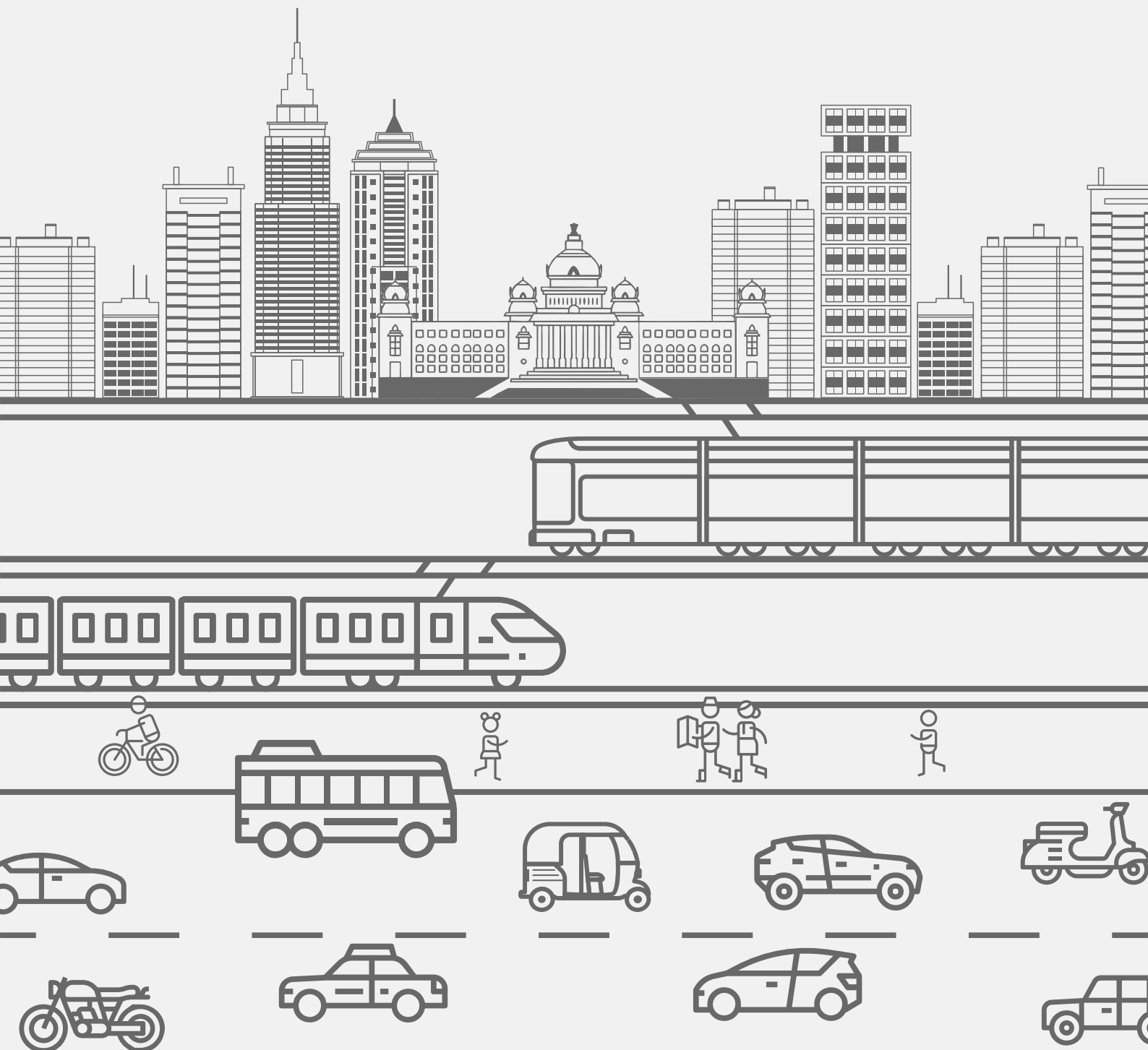


REPORT SUSTAINABLE MOBILITY FOR BENGALURU

MARCH 2020



ABOUT THE PARTNERSHIP:

The rapid urbanization has led to drastic increase in travel times, loss of productivity and reduced mobility access across travel modes. The mobility options in Bengaluru need to cater to the growing population and also address the requirements of safety, accessibility and affordability.

B.PAC and Uber in 2019-20 partnered for a study on "Sustainable Mobility for Bengaluru". The objective of the partnership is to bring together all the mobility service providers, civic groups, citizens, think tanks and government officials among others to discuss and deliberate upon the topics of Regulatory ecosystem in Bengaluru Mobility, Incentivizing shift from private to public transport, First and last mile connectivity to public transport, Sustainable and Green Transport.

ABOUT B.MOBILE:

B.MOBILE is B.PAC's mobility initiative that works on research, policy advocacy, stakeholder awareness in the areas of sustainable mobility, shared/pooled mobility, nonmotorised transit, para transit including related planning and infrastructure needs for providing seamless and integrated first, middle and last mile connectivity to citizens of Bengaluru. Our goal is to push for sustainable mobility for all by encouraging the use of public transport and disincentivizing the private vehicles usage.¹

ABOUT UBER:

Uber's mission is to create opportunity through movement. We started in 2010 to solve a simple problem: how do you get access to a ride at the touch of a button? More than 10 billion trips later, we're building products to get people closer to where they want to be. By changing how people, and things move through cities, Uber is a platform that opens up the world to new possibilities.

¹ Any queries regarding this report may be directed to forbangaore@bpac.in

FOREWORD

Bangalore Political Action Committee (B.PAC) is a non-partisan citizen's advocacy group that aims to enhance the quality of life of every Bangalorean by bringing multiple stakeholders under one platform through dialogue and action. Urban mobility is one such basic requirement which has a significant impact not only on the quality of life of a citizen, but also on economic access and progress. B.PAC started the B.MOBILE initiative which advocates sustainable mobility for all by ensuring smooth and efficient movement of people and goods in Bengaluru which has direct economic benefits and enhances productivity of people. Availability of good and efficient transportation services at affordable costs also enhances the quality of life of residents. Importance of public transportation and move towards a mobility system that is powered by shared and electric mobility has also come under increased focus due to the contribution of vehicular pollution to climate change and deteriorating air quality and its adverse impact on health. B.MOBILE works on research, policy advocacy, stakeholder awareness in the areas of sustainable mobility, shared/pooled mobility, non-motorized transit, para transit including related planning and infrastructure needs for providing seamless and integrated first, middle and last mile connectivity to citizens of Bengaluru.

Bengaluru is one of the fastest growing cities in the world, but its urban mobility solutions have not kept pace with the city's scorching pace of growth. The city has public mobility of 48% and private mobility of 52% as against Mumbai's public mobility of 80%. This inverted structure is clearly unsustainable for any city. It is to understand comprehensively the reasons for this situation, the opportunities, challenges and actions required to improve Bengaluru's mobility that a specific study was required.

We are grateful to Uber India for supporting this initiative. This helped us bring together various government agencies and new age mobility providers to discuss many contentious issues that were actually ending up incentivising private transport. We hope that the insights from the study and the recommendations will contribute to advancing the case for sustainable mobility solutions to the city.

Revathy Ashok
Hon Managing Trustee and CEO, B.PAC

FOREWORD

Uber has been serving Bengaluru since 2013 and as we have grown with the city, so has our commitment to drive positive change. Our partnership with Bangalore Political Action Committee (B.PAC) is a step in that direction and in line with our vision to move a step closer to transforming the mobility ecosystem with sustainable solutions. B.PAC, a citizen's group working to improve governance and enhance the quality of life of residents in India's tech capital has been an able partner in this endeavour. They have been successful in facilitating dialogue among stakeholders on the city's mobility challenges to find workable solutions.

Issues of traffic congestion and high vehicular emissions take centre stage in the daily life of a Bengaluru commuter. Uber has time and again voiced and acted towards the need for shared mobility and a shift to greener fuel sources. The partnership with B.PAC only goes to further embolden our intent to work towards proposing favourable policies that can help build smarter and more sustainable cities.

Through our partnership with B.PAC, we have jointly been able to rethink mobility solutions for enhancing the quality of transport for commuters in the city. The report on this partnership highlights the current challenges the city faces while also suggesting measures to promote sustainable mobility.

Prabhjeet Singh,
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ABBREVIATIONS

BMTC	Bangalore Metropolitan Transport Corporation
BBMP	Bruhat Bengaluru Mahanagara Palike
BDA	Bangalore Development Authority
BMLTA	Bangalore Metropolitan Land Transport Authority
BMR	Bangalore Metropolitan Region
BMRCL	Bangalore Metro Rail Corporation Limited
BTP	Bangalore Traffic Police
CMP	Comprehensive Mobility Plan
DULT	Directorate of Urban Land Transport
e-NMV	Electric Non-Motorized Vehicle
EV	Electric Vehicle
FAME	Faster Adoption and Manufacturing of Electric Vehicles
HTDC	High Traffic Density Corridors
ICE	Internal Combustion Engine
ITS	Intelligent Transport System
K-RIDE	Rail Infrastructure Development Company (Karnataka) Limited
NEMMP	National Electric Mobility Mission Plan
NUTP	National Urban Transportation Policy
ORR	Outer Ring Road
TTMC	Traffic and Transit Management Centre
UDD	Urban Development Department
UMTA	Unified Metropolitan Transport Authority

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EXECUTIVE SUMMARY

As per the results of the TomTom Traffic Index, a report detailing the traffic situation across 417 cities in 57 countries, it is found that Bengaluru stands to be the most traffic congested city in the world. This stands evidence for the latent congestion in the city and the personal experiences of millions of commuters whose daily commute is tedious, time consuming and toxic. This situation urgently calls for action and signifies the need for stakeholders in the city to explore new age mobility options that will support existing and upcoming public transport infrastructure and augment its use.

Public transport in the city has failed to keep up with the demands of its rapidly expanding urban population. Bengaluru, one of the fastest-growing metropolitan cities in the country, is plagued with the inadequacies of its unsustainable transportation network. Consequently, the city suffers from lower share in public transport usage, which can be attributed to the steady rise in private vehicle ownership.

The share of private vehicles in the city surged by a massive 280% between 2007-2020, amounting to 2.1-8 million vehicles. The public transport infrastructure, which takes up a low 48% usage, is frightfully scant to cater to increasing demand in the city. Between 2011 and 2019, the fleet strength of BMTC was increased only by 7.89%, whereas the population increased by 32% (BMTC; Voters list 2019; Census report 2011).

The mass transit infrastructure planned for the city are projects of long gestation, which means they will only be fully operational in a couple of years. The tentative date put forth by BMRCL for the completion of subsequent phases of metro and suburban railways, i.e. phase 3 and 4, is 2022; the focus on increasing public transportation in this interim period is solely shouldered by BMTC. Therefore, it is important to focus on new mobility alternatives and solutions that will smoothly facilitate this transition while simultaneously increasing the ridership of public transport to resolve congestion.

The shift from private to public transport could be incentivized, chiefly, by improving the service quality and scale of public transport while also integrating the diverse modes of public transport in the city.

The mass transport services in Bengaluru need to undergo massive improvement to be perceived as an attractive and reliable alternative to private commuting options. This process will entail addressing a number of barriers obscuring accessibility to public transport, such as long travel times, limited or lack of dynamic passenger information to commuters and limited or lack of seamless first and last mile connectivity among others.

As a result of the issues outlined above, it is evident that the demand for shared mobility is palpable in the city. However, the administration is yet to create a conducive environment for the economic viability of shared mobility options which could radically help lessen the dependency on private vehicle usage.

In the subsequent sections of this report, we provide an overview of the Acts, reports and policies of the Centre and State government. The analysis highlights a mismatch between the demand for newer modes of transport and the lack of regulatory ecosystem which promotes these services. The challenges faced on the regulatory front by the operators in Karnataka while offering these mobility solutions, imply the need for an immediate revision of certain provisions in the Acts to support the evolving mobility sector.

The first and last mile connectivity front is an important part of the travel experience of public transport and is a major incentivizing factor for people to move from private transport to public mode. In a recent survey conducted by B.PAC, 24% of non-users of public transport stated a lack of good first and last mile connectivity as the reason for them using private modes of transport. The question, therefore, is how to provide a first and last mile connectivity which is accessible, affordable and efficient. Considering the varying demography and public transport availability in the city, Bangalore needs to center its focus on addressing the last and first mile connectivity at a micro level. Offering solutions at different price points and for different travel purposes, and also cater to the diverse socio-economic groups of the society.

The need of the hour is to convert mass transit to efficient, sustainable and green transit. Rapidly evolving technologies and business models offer a way to decarbonize the system. While governments help to create an enabling policy landscape, it is necessary to make an effort to deconstruct the potential segments and platforms that have emerged as easy targets for EV adoption, especially those in mass transit.

Through this report we put forth short, medium and long-term goals to achieve public transport ridership in Bengaluru to 80 %. The key recommendations emerging from the report are:

1. Regulatory and Policy Interventions:

- i. Stage and Contract Carriage:
 - a. It is pertinent that aggregators be allowed to legally aggregate shared cabs, shared autos and bike pool within the existing contract carriage permit. This would encourage shared mobility and innovative mobility solutions. For example: sharing cabs and auto rickshaws should be allowed with the consent of the passengers
 - b. Allow private shuttle services and feeder buses to help close the first and last mile gap to transit stations.
 - c. Allow the grant of carriage licenses to non-transport vehicles to encourage shared mobility services in the city such as bike pool and carpool.
 - d. To define carpooling and formulate separate policy for service providers of pooling which address the concern of safety, liability and pricing
- ii. Regulatory interventions for Electric Vehicles
 - EV definition to include vehicles without pre-installed batteries, treating electric vehicles and batteries as separate entities and extending demand incentives for both.

- FAME II must include under 60km EV and inclusion of e-NMV in EV Policy of GoK
 - Policy specifically targeting B2B & B2C customers to transition to EV
 - Implement electric vehicle parking regulation, exempt parking fees for EV & provide designated parking
 - Set up a policy framework for recycle and reuse of batteries
 - Facilitate standardization of charging infrastructure and mandate fuel stations to install charging points
- iii. The Government should create opportunities for new mobility service providers through a Regulatory Sandbox, allowing them to pilot their solutions in a specific location for a specific period. Mobility data should be open, safe and secure to help gauge and assess the impact of new mobility solutions in connecting public transit and their contributions to reducing congestion.

2. Infrastructure facilities:

- i. Promote infrastructural support such as priority parking for shared mobility services, electric vehicles and geofence specific locations in the city for shared transport options only. For instance, locations like Commercial Street, Malleshwaram Market etc.
- ii. Provision of priority lanes for BMTC buses across 12 High Traffic Density Corridors in Bengaluru
- iii. Increase the fleet size of BMTC buses to 15000 by 2021
- iv. Providing walkable footpaths around 1 km radius of all mass transit stations and stops – BMTC, BMRCL and Suburban railways.
- v. Distributed Public Charging Infrastructure with the help of DULT and BESCOM; public charging stations which could cater to different categories of 2W,3W,4W in public transit hubs, airports, and train stations.
- vi. Install fast-charging stations along highways

3. Quality of service of Public Transport:

- i. **Integrated Ticketing System:** The smart card based automatic fare collection system to provide seamless ticketing across the various modes of public transport – BMTC, BMRCL and Suburban
- ii. **Information integration:** The upcoming metro stations in Bengaluru should consider introducing bus bays and transit plus zones for intermediate public transport to provide ease of transit and interchange facilities
- iii. Introducing smaller capacity buses to transit stations of BMRCL and Suburban railways to cover the first and last mile gap.

4. Governance Framework:

- i. BMLTA: The Bengaluru Metropolitan Land Transport Authority should be made a statutory body which has financial and legislative autonomy to ensure that the proposed solutions are implemented. This body should have the power to decide the nature of investments for the city.

INTRODUCTION

Development of sustainable and efficient mobility solutions in Indian cities is key to addressing congestion challenges. Efficient transportation is the driver of economic growth, connecting goods and services to markets and citizens to education, healthcare, livelihood opportunities and other social activities. The absence of efficient public transport services accompanied by an increase in average household incomes have led to a surge in vehicular ownership, resulting in an exponential growth in the number of registered vehicles in cities across the country. Over the last decade there has been a phenomenal growth in the population of vehicles in India, with an annual average growth rate of about 9.8% (MoRTH, 2020).

The economically weaker sections of the community disproportionately bear the brunt of inefficient public transport. Not only do they have to spend more time travelling to their workplace, but they also may have to forego lucrative employment opportunities due to lack of affordable and accessible transport. Bringing a shift in commuter preferences from private transport vehicles to public transport is at the core of sustainable urban transport goals (Urban transportation financing, PWC).

Road transport is a subject on the concurrent list, both state and the central government jointly frame and implement regulations with respect to issuing permits to vehicles, fare and taxation. While the guidelines are issued by the Centre, State Governments can make revisions as applicable to their context. Therefore, on the subjects mentioned above, each state could frame its own rules catering to its specific requirements. The Motor Vehicle Act, 1988 is the principal act that governs most of the motorised urban road transport in India. The Act outlines a framework for the Central and State government to regulate various aspects of motorized transport.

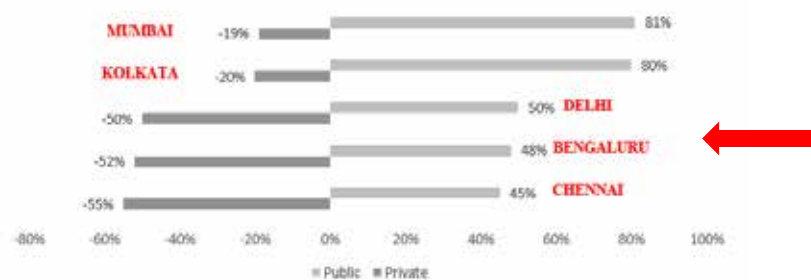
The increasing growth rate of private vehicular population in all major cities is unsustainable, requiring a thorough overhaul of the regulatory framework in the mobility sector. This restricts the choices of new age mobility options including shared mobility. As the cities are continuing to expand outward, there is a need to connect the peri-urban areas to the city via modes of transport, which is affordable, accessible and sustainable. Further, the increasing congestion needs to be addressed by the Government holistically by building adequate infrastructure, addressing connectivity issues to public transit hubs and policy interventions to incentivize citizens away from private vehicular usage to public or shared transport.

The Case of Bengaluru: The fastest-growing metropolitan city in the country, Bengaluru is struggling with the challenges of an overburdened and unsustainable transport network. Private vehicle registration has increased by 280 % between 2007 – 2020 (2.1 million to 8 million). On average, the city witnesses approximately 100 – 110 lakh trips every day, out of which 35 – 42 lakh trips are on BMTC buses, 4 – 4.5 lakh trips are on Metro and about 1.5- 2 lakhs trips on Suburban Rail. Over the years the number of trips by suburban rail has increased. A large portion of daily trips in the city are through privately owned vehicles, auto-rickshaws, cabs and shared mobility services. Bengaluru has one of the lowest share of public transport at 48 %, much lower than Mumbai, Kolkata which are at 80% public transport. The increasing

dependence of private transport in Bengaluru is unsustainable and there is an urgent need to look at interventions that can improve the public modal share.

The only mass transit infrastructure under development in Bengaluru is BMRCL's metro phases 2, 2A and 2B slated for completion 2022 onwards. The Metro Phase 3 is still on the drawing board and the suburban rail project after years of political and bureaucratic hurdles has just received the cabinet nod. Both these projects will have a long gestation period. The only immediate solution for the city for enhancing public transportation infrastructure in this interim period is the bus. Increasing the BMTC fleet size and improving the connectivity to existing public transport infrastructure are therefore the only immediate solutions. Better connectivity can happen only by better use of shared and new age mobility solutions to reach the point of public transport.

Figure 1: Share of Private and Public Transport in Metropolitan Cities



Source: Collated from various studies

While it is important to invest in public transport services, it is also equally important to improve the accessibility to public transport, through excellent first and last mile connectivity facilitated by a strong data sharing framework. Multiple studies that have been conducted in Bengaluru to understand the low ridership on public transport, have also found the lack of first and last mile connectivity as one of the primary reasons for poor usage.

The objective of this report is to suggest short term, medium term and long-term actions to achieve the aspirational goal of 80% ridership on public transport in Bengaluru by 2030. Towards this objective, the study proposes the following:

1. Reviewing existing regulatory framework for mobility in Bengaluru and proposing recommendations to create a conducive environment for new mobility service providers.
2. Proposing incentives and disincentives to encourage the usage of public transport and discourage private ridership respectively, in Bengaluru
3. To review the existing first and last mile options and propose practical solutions to bridge the last mile gap from public transit
4. Assessing the policies and framework for sustainable and green mass and shared mobility and suggest way forward

The existing and new mobility options in the city should be citizen centric with focus on ease of transport, accessibility, affordability, convenience, sustainable and offer a high user experience. In the subsequent sections, we discuss the four objectives of the study in detail.

Chapter 1: Regulatory Ecosystem in Bengaluru Mobility

The Motor Vehicle Act of 1988 is the principal act governing all the aspects of land transport in India. The Act (1988) specifies two kinds of permits for transport operators - stage carriage and contract carriage. Vehicles are required to register either as a 'Contract carriage' providing end to end services between fixed origins and destinations; or as a 'Stage Carriage' to operate as a shared vehicle on pre-defined routes with multiple stoppages to pick-up and drop passengers.

- **Contract Carriage Permits 2(7):** Are required by vehicles that carry passengers for hire or reward and are engaged under a contract, whether expressed or implied. Currently, shared mobility options operate under this type of permit (Praj, 2011).
- **Stage Carriage Permits 2(40):** Are required by vehicles that carry more than 6 passengers at separate fares paid by the individual passengers for the whole journey or stages in the journey. Essentially this permit allows the operator to pick up and drop off people at different points.

A major bottleneck identified in the regulatory framework in the mobility sector is allotment of the two permits, which vary from state to state. For instance, shared mobility operators are not permitted stage carriage permits in Karnataka, whereas some other states such as Delhi, Haryana, Tamil Nadu and Kerala have provisions for private stage carriage permits for shared mobility. The Motor Vehicle Act of 1988 has failed to include provisions for shared mobility until the recent amendment in 2019.

1.1 Regulatory Framework

i. Overview of the Central Regulatory interventions

As mentioned in the above section “The Motor Vehicles Act of 1988 is the principal Act that governs and regulates the road transport, vehicular ecosystem, including permits, penalties, registration, and insurance” (Moving Forward Together, 2018). The Act came into force on July 1, 1989.

The act clearly states that:

- None of the motor vehicles can be used as a transport vehicle in public spaces whether the vehicle is carrying goods or passengers, in accordance with the conditions of the permit granted by a Regional Transport Authority or any prescribed authority.
- None of the vehicles can be used for hire or reward without permit, it may result in the suspension of certificate of registration of that vehicle. Therefore, services such as shared cabs, shared autos, and bike taxis, among others are not legalized to operate in the cities.

The Motor Vehicles Act of 1988 has been amended several times on the aspects of fare, taxation and parking, yet ignoring the provisions for new age mobility service providers. Only

in the recent Amendment of 2019, the Act has introduced certain changes to recognize the new age mobility service provider for the first time. The Act defines aggregators as digital intermediaries or marketplaces which can be used by passengers to connect with a driver for transportation purposes (taxi services). Prior to this, the Motor Vehicles Act did not recognise the ride sourcing aggregators, they were expected to comply under Information Technology Act, 2000. The Bill provides guidelines for Aggregators, though these guidelines haven't been released yet. The Act gives authority to the state government, which will grant licenses to the aggregators based on the guidelines framed. For the first time the Act after amendment says that states may create schemes and issue permits under such schemes to promote-

- Last mile connectivity
- Reducing traffic congestion
- Improving urban transport
- Safety of road users
- Better utilisation of transportation assets
- The enhancement of economic vitality of the area, through competitiveness, productivity, and efficiency
- The increase in the accessibility and mobility of people
- Enhance integration and connectivity of the transportation system, across and between modes of transport” (Motor Vehicles Amendment, 2019).

In the Amended Act, although the classification of vehicle permits 'stage carriage' and 'contract carriage' has remained the same, the state governments have been given the power for issuing them to private operators.

Apart from the Motor Vehicle Act, the Central Government has commissioned a few studies and reports which have come out in support of the new age mobility services. In the year 2018, a report by NITI Aayog, the policy thinks tank of the Government of India was published, titled - “Moving Forward Together” that recommended certain new age mobility options. The report made some key observations as below:

1. Shared mobility has a number of potential benefits, most of which arise from an increase in system efficiency through higher asset utilization and improved connectivity. This leads to reduction in total vehicle kilometres travelled, lower fuel consumption, reduced emissions and lower cost of transportation.
2. For promoting high occupancy vehicles, contract carriage permit systems may need to be reviewed in order to allow more flexibility to state governments to support different types of shared mobility models.
3. To promote motorcycle-based shared models, there is a need to increase awareness of the ability of Transport Departments to issue contract carriage permits for motorcycles.
4. Regulations should be developed to ensure the safety of drivers and passengers as well as the “quality vehicles” (Moving Forward Together, NITI Aayog).

A report titled “Taxi Policy Guidelines” by the Ministry of Road Transport and Highways (MoRTH) in 2016 has stated the importance of shared mobility and other new age mobility alternatives as options to promote sustainable mobility in cities. The MoRTH report has outlined the following:

1. The need to liberalize the existing taxi permit systems
2. Recognizes various forms of sharing of private and commercial vehicles
3. Promote sharing of buses, motorcycles among other recommendations.
4. Need to bring aggregators, radio taxi operators and traditional city taxis under a uniform fair and regulatory framework reflecting transparency.
5. The State Transport Department may allow two-wheeler taxi permits on the lines like those for city taxis. This will offer an economical and convenient last mile connectivity solution to the citizens” (MoRTH, 2016).

While the Central Government has established the need to promote shared mobility services and new age mobility services in the city, the Motor Vehicles Amendment Act (2019) has not completely recognized these services, rendering some services ambiguous, without definition, and hence, illegal to operate. There is an immediate need for the Centre and the state government to expand the definitions in the Motor Vehicles Act to include these services.

The scenario in Karnataka

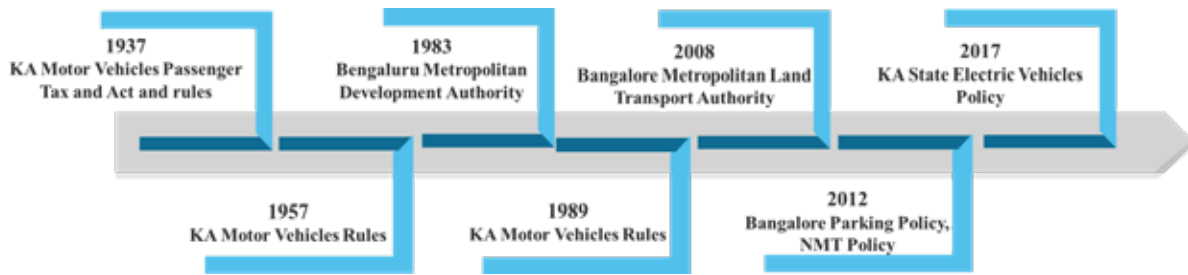
The State of Karnataka has seen 33% growth between 2015 and 2019 for new vehicle registrations. The current registrations of vehicles in Karnataka stands at 20 million as of September 2019, of which 41.9% of the vehicles are registered in Bengaluru city (Transport Department, 2019). The total number of registered vehicles has increased almost three-fold between 2007 and 2016, which makes Bengaluru, the city with the highest annual growth rate (14.9%) in vehicle registrations among all megacities in India (Roychowdhury & Dubey, 2018).

The public transport system in Bengaluru has been inadequate leading to a greater use of private vehicles (RITES, 2011). Bangalore has a lower mode share of public transport at 48 %, lagging behind Mumbai and Kolkata. This has added to congestion, loss of productivity, environmental pollution, and a reduced quality of life.

ii. State level regulatory interventions

The first Karnataka Motor Vehicles Rule was passed in 1957 which was based on Motor Vehicle Act 1939. Later, the Karnataka Motor Vehicles Rules was revised in 1989, which sets the rules based on the guidelines given by MV Act 1988. The Motor Vehicle Rules of 1988 have outlined the functions for licensing authority, transport authority. Figure 2 shows the Acts, policies passed by the Government of Karnataka regarding the transport sector relating to safety, parking, and electric vehicles among others.

Figure 2: Timeline of acts, rules, policies authorities formed relating to motor vehicles in state of Karnataka



Source: Collated from various sources

Below listed are certain initiatives by Government of Karnataka in the recent past to promote new modes of mobility in the state:

- Karnataka is the first state to have drafted the Electric Vehicle and Energy Storage Policy in 2017. This was done with an intention to make Bengaluru city the Electric Vehicle Capital by not only developing human resources to meet industry needs, but also to attract investments in manufacturing electric vehicles, opportunities for developing research and development in electric mobility
- The state of Karnataka has also made progress in terms of encouraging the non-motorized transport options in the city. Directorate of Urban Land Transport (DULT) has been set up by the Government of Karnataka (GoK) under the Urban Development Department (UDD) with the objective to coordinate planning and implementation of Urban Transport projects and programs and encourages Non-Motorised Transportation.
- Karnataka has implemented the model of public bicycle sharing. In Mysore, over 1200 to 1300 rides per day happen on the PBS (A Handbook of Select Global and Indian Best Practices on Mobility, 2018). Bengaluru has made a small beginning by implementing a permit system which allows interested operators to launch PBS in the city. This service has to now be used more thoughtfully to bridge the first and last mile connectivity gap of the city and increase use of public transport.

Although the state has made a small beginning to encourage solutions for sustainable mobility as mentioned above, the regulation has not kept pace with the innovations in urban mobility. There have been limited or no regulatory interventions for new mobility solutions which provide shared mobility services, technology-based cabs, autos, bike taxis, car and bike pooling.

The major regulatory bottlenecks in Bengaluru include stage carriage permits which lays restrictions on shared cabs and shared autos, fare caps and no surge pricing and does not provide a policy for carpooling and bike taxis which are a need of the hour. Allowing vehicles with contract carriage permits to operate in these areas will greatly help solve the issue.

The restriction on private stage carriage permit in Karnataka, to be used by shared cabs or shared autos is a serious regulatory barrier. This, combined with poor public transport in the city, has incentivised increasing usage of private vehicles in the city. The operators of these shared services, however, continue to operate, though legally in a grey area.

In the next section, a detailed analysis of the regulatory challenges encountered by the new age mobility service providers in the state of Karnataka - specific to Bengaluru city has been outlined.

1.2 Intermediate Transport Option and their Regulatory Challenge

Bengaluru has a wide range of intermediate transport modes; for the purpose of this study, they have been classified as below:

i. **Ride Sourcing:**

“Ride sourcing could be defined as on-demand services that link riders to drivers who are using their own vehicles as commercial vehicles” (NITI Aayog, 2018). For instance, digital aggregators having intermediate options of cabs, autos come under the classification.

Until recently, the Motor Vehicles Act failed to recognise the ride sourcing aggregators, which explains the absence of proper guidelines for them to operate. The Motor Vehicles (Amendment) Act of 2019 officially recognizes aggregators as digital intermediaries or marketplaces which can be used by the passenger to connect with a driver for transportation purposes (app-based taxi services). The Bill provides guidelines for Aggregators, though these haven't been released yet.

The hurdle faced by ride sourcing operators is that Bangalore has imposed both a lower and upper cap on prices. This restricts the ability of the operator to cater to high-demand areas. Further, the caps act as disincentives for the drivers since the pricing does not take into account time of the day, time taken for travel and related fuel consumption and distance leading to a serious drop in ride availability and service during peak hours. However, cities in other states have recognised this and have provisions for time-based pricing.

ii. **Ride Splitting**

“A type of ride sourcing that allows customers to be paired with others traveling along a similar route” (Federal Transit Administration, 2019). For instance, digital aggregators having intermediate options of shared cabs. However, shared autos and shuttle services do not operate on a large scale in the city.

Cabs and Autos operate on variations of contract carriage permits which disallow pick up and drop off passengers from different points. To provide services of shared autos and cabs, stage Carriage permits are required which are only granted to public buses in the state. The state instead should allow vehicles with contract carriage permits to pick up and drop off passengers from different points in the interest of efficiency. The MoRTH (2016) Committee recommends

allowing seat sharing in taxis and auto rickshaws to promote eco-friendly use and provide cheaper travel.

However, the Amendment Act (2019) still does not allow shared cabs and autos to operate within the purview of a contract carriage permit. These permits have been issued to state run operators by certain states like Karnataka, however other states like Delhi, Haryana, Tamil Nadu and Kerala have provisions for private stage carriage in order to improve connectivity through shared mobility. Karnataka allowing vehicles with contract carriage permits would make operations of these services legal, thus expanding their scope and utility. (Frameworks for Integrated Shared Mobility Governance In India, 2018).

iii. **Ridesharing (carpooling and vanpooling)**

“Adding passengers to a private trip in which driver and passengers share a destination” (Federal Transit Administration, 2019). This refers to carpooling and Bike Pooling services; also includes the model of bike taxi

The Motor Vehicles Act of 1988 clearly states that “*no person can earn a profit with a privately-owned vehicle*”. This implies that services like carpooling and bike pooling can be used to offset the cost of the trip but *cannot be used to make a profit*, which negates the purpose of commercially owned fleets. The services of carpooling and bike pooling through appropriate app-based solutions have been supported by the MoRTH (2016) report. This model of providing pool services on app-based platforms has been promoted in states of Delhi and Maharashtra; whereas in Karnataka the state government has not given provision for these services to operate.

The regulatory barriers faced by the carpooling and bike pooling operators is lack of clear definition in the Motor Vehicle Act, 1988. The MV Amendment Act of 2019 has still not clarified the terms of model of carpooling / bike pooling which are currently being offered through apps. The three specific challenges associated with car and bike pooling services as identified by the operators are - safety, liability and pricing. Unless a specific policy is formulated at the state level which defines carpooling and bike pooling, their legality would be questioned although they provide additional capacity in the city and clearly are a better solution than private vehicle usage.

iv. **Bike/cycle sharing, scooter sharing, carsharing**

This is defined as a service that provides access to an automobile for intervals on an hourly, daily or other basis. For instance, operators who offer app based rental services would come under this banner.

The rental services are operating under Rent a Motorcycle Scheme, 1997 which grants licenses to operators with more than five vehicles. At present, in the state of Karnataka, 28 such service providers have obtained permits from the state government to operate their service in the state. They currently cater to a large number of daily trips in a day, ranging between 60,000 - 1,00,000

trips. Therefore, the Rent a Motorcycle Scheme of 1997 must be made more comprehensive to address the growing market size of the rental services and the requirements of the operators.

1.3 Recommendations

Bengaluru's public service infrastructure is woefully inadequate to support the growing population and economic activity of the city. Because of lack of adequate public mobility infrastructure various new mobility solutions have sprung up and regulation has not kept pace with innovations in mobility services. The government continues to view these services as competing rather than complimentary that has the potential to enhance the use/ improve the customer experience in public mobility.

The overview of the Acts, reports and policies by Central Government and the State government outlined in the previous sections highlights a mismatch between the demand for new modes of transport and the regulatory ecosystem that governs these services. New mobility solutions have a great potential to enhance the usage of public transport. The challenges faced on the regulatory front by the operators in Karnataka while offering new mobility solutions have to be urgently addressed through revision of certain provisions in the Acts.

As seen in the earlier sections, the Central Government has clearly acknowledged the importance of having shared mobility services in the city to cater to various mobility requirements of citizens and businesses. A few states have adopted changes in their regulatory framework to promote services such as shared cabs and shared autos, shuttle services, bike taxis, carpooling and bike pooling, among others. However, Karnataka state is yet to overhaul the regulatory framework in support of these services. The recent Amendment to the Motor Vehicles Act, 2019 provides for the state government to create schemes and issue permits to new age mobility solutions if they are addressing the objective of sustainable mobility and reducing urban congestion. Therefore, the Karnataka Government should reconsider its decision on restricting/banning the new age mobility solutions in the state and create a conducive environment for the operators to provide their services within the legal framework.

A few key suggestions and recommendations specific to the state of Karnataka have been listed below. They are aimed at creating a regulatory ecosystem that addresses the interests of all stakeholders – the commuters, operators and the government.

1. Policy initiatives:

- i. Given the number of new mobility solutions that are rapidly evolving such shared cab, autos etc., there is a need to formulate a comprehensive policy to oversee their legality and focus on dispute resolution and safety.
- ii. Such a policy for service providers should address the concerns relating to safety, liability and pricing.
- iii. Further, the Central Government needs to have a legislation, applicable across states for carpooling which will help to reduce the confusion in case of interstate travel.
- iv. The State government should promote shared mobility services by providing infrastructural support such as priority parking for shared mobility options and

geofencing certain locations in the city for shared transport options only to discourage private car usage.

- v. BBMP should formulate a parking policy with a hierarchy that encourages parking zones for various forms of shared mobility and charging a heavy fee for on road and off-road private vehicle parking. Further strict enforcement is required and this would discourage people from using their private vehicles and shift to shared mobility and/or public transport

2. Legislative changes to be made by the State Government

- i. Amend the Karnataka Motor Vehicles Rules, 1988 to:
 - a. Introduce definitions of ridesharing, carpooling, van pooling,
 - b. Allow shared cabs and shared autos with contract carriage permits to legally operate in Bengaluru. This extension of permit will help and improve connectivity to metro stations, bus terminuses, bus stops and suburban rail stations.
 - c. Allow private shuttle services and feeder buses with contract carriage permits to operate which will help to close the first and last mile gap to transit stations.
 - d. Allow the grant of carriage licenses to non-transport vehicles will encourage shared mobility services in the city such as bike pool and carpool.
 - e. Create separate regulatory regimes for shared cabs and autos, private shuttle services and car and bike pool keeping in mind their business models.
- ii. Reform the Rent A Motorcycle Scheme 1997 to make it more comprehensive and cater to the current market growth and rental vehicles operator's requirement.
- iii. Amend the Karnataka On-demand Transportation Technology Aggregators Rules, 2016 to allow for dynamic pricing by aggregators that is based on time, distance and fuel cost.

3. Providing more authority to Bangalore Metropolitan Land Transport Authority (BMLTA)

The National Urban Transport Policy (NUTP), 2006 framed by Ministry of Urban Development, Government of India recommended setting up of a Unified Metropolitan Transport Authority (UMTA) for every million plus city in India. The Government of Karnataka was the first to respond to this suggestion by creating the Bangalore Metropolitan Land Transport Authority (BMLTA) – the UMTA for Bangalore Metropolitan Region (BMR) in 2007. Thirteen years since then, BMLTA still remains inactive and has shown no progress in coordinating mobility projects in BMR. In December 2019, the BMLTA bill was submitted to the Government which has reiterated the need to have a single body to coordinate and integrate all land transport activities in Bangalore; monitoring and reviewing them and ensuring their sustainable implementation

The BMLTA should be made a statutory body which has financial and legislative autonomy to ensure that the proposed solutions can be implemented. This body should have the power to prioritise and finalise all mobility related investments for the city. The proposed BMLTA

should be able to fund both operational and capital costs. The BMLTA should be headed by an officer of the rank of Chief Secretary and should have the mandate to provide the most effective mobility solution for different categories of people and different mobility use cases at multiple price points. In the short run, the Government can provide a collaborative platform for various public transport providers and policy makers/ regulators to work together. This would be an interim, practical and implementable approach before BMLTA is strengthened in the medium term.

4. Data Sharing Framework

Mobility today has become a digital service, with the schedules and bookings available at the click of a button. Every mobility service availed by a citizen generates data that when aggregated at city population level becomes key for evidence-based planning, policy enablement and evolution as well as for driving innovation in solving for the urban mobility problem. Journey dataset is but one such dataset that can make this possible. Datasets like license, vehicle registration and permits data held with Transport department; road network, parking, land-use and plot level data held with BBMP and BDA; traffic violations and accidents data with BTP need to be brought under the open data agenda.

While designing a sustainable framework for open data, it is important to recognise the factors that act as natural enablers and blockers in generating open data.

1. It has become evident that no one operator or form of transport can alone solve for the city's mobility problem and address the diversity of mobility needs in a city. If integrated multi-modal journeys - that are seamless and allows multiple operators and forms to come together to offer choices (in terms of time, cost, safety and comfort) to the commuters, it becomes imperative that the journey data held in silos by operators is opened up and worked on tangentially. Open and shared data among operators can unlock more value for operators than the datasets they exclusively own.
2. Data sharing efforts in the past however have suffered due to the lack of trust among mobility operators. With access to data being key to maintain competitiveness, voluntary data sharing has offered no *real incentives* for operators.
3. Further, the data that is shared or collected from an operator may run the risk of being not authentic and without a trail of the real source (i.e. as generated from the actual journey transactions in their mobility system). There is a need to move away from the exercise of collecting or extracting data to a system where the data is naturally *emitted* and open.

The Government of Karnataka (under BMLTA) must consider creating an open digital infrastructure for data that brings the operators, both public and private, together to enable voluntary participation, allowing them to collaborate while being competitive at the same time.

These seemingly conflicting objectives can be met if we consider following as the key principles of design:

1. The open digital infrastructure must recognise the common incentive for any operator to be in the business of mobility that is *to generate more rides*. The infrastructure must allow participating operators to find more rides in addition to what they can on their own. For example, the first and last-mile integration works well for all players if the infrastructure enables that. A public bus or metro operator needs first and last mile connectivity to increase patronage and the emerging demand from this is valuable for private shared mobility operators today in terms of scale and predictability.
2. Open Data must be a natural derivative of mobility journey transactions. Data must be emitted not extracted. i.e., instead of operators sharing data post journey, the open digital infrastructure must allow mobility journey transactions to be generated on the infrastructure itself thus naturally emitting data. An open digital infrastructure therefore must look beyond being an open data repository but instead become an open transaction platform or protocol that allows each operator or its system to connect to receive journey requests and respond with journey confirmations and fulfilment. This would be enabled by the journey data independently generated on the open digital infrastructure and not just on the operators' individual platforms. This obviates the need for data collection efforts at an individual agency level. The notion of a voluntary data provider is replaced by that of a seeker of ride request/demand, and such an engagement thus generating the required data as a natural by-product.
3. The data thus generated must however be protected for privacy (of traveller) and confidentiality of participating operators. The open digital infrastructure must factor this in its design. The datasets thus generated must be anonymised and made available at aggregate level for public access.
4. Such an open digital infrastructure must be governed with transparent and fair rules to provide confidence to its users. It may be useful to consider setting up a Mobility Data Council/ Task Force with participation from relevant stakeholders from public and private organisations that can be entrusted with developing a more detailed framework, with a bias for action in terms of building and testing such an open digital infrastructure, at the earliest at least with a limited scope to begin with.

These principles, when considered in tandem, offer an approach that does not just overcome barriers with data sharing, but also amplifies the degree of participation from the ecosystem. Such an open infrastructure that is trust-inducing goes a long way in accelerating and scaling the open-data efforts around mobility. As an example of such a solution being already conceived is the Beckn protocol as designed by the Open Shared Mobility Foundation, a not-for-profit organisation co-founded by Nandan Nilekani, Dr Pramod Varma and Sujith Nair (Visit Beckn.org for more details). The Government of Karnataka (under BMLTA) could

explore such solutions and designs to enable its data sharing agenda backed with intent and the necessary institutional support.

5. Regulatory sandbox

The State Government has tabled The Karnataka Innovation Authority Bill, 2020, in February 2020, to provide a limited window of exemption to innovators and help regulators frame laws to keep pace with disruptive technologies. This provides a legal framework that broadly describes a set of conditions under which innovative technologies can be tested in a controlled testing environment by relaxing regulatory requirements.

Once the Innovation Authority Bill is passed, Karnataka Government should encourage new mobility service providers to operate through a regulatory sandbox by allowing them to pilot their solutions in Bengaluru at specific locations and use cases for a specific period. The operator should be encouraged to share the data which will help to gauge and assess the impact of the services in connecting the public transit and in reducing congestion. Further, based on these learnings, it can be appropriately scaled to the entire city with further legislation and amendments, as required.

1.4 Conclusion

This chapter provides an overview of the acts, reports and policies by Central Government and the State government, and regulatory challenges encountered by the intermediate transport options i.e., ride sourcing, ride splitting, bike/cycle sharing, scooter sharing, carsharing in the state of Karnataka. Bengaluru is witnessing severe congestion, leading to a loss in productivity, growing environmental pollution, and poor air quality leading to a reduced quality of life. This requires the government to undertake immediate efforts in promoting sustainable and efficient new age mobility solutions. The recent Amendment to the Motor Vehicles Act, 2019 has given provisions to the state government to create schemes and issue permits to new age mobility solutions if they are addressing the objective of sustainable mobility. Therefore, the Karnataka state government should create a conducive environment for the operators to provide their services under the jurisdiction of the law. The recommendations to the state government involve supportive policy reforms which enables safe, accessible, efficient, reliable and equitable transport options. The government must address these changes with a sense of urgency and with a goal to improve the share of public transport in mobility and reduce private mobility.

Chapter 2: Incentivising Shift from Private Transport in Bengaluru

As established previously, the public transport mode share in Bengaluru is at 48 % much lower than the other metropolitan cities in India. The lower ridership on public transport is because multiple factors, one of the key ones being the government has inadvertently through its policies, infrastructure investment priorities has ended up incentivising private transport. While there has been some effort to improve road infrastructure, in the last three years there hasn't been any addition to the BMTC fleet. In the earlier chapter we demonstrated that in the short to medium term, bus is the only public mobility investment that could incentivise a shift to public mobility. Both metro and suburban rail, though required have long gestation periods and cannot yield any immediate results. The provision of mobility services and mass transit infrastructure needs a paradigm shift. It has to become commuter centric with service level benchmarks. Such services should be affordable, accessible, safe and reliable. And should be able to compete effectively on cost and commuter experience with private vehicle. This section details out incentives and disincentives that should be provided by the Government to encourage higher usage of public transport.

2.1 Current status of Mass Public Transport services in Bengaluru

The public transport system in Bengaluru has not kept up pace with the city's population growth. Lack of a comprehensive mobility plan, poor prioritisation of public mobility infrastructure investments, poor frequency and connectivity of mobility services, lack of multimodal integration in public transport have all led to poor commuter experience and resulted in shift away from public mobility. The three major public transport modes – bus, metro and suburban railway ferries over 40 lakh people on a daily basis making up to less than 50 % of the daily trips carried out in the city.

i. Bus service provided by Bangalore Metropolitan Transport Corporation (BMTC)

Between 2011 and 2019, the fleet strength of BMTC has increased only by 7.89%, whereas the population in Bengaluru has increased by 32% (BMTC; Voters list 2019; Census report 2011). As of January 2020, the number of buses in BMTC was 6483 which reveals a 3% dip compared to 2019. Earlier, BMTC buses used to cover 230 kms per day which has fallen to 180 kms per day. The fall in ridership of BMTC from 51.3 lakh in 2014-15 to 35.8 lakh in 2018-19. This highlights a significant drop in the level of service and inability to match the schedule due to congestion in city roads and is a vicious downward spiral unless immediate steps are taken to stem the decline.

ii. Metro services provided by Bangalore Metropolitan Rail Corporation Limited (BMRCL)

Although a late entrant to Bengaluru city, Metro services have been a blessing for congestion relief in Bengaluru. At present, the two metro lines which run for a total distance of 42.3 km have a daily ridership of 4.5 lakh. The Phase 2 of the metro project is expected to increase the ridership to 20 lakh people when it reaches completion in 2022. However, the lack of

multimodal integration, especially between the metro services and bus services is still a deterrent Phase 3 is still in the distant future and the city needs to be planning for 700 Kms of Metro with circular lines connecting the radial. Though a critical mode in urban mobility, given the long gestation period this does not solve the city's congestion problem for the next three to five years

Figure 3: BMRL Phase 2 and 2A

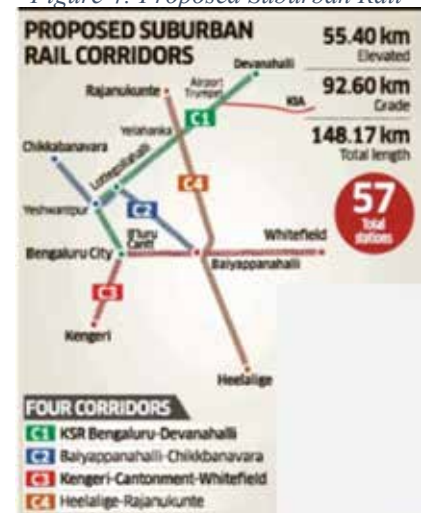


Source: BMRL

iii. Sub urban services in Bengaluru

The history of Sub urban rail in Bengaluru dates back to 1963 when there were regular trains running between HAL and City Railway Station. The first modern suburban railway system for Bengaluru was initiated in 2007 which proposed routes for a total of 204 km. Despite regular requests from citizen forums, the project has not yet seen the light of the day. In the Union budget of FY 20, the Bengaluru suburban railway project was mentioned for Rs. 18,600 crores. The central government will fund 20% of the total project cost and state government will invest another 20% and the balance 60% will be raised through external funding A well-connected suburban rail in the city will be beneficial in connecting the peripheral areas of the city and reduce the congestion.

Figure 4: Proposed Suburban Rail



Source: Deccan Herald

2.2 Incentives and Disincentives for shift from private transport

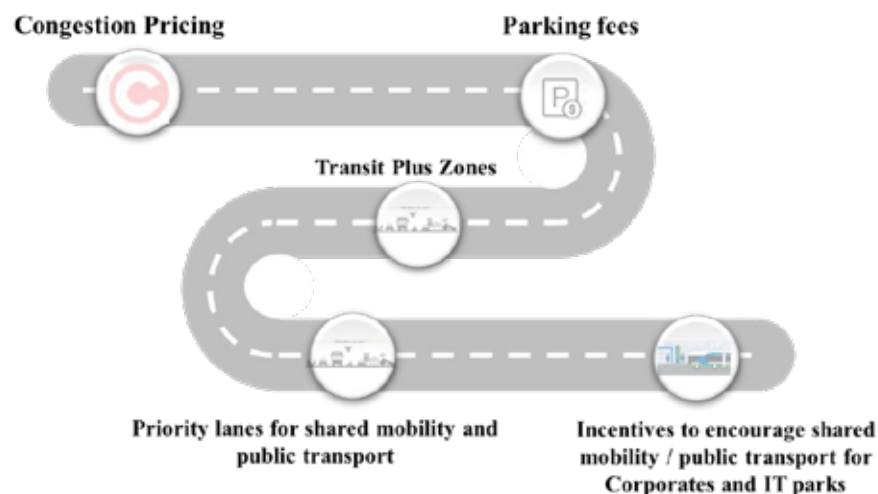
The city needs to take immediate cognisance of the skewed share of public transport in the city. This will change only if it takes some well-coordinated measures to incentivise public transport and disincentivise private transport. This shift from private transport could be encouraged by improving the service quality of public transport and bringing about seamless integration of all modes of public transport and shared mobility the mass transport services in Bengaluru need to undergo transformational improvement to be perceived as an attractive and reliable alternative to private mobility. This process will entail addressing a number of barriers that serve as disincentives to public transport usage such as

1. Long travel times
2. Limited or lack of information to the passengers
3. Lack of seamless first and last mile connectivity

Governments have often used various modes of incentives and disincentives for modifying traveller behaviour such as providing convenient or free parking for carpool vehicles, subsidizing public transportation, compensating employees for travel time while using mass transit. These have proven to be effective in encouraging people to shift from private mode of commute. The disincentive of any form should be accompanied with enhancing the quality of public transport

Bengaluru can use a mix of incentives and disincentives to promote a more sustainable shift to public transport. This chapter discusses the various models' cities around the world have adopted earlier to drive a shift from private vehicles to public transport.

Figure 5: Modes of Incentives Disincentives



i. Congestion Pricing

Congestion pricing involves charging the private vehicle users a fee to drive in specific congested areas or **corridors, and using the revenue generated to fund transportation improvements, such as better** transit service, road improvements, and bicycle and pedestrian projects (San Francisco County Transportation Authority, 2010).

The congestion pricing can be of several types:

- a) *Time distance and/or place-based pricing*: Road users pay a toll proportional to the distance travelled on some or all roads
- b) *Cordon pricing*: Under this method the fee is charged on vehicles that cross a specific boundary. This charge varies between weekdays, weekends, peak hour, non-peak hour. This is being implemented in London and Stockholm
- c) *High Occupancy Toll Lanes*: In this model, certain carpool vehicles can use High Occupancy Toll lanes while vehicles with a fewer occupancy may access the lanes by paying a toll.

Bengaluru could easily use the methods of congestion pricing listed above. Typically, most cities face congestion pricing in the city center. However, Bengaluru has multiple high-density points spread across the city. Congestion pricing needs to be implemented in these high-density corridors.

ii. Parking Fees

High parking fees are an effective way to discourage use of private vehicles. Bengaluru needs to formulate a parking policy that defines on street and off-street parking and determines the parking charge accordingly. Cities like Oslo and Sevilla have successfully introduced measures to make parking more expensive in high density areas by introducing a high parking fee and turning the on-street parking into cycling lanes. By dragging its feet over the parking policy for several years, the Karnataka government has ended up providing free parking all over the city. This has not only reduced the road width available for carriage, but also incentivised the use of private vehicles because of easy and free parking available anywhere in the city. In the absence of planned parking availability, footpath parking, haphazard parking, double parking are all the issues the city has to now contend with.

The Management and Maintenance of Parking Rules, 2018 proposed to make all forms of street parking in Bengaluru payable. The Rules also propose prohibition of parking within 150 meters of Metro stations, TTMC's and any other major public transit stations. It has laid out mechanisms in which private vehicle parking would be charged but has not been implemented. The comprehensive mobility plan CMP, now in draft phase seeks to address the gap by focussing on paid parking spaces and demand management for parking.

iii. Transit Plus Zones

Another way to reduce the use of private vehicles is by restricting the areas within which private vehicles can travel. Cities across the globe have defined an area, usually in the city's core, that is restricted to pedestrians and perhaps other special vehicles (such as bicycles, delivery vans, taxis and public transport). The other way is by creating a zone around the metro stations and bus stands which allow only shared mobility operators and charge a nominal fee to the private vehicles. This would help in:

1. Disincentivizing use of private vehicles
2. Provide source of revenue to the Municipal Corporation to improve public infrastructure.

Case Studies:

1. 'The Walkable Locality - encouraging walking' describes how Curitiba pedestrianized its town centre when Bogotá restricted car access during peak hours, there was a 28% decrease in road accidents. Bogotá's citizens have now voted to ban private vehicles from the streets for six peak hours a day from 2015 (The Natural Advantage of Nations, 2005).
2. Sarojini Market in New Delhi turned into a vehicle free street from 2019, where vehicles cannot enter the stretch between 7 a.m. and 10 p.m. Although a new initiative, this move has been well received from shopkeepers as well as shoppers

iv. Priority lanes for shared mobility and public transport

Disincentivizing private vehicles has to be supported by offering incentives for users of public transport. Providing priority lanes for shared mobility and public transport would make these services quicker and more desirable among commuters. The alternative to keep private vehicles off roads altogether in certain localities, is to simply restrict the road space available to them.

Bengaluru has recently introduced the much-awaited bus priority lane on 18 km stretch on Outer Ring Road (ORR) for buses operated by BMTC. This bus priority lane is expected to be introduced in other high-density corridors of the city. This is a first step but impactful in encouraging people to use public transport.

v. Incentives to encourage shared mobility and exclusive public transport for Corporates and IT parks

While the efforts taken at individual level to shift from private mode of transport to public mode is commendable, given the mammoth scale of urbanization in Bengaluru, it is important for Corporates and IT parks in Bengaluru to provide incentives to its employees to use public transport or shared mobility. The Corporate sector and the IT-Business parks in the city could provide incentives or redeemable points to employees who choose public transport over their personal transport. In addition, the IT-Business parks could levy parking charges to employees

using single ride cars and provide free parking to those who carpool. This would be a definitive step towards discouraging single occupancy vehicles.

2.3 Recommendation

Some of the incentives and disincentives that could be used to drive change in commuter behaviour have been discussed in previous paragraphs. We now summarise them below as fiscal and non-fiscal incentives and disincentives. Different use cases will require different approaches.

I. Incentives

1. **Fiscal Incentives:** Fiscal incentives provide direct monetary benefit to public transport users which makes it appealing. The monetary benefits could be provided in several ways such as:

- i. Free bus passes (on one working day of the week on the lines of cycle day to popularise the concept).
- ii. Obligatory and tax-free reimbursement of at least 50% of the costs for public transport which is the major fiscal incentive in Belgium.

2. **Non – Fiscal Incentives:** Non fiscal incentives offer benefits like time saving and convenience to public transport commuters. Although the incentives do not entail monetary benefits, commuters will shift if they see value in doing so. Non fiscal incentives would have benefits for the long haul.

i. **Improve the quality of service of public transport:** The public transport services BMTC, BMRCL and Suburban railway need to improve in order to be efficient, affordable and appealing to riders. Below are some of the key requirements for the public transport service providers in the city:

- a. Real time Passenger Information System (PIS) to be installed in all public transit stations which help the riders determine the time taken to commute and to plan their trip efficiently
- b. Bus route optimisation can improve utilisation, reduce duplication and release capacity to cover areas hitherto unconnected.
- c. Increase the fleet size of BMTC buses to 15,000 by 2021.
- d. Introducing smaller capacity buses to transit stations of BMRCL, Suburban railways can help cover the first and last mile gap
- e. Providing priority lanes for shared mobility and public transport would make these services a faster and a more desirable option
- f. Footpaths: Pedestrians waiting at transport terminals like BMRCL stations, Bus stations and Sub urban railway stations require well designed walkable footpaths with safe access, along with camera surveillance for minimum 1km radius from the public stations.

- g. Parking infrastructure provided to first and last mile mobility providers around the transport terminals like BMRCL stations, Bus stations and Suburban railway stations.
- h. Connectivity to Metropolitan regions: Bangalore has expanded beyond 800 sq. km, and people from surrounding peri urban areas travel to the city on a daily basis for employment, education and recreation. These far flung areas need to be connected to the city centre via suburban rail. Further, this network should be integrated with BMTC and BMRCL timings to ensure ease of transit. This will promote usage of public transport among the commuters who travel on a daily basis to the city.

ii. **Integrated mode of transport:** Transport Integration across the modes of public transport service in the city is necessary for seamless connectivity. The integration can happen in two ways:

- a. Integrated Ticketing System: Currently, there is no formal integration of ticketing for Metro and BMTC users. The smart card based automatic fare collection system which provides for seamless ticketing needs to be integrated at the earliest.
- b. Information integration: Integration of information among the modes of public transport helps in efficient planning of trips and routes. At present, there is lack of data integration between metro, bus and suburban which is a huge setback for users of public transport. BMRCL is currently in the process of integrating their data with BMTC to offer a seamless first and last mile connectivity to metro stations. The next step in information integration, would be to integrate data from paratransit service providers with public transport operators to offer a smooth door to door journey. The upcoming metro stations in Bengaluru should consider introducing bus bays and transit plus zones for intermediate public transport to provide ease of transit and interchange facilities. The previous chapter deals with a framework for data sharing in which data is emitted and shared in an anonymised way

II. Disincentives

Private vehicles are being used extensively, and in dangerous ways which is majorly because of absence of subsidized roads and socialized costs of pollution. Across the globe, there are several parameters which have been adopted as disincentives to discourage people to use their private mode of transport. A few of such disincentives are discussed below:

1. **Fiscal Disincentive:** Using private vehicles is a choice, and it is only right that the users incur all costs associated with making that choice. This form of fiscal disincentive enables the government to earn revenue which can be diverted for public transportation.

- i. Parking pricing: Strictly implement parking policy that charges a hefty fee for on road and off-road parking with strict enforcement. This would cause people

to limit the usage of their private vehicles and shift to shared mobility or public transport.

- ii. Congestion pricing: Implement congestion pricing in high density corridors
- 2. Non-Fiscal Disincentive:** As mentioned in the previous section another way to reduce the use of private vehicles is by restricting the areas within which private vehicles can travel by creating Bus Priority Lanes and transit plus zones.

The mass transit service providers along with the support of other parastatal agencies, could implement pilots in short-medium term in one or more High Traffic Density Corridor²- to increase the efficiency of vehicular movement.

2.4 Conclusion

Mass transit is a key ingredient in a sustainable, low-carbon transport future, whether in urban or rural settings, in developing or developed countries. Because of the fast-growing vehicular population in Bengaluru leading to severe congestion and loss of productivity, it is absolutely imperative to address this on war footing. It is the need of the hour to incentivise shift from private transport and increase the public transit ridership from the current 48 %. A good public transport system provides services that are frequent, fast, punctual, safe, comfortable, clean and affordable. In the next chapter we detail out how an efficient, seamless and sustainable first and last mile connectivity will help and create a conducive environment for people to travel on public transport in the city.

² Bruhat Bengaluru Mahanagara Palike (BBMP) has identified 12 High Traffic Density Corridors (annexure) based on the traffic density in peak and nonpeak hours. These corridors are home to high density Business and IT parks which have a high flow of private vehicles often causing congestion and traffic snarls

Chapter 3: First and Last Mile Connectivity to Public Transport

In transportation, first and last mile connectivity refers to the end segment of a journey undertaken by a public or mass transit, connecting origin and destination points to stations or stops on the transit network. An important requisite to improve the ridership on public transport is to provide for a convenient, economical first and last mile connectivity which at present is a neglected theme.

Research conducted in the realm of sustainable transport has indicated that first and last mile commute remain a concrete concept that contributes to the optimization of transit infrastructure intervention (S.Y Razak, 2015). More often than not, the transit infrastructure intervention stops at major transit hubs and neglects first and last mile commute. This coupled with no adequate non-motorised transport (cycling and walking) infrastructure increases the dependency on motorized means to cover first and the last mile. The literature shows that convenience and increased accessibility of first and last mile commute infrastructure to commuters has the capacity to increase transit ridership and reduce city-wide automobile dependence (Shaheen, 2011) (WRI, 2012), (Dai, 2014), (Lesh, 2013), (Fishman, 2013).

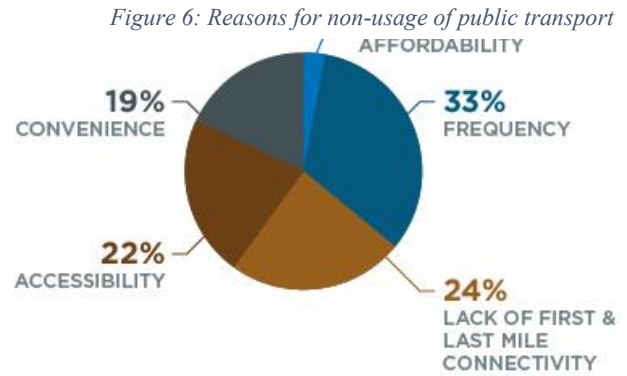
3.1 Existing Scenario of First and Last Mile in Bengaluru

Improving the first and last mile connectivity can be a challenge in Bengaluru considering the varying demographics and public transport connectivity. The city which has only 42 Kms of Metro serviced that too for limited locations and a negligible suburban rail service, an efficient bus transport system is the only most significant public transport system available in the short and medium term. Therefore, the first and last mile solutions should focus on connecting far off localities to public transport.

The new mobility service providers in the city are working on solutions to address this gap in public transport which has a huge potential in Bengaluru. There is evidence to suggest that new mobility services and intermediate para-transit providers have the potential to be key stakeholders in overcoming the last-mile gap to mass transit. However, the existing regulations in the state are not supportive of shared services – shared auto, shared cabs, bike taxis, carpooling. With the upcoming new phase of metro and expansion of suburban railway network, the problem of first and last mile connectivity would escalate if not addressed. The mass transit service providers should hold consultation meetings with the citizens, private stakeholders to plan for a smooth transit from new mass transit stations.

First and last mile connectivity to public transport forms an important part of the travel experience of the latter and is a major incentivizing factor for people to move from private transport to public mode. In a recent survey conducted by B.PAC, 24% of the non-users of

public transport stated a lack of good first and last mile connectivity as the reason to use private modes of transport (B.PAC, 2019). The question, therefore, is how to provide first and last mile connectivity which is based on principles of accessibility, affordability and efficiency. The last mile solutions should offer different options for people to choose from at different price points and for different travel use cases.



Source: B.PAC Survey

There is a difference in the travel patterns of public transport between men and women. This difference is also observed in the way women and men travel their first and last mile. In the B.PAC survey, there were gender differences observed in travel patterns for men and women in choosing the modes for first mile connectivity (B.PAC, 2019) 65% of the women said that they prefer shared mobility – auto, cabs, shared cab as their first mile connectivity option to access public transport whereas, 50 % of the men preferred personal owned vehicles to cover first mile to access public transport. The innovations in first and last mile space have to take into account the gender travel patterns to provide for sustainable first and last mile solutions.

Existing First and Last Mile Solutions:

Table 1: First and Last Mile Connectivity Solutions

First and Last Mile connectivity solutions	Policy, Regulatory and Infrastructure challenges
Shared Mobility – Bike Taxi, Shared cabs, Shared autos, Carpool	<ol style="list-style-type: none"> 1. Lack of clear definition of carpooling 2. Existing regulatory framework is not supportive of services of shared cabs and shared auto
Rental Mobility- Rental bikes, Rental bicycles	<ol style="list-style-type: none"> 1. No designated parking zones for rental vehicles leading to parking of rental vehicles on footpaths
Shuttle or Feeder bus services by private operators	<ol style="list-style-type: none"> 1. Currently not operational in the state because of the stage and contract carriage definitions.

3.2 First and Last Mile Challenges in Bengaluru:

- Lack of connectivity to public transit from inner localities:** The public transit in Bengaluru covers only a few localities leaving the inner localities with limited or no connectivity. There are no feeder bus services currently operational in the city because of which commuters rely on their own vehicle or cabs/ autos to reach the nearest transit stations. In the B.PAC conducted survey, it was noted that 44% of public transport commuters their own vehicles to cover the first mile. (B.PAC, 2019)

- ii. **Lack of shared mobility services to cover the first and last mile gaps:** The three-seater shared auto services which operate in certain parts of the city effectively work as a primary medium to cover the first and last mile travel. 51% and 68% of the commuters on public transport use shared mobility (shared cabs, single ride cabs) as their first mile and last mile respectively. (B.PAC, 2019)
- iii. **Poor infrastructure for walking and cycling:** Walking is the most desirable form of first and last mile connectivity. In Bengaluru, 53% of people who travel on public transport walk both their first and last mile, while 18 % of them do not walk even one leg of the journey. (B.PAC, 2019)
- iv. **No integration of services at public transport transit points:** Several metro stations in the city do not have parking spaces for rental operators to provide service. Further, the metro stations which have a facility for bus stops outside the metro stations have not been integrated with timings. 36% of the commuters in the city use more than one public transport service, therefore, it is important for the public transport operators to plan for an integrated and seamless public transport network. (B.PAC, 2019)

The upcoming public transit stations cannot be perceived as a standalone infrastructure project. It needs to achieve physical integration (parking facility for private vehicles, bicycles), information integration (displaying real-time bus timings at the station) and service integration that will ensure different services such as suburban train, cabs and autos complement each other.

3.3 Initiatives by Mass Transit Operators to improve first and last mile connectivity

The *National Metro Rail Policy of 2017* has stated the need to bridge the first and last mile gap as one of its objectives. Since then, the Ministry of Housing and Urban Affairs (MoUHA), has started focusing on services at the metro station, which is sustainable, efficient and affordable. Some of the initiatives proposed by MoUHA are - feeder bus services, electric rickshaws, smart cycles (that can be rented out), electric scooter services, and partnerships with cab aggregators for providing hassle-free last mile connectivity to passenger and to increase the catchment area of metro at least to 5 km.

The policy states that each State must make the metro self-sustaining, enhance other kinds of mass rapid transport systems, such as monorails or buses, and provide last mile connectivity, between the metro station and the commuters' destinations. Some of the initiatives adopted by the Metro Rail Corporations in India are as follows:

- i. **Chennai Metro Rail Limited:** The CMRL has launched an app for feeder services from metro stations which is aimed at making the first and last mile connectivity cheaper, easier and safe. The services offered are shared cabs and shared auto services

with a fixed route. This provides for a seamless transit from the metro stations. Due to this initiative, the ridership on Chennai Metro increased to 34 lakh passengers as of December 2019, as opposed to 18 lakhs in Jan 2019.

- ii. **Delhi Metro Rail Corporation (DMRC):** The DMRC has been efficiently running the feeder bus services which runs on 32 routes connecting the interior parts to the metro station. The DMRC has also introduced e-rickshaw services which operate from 17 metro stations (expanded to 12 more metro stations in Feb 2020). A fleet of over 1000 e-rickshaws are helping to cover the first and last mile distance in an eco-friendly way. In addition, DMRC has also introduced cab aggregators kiosks, e-scooter rental and public bicycle sharing across metro stations in Delhi.
- iii. **Kochi Metro Rail Limited:** In 2019, KMRL introduced e rickshaws in 6 metro stations to improve the last mile connectivity.
- iv. **Bangalore Metro Rail Corporation Limited:** BMRCL has introduced scooter and cycle rental services from 42 number of metro stations in Bengaluru. The feeder bus services which were operational previously from metro stations are currently inoperative, although there is a demand for this service among the commuters. In 2019, BMRCL has announced to introduce e rickshaw for last mile connectivity from metro stations, however, the services are yet to be flagged off.

3.4 Potential solutions to close First and Last Mile Connectivity Gap in Bengaluru:

- i. **Transit Station to Industrial Corridors/Company Campus:** Connecting transit stations to IT and Business Parks by mass transit would help in reducing the private vehicles usage for first and last mile connectivity. For example –the existing feeder buses connecting Byappanahalli Metro Station to ORR and Whitefield are a good use case where the gap between metro station to industrial corridor/near campus and the reverse as well could be closed. The frequency of such feeder buses should be increased.
- ii. **Transit Station to Public Place (e.g. shopping mall/ large hospital):** The connectivity from transit stations should be extended to places of shopping having high footfalls. For example: A locality like Commercial Street in Bengaluru should be connected with nearby metro stations via a shuttle service or an e-auto services which will help people who go shopping to cover their last mile.
- iii. **Shuttle service from interior localities to transit Station:** A shuttle service or a feeder bus system with a specific route covering the distance between residential areas to public transit stations is the other desirable option to close the first and last mile gap.

3.5 Recommendations

- i. **Last Mile solutions by State Government:** The recently amended Motor Vehicle Act has outlined that the State Government can modify the permits issued under the MV Act or formulate schemes and issue licenses to promote last mile connectivity solutions in the city. The Transport department in Karnataka should take note of this amendment and issue permits for shared mobility operators to operate services such as – shared auto, shared cabs and feeder buses which have proven efficient in closing the first and last mile gap.
- ii. **Pedestrian Infrastructure:** The operators of mass transit services should invest in improving the infrastructure for pedestrians who access their first and last mile by walk. The operator should develop and maintain the footpath for 1 km radius surrounding the transit stations.
- iii. **Feeder buses:** The feeder buses operated by BMTC from a few metro stations to residential areas had helped to connect the interior parts to the transit stations. This service has been discontinued by BMTC. Reintroducing this service will be able to cater to the last mile travel of commuters. Further, the Transport Department needs to allow private operators to operate the shuttle service from transit stations. Some of the identified locations for pilot are:
 1. MG Road – Commercial Street
 2. Byappanahalli – Whitefield
 3. ORR – Indiranagar Metro Station
- iv. **Solutions of last mile should be location specific:** The last mile solutions from the transit stations needs to be designed specific to location. In Bengaluru, the connectivity to public transport varies across various micro locations, with certain areas having either one or more of public modes namely metro, bus or suburban connectivity while some far-flung areas having limited or no connectivity to public transport. Therefore, the last mile solutions need to be planned at a micro level taking into consideration the purpose of travel.
- v. **Stakeholder consultation meetings:** The new phase of Metro and Suburban railways are expected to be completed by 2022. The mass transit operators should hold stakeholder consultation meetings with commuters, private operators to introduce feasible connectivity options for first and last mile.

3.6 Conclusion

First and last mile connectivity to public transport forms an important part of the travel experience on public transport. In Bengaluru, the connectivity to public transport varies across the localities, with certain areas in the city having either metro, bus or suburban connectivity. At present, there is no formal physical integration or information integration across the modes of transport in the city. This level of integration is imperative to encourage people to use public

transport. A study in 2017 highlighted that a lack of affordable transport to the metro and bus stations in Bengaluru which further highlighted that people who live beyond 5 km from the metro stations are unlikely to prefer public transport. (Chaitanya Kanuria, 2019)

The new age mobility service providers in the city have been working on solutions to address the first and last mile gap. At present, the app-based bike taxi, bike rental, cycle rental, shared cabs and carpooling among others are the options to cover the first and last mile journey. However, not all public transit stations at present have parking facilities for app based rental vehicles. As highlighted in the sections above, the use of walking as mode of first and last mile connectivity is very minimal. The use of non-motorized transport such as walking and cycling can be encouraged by providing walking and cycling infrastructure as well as providing cycle parking at metro stations.

Innovations in the mobility space to close the first and last mile gap such as bike taxis, e-rickshaw, e-scooters should be encouraged as they offer better first and last mile connectivity. Further, a multi modal integration of all public transit modes in the city would enable service providers to build solutions to close the first and last mile gap.

The city's poor public transport utilization needs urgent attention. We need to conduct pilots in a few high traffic corridors aimed at providing the requisite physical infrastructure, connectivity services for above use cases and complete information integration across different public and shared mobility modes. Such a pilot would provide massive learning for deployment at scale across the city

Chapter 4: Sustainable and Green Transport for Bengaluru

Mobility is at the center of modern life. With many urban transport systems already under strain and mobility demand predicted to grow significantly in the future, mobility needs to change to meet our future needs. It has evolved beyond congestion, with the immediate need for reducing carbon emissions and head towards clean, cost-effective and efficient mobility.

This chapter talks about understanding the policy on Electric vehicles which is in its infancy, the challenges that current urban mobility climate poses and attempts at making recommendations to resolve the roadblocks in achieving full e-mobility. There is specific attention given to the state of Karnataka, which is a pioneer in drafting an EV policy.

Rapidly evolving technologies and business models offer a way to decarbonize the system. While governments help to create an enabling policy landscape, businesses are well placed to address rising global transportation requirements as well as improve local environments for their stakeholders. The chapter also attempts to deconstruct the potential segments and platforms that have merged as easy targets for EV adoption, especially those in Bengaluru.

Apart from environmental considerations, the shift is almost a necessity, considering India paid Rs4.16 trillion to buy 202.85 million tonnes of crude oil in 2015-16, says a report titled 'India's electric vehicle drive: challenges and opportunities' by Livemint. ('India's electric vehicle drive: challenges and opportunities').

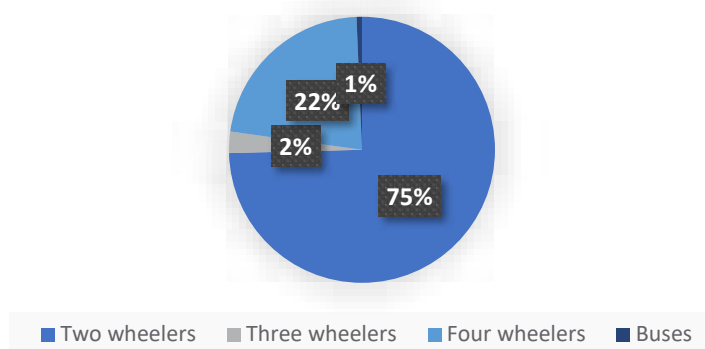
The recommendations made in this section range from disincentivizing sales and usage of Internal Combustion Engines (ICE) vehicles' to establishing appropriate charging infrastructure and machinery to popularise EVs.

4.1 Current Scenario

There is a need to divert attention to Electric and green mobility now, as traffic congestion and pollution are the biggest challenges that India is met with. A survey by the Economic Times in May 2019 that sampled car owners, showed that 90% of them are willing to shift to electric vehicles provided there is an appropriate charging system in place and EVs are available at an affordable price. Currently, the EV market has only 1% share in India with a predominant share of that being two-wheelers.

The Government of India has signalled the beginning of a new era for mobility in India. Global technology trends and India's rapidly growing vehicular populations have emerged the need for EV. According to the transport department, the current vehicular population of Bengaluru is around 80 lakhs inclusive of two, three and four-wheelers and buses.

Figure 7: Vehicular Population 2019



Source: Transport Department, GOK

According to Table below, the number of electric vehicles is less than 1%, where only three wheelers exhibit a slightly higher scale of adoption.

Table 2: Percentage of EV in Bengaluru as of 2019

Vehicle Type	Total Vehicular Population	EV (as on Dec 19)	EV %
Two-wheeler	57,72,673	7545	0.13%
Three-wheeler	2,01,017	13,522	6.46%
Four-Wheeler	17,13,023	6050	0.35%
Buses	50988	Nil	0.00%
Total	77,37,701	27,117	0.35%

Source: Transport Department, GOK

This slow growth in adoption of EV is because of reluctance on part of existing automotive manufacturers to shift to EV (this would increase competition because of relatively low barrier to entry and render a number of investments redundant) , slow adoption by commuters because of range anxiety and high entry price and lack of much needed policy interventions to support faster adoption. Karnataka's EV policy aims to convert 50% of its entire fleet into EV by 2030, thus shifting the focus to electrification of transportation which is the primary technology pathway to achieve the transformation to green mobility.

The state's vehicular population by 2030 is predicted (via the CAGR method that is considering the growth over the last five years) to be over 24 million. If the state plans on converting 50% of its fleet by 2030, amounting to 12million, which is a steep target to chase.

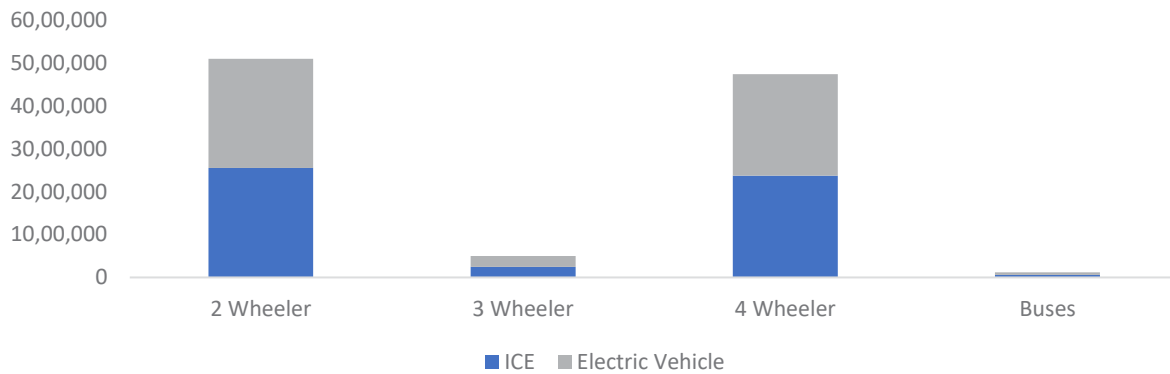
Table 3: EV Target 2030

Vehicle Type	CAGR (2014-2019)	Total Vehicular Population (prediction for 2030 using CAGR)	EV Target for 2030	EV%
Two-wheeler	11.2%	1,86,87,175	9343588	50%
Three-wheeler	8.63%	4,99,667	249833.3	50%
Four-Wheeler	9.85%	48,14,641	2407320	50%
Buses	7.91%	1,17,800	58900.18	50%
Total		2,41,19,283	120,59,641	50%

Source: Transport Department, GOK

The acceleration of EV adoption in India between 2020 – 2030 is critically necessary to catch up with demographic growth. A slow transition could mean tens of millions of additional ICE vehicles on Indian roads.

Figure 8: Karnataka 50 % EV in 2030



Source: Transport Department, GOK

Representing the largest section of fastest growing vehicles in the country, fleet like ride-hailing, delivery or employee transport aggregators are pegged to be ideal for early EV adoption. Fleet adoption, which refers to players transitioning their fleet into EV, is also economically feasible for fleet owners first, as the cost of EV is high. Focusing on high utilization vehicles operating commercially on defined routes have a high chance of creating a big impact.

4.2 Initiatives to support electric mobility in India

Figure 9: Policy Framework Timeline for EV



At the central level, several ministries and departments have been actively pursuing the transition to electric mobility, including the Ministry of Road Transport and Highways, Department of Heavy Industry, Department of Industrial Policy and Promotion, Ministry of Finance, Ministry of Housing and Urban Affairs, Ministry of Power, Ministry of New and Renewable Energy, Department of Science and Technology and NITI Aayog. Additionally, 27 states have formulated strategies for transforming their mobility systems in MOVE summit. Karnataka is the first state to formulate an EV Policy and several states followed suit in drafting their respective policies. (India's Electric Mobility Transformation, 2019)

The Government of India launched the National Electric Mobility Mission Plan (NEMMP) 2020 which envisages the introduction of about 6-7 million electric/hybrid vehicles in the country by 2020.

i. Faster Adoption and Manufacturing of Electric Vehicles (FAME)

Under this NEMMP, Faster Adoption and Manufacturing of Electric Vehicles (FAME) India scheme was introduced in 2015, with the objective to support hybrid/electric vehicles market development and manufacturing ecosystem. The FAME scheme was extended in the form of the FAME-II in 2019 with a total outlay of INR 100 billion.

a. FAME I

FAME I provided incentive to private vehicles. FAME I had a planned outlay of INR 7950 million in two years as shown in the table 4 but only INR 5800 million was actually allocated in over four years. Between FY 2015-19 0.15% - 2W, 0.04% 4W of total domestic sales is EV in India, which is evidently less as government envisaged of having about 6-7 million EVs by 2020. Learnings from FAME I need to be critically looked upon to increase the pace of EV adoption.

Learnings from FAME I

FAME India scheme was initiated in 2015, when there were only few electric vehicles on the road. Government of India implemented FAME scheme to accelerate adoption of EV in India. In this section learnings from FAME I Scheme is discussed which provides useful insights for future interventions.

- Batteries/vehicles should be incentivized in proportion to their efficiency and range
- For a fiscal purchase incentive to be effective, consumers need to have a range of product options in the market
- The development of a charging network is essential to the adoption of electric mobility
- Emphasizing domestic manufacturing of batteries, EV components (including electronics), and charging infrastructure is critical to India's electric mobility transition
- Focusing on shared and public transport has a higher overall impact than focusing on private vehicles (India's Electric Mobility Transformation, 2019).

Since the implementation of FAMEI there are developments seen in the EV market as more options are available, awareness among people, setting up charging infrastructure. To accelerate the adoption of EV more significantly FAME II scheme is initiated.

b. FAME II

As discussed, FAME II is the expanded version of the present scheme titled FAME India which was launched in 2015. The scheme offers upfront incentive on purchase of Electric vehicles. The phase 2 of FAME will provide incentive for public transport in 10 cities. The outlay of ₹1,00,000 million has been made for three years till 2022 for FAME 2 scheme as shown in the table. The centre has sanctioned ₹85,960 million for incentives, of which ₹10,000 million has been earmarked for setting up charging stations for electric vehicles in India.

The government will offer incentives for electric buses, three-wheelers and four-wheelers to be used for commercial purposes. The FAME II scheme specifies that e-scooters in order to avail the scheme need to **have a range of 60 km** – a specification that could turn out to be a dampener for electric two-wheelers – electric two-wheelers currently have a range of around 60 km. Owing to this specification, around 95 % of electric two-wheelers may not benefit from the scheme.

Table 4: Fund Allocation in FAME I and FAME 2 (Rs in million)

	FAME 1	FAME 2			
	2015-19	2019-20	2020-21	2021-22	Total
Technology platform	1900	3660	0	0	3660
Demand incentives	4950	8220	45,870	31,870	85,960
Charging Infrastructure	300	3,000	4,000	3,000	10,000
Pilot Projects	700	0	0	0	0
Total	7,950	15,000	50,000	35,000	1,00,000

Source: FAME, GoI

ii. Comparison of Electric Vehicle Policy

Although a national mission on e-mobility has been launched, India has yet to issue a national level EV policy. But eight states such as Andhra Pradesh, Delhi, Karnataka, Kerala, Maharashtra, Telangana, Uttarakhand and Uttar Pradesh have designed individual state level EV policies to cater to their respective requirements based on available resources. The state of Karnataka was the first in India to release an EV policy titled “Karnataka Electric Vehicle and Energy Storage Policy” in September 2017. Twelve State Electricity Regulatory Commissions (SERCs) have also issued tariffs for EV charging. The key policy elements of state’s EV policy are mentioned below

Table 5: State Level EV Policies and Key Elements

State	Policy Name	Key Policy Elements/ Targets
Andhra Pradesh	Electric Mobility Policy 2018–2023	<ul style="list-style-type: none"> » Goal of 10 lakh EVs by 2024 » Goal of 1 lakh slow and fast EV charging stations by 2024 » Government plans to stop registration of petrol and diesel cars by 2024 in the upcoming capital city of Amaravati » All government vehicles, including corporations, boards and government ambulances to be electric by 2024
NCT of Delhi	Electric Vehicle Policy 2018	<ul style="list-style-type: none"> Aims at 25% of new vehicle registrations to be electric by 2023 » 50% of entire public transport targeted to be electric by 2023 » Proposes a feebate to fund a high proportion of the incentives » Encourages the reuse and recycling of EV batteries that have reached the end of their lives
Karnataka	Electric Vehicles Policy 2018	<ul style="list-style-type: none"> 100% of three and four-wheelers moving goods will be encouraged to transition to electric by 2030 » Incentives for first 100 fast chargers » Encourages startups to develop business models focused on supporting economic applications for EVs
Kerala	Electric Vehicle Policy 2019	<ul style="list-style-type: none"> Target of bringing 1 million EVs to the state by 2022 » By 2022, the state aims to pilot a fleet of 200,000 two-wheelers, 50,000 three-wheelers, 1,000 goods carriers, 3,000 buses and 100 ferry boats
Maharashtra	Electric Vehicle Policy 2019	<ul style="list-style-type: none"> Target of bringing 1 million EVs to the state by 2022 » By 2022, the state aims to pilot a fleet of 200,000 two-wheelers, 50,000 three-wheelers, 1,000 goods carriers, 3,000 buses and 100 ferry boats
Telangana	Electric Vehicle Policy Draft 2017	<ul style="list-style-type: none"> Telangana State Transport Corporation to set a target of 100% electric buses by 2030 for intracity, intercity and interstate transport » Telangana Government will set up first 100 fast charging stations in GHMC and other cities in a phased manner

Uttar Pradesh	Electric Vehicles Manufacturing Policy 2018	Goal of 1,000 electric buses deployed in the state by 2030 » Target of achieving 100% electrification of autorickshaws, cabs, school buses/vans, etc., by 2030 in five cities: GB Nagar, Lucknow, Kanpur, Varanasi and Ghaziabad ¹⁸
Uttarakhand	EV Manufacturing, EV Usage Promotion & Related Services Infrastructure Policy 2018	Aimed at making Uttarakhand a preferred destination for investment in EV manufacturing capacity » Special focus on developing green highways in Dehradun, Haridwar, Rishikesh, Haldwani, Rudrapur and Kashipur » Term loans in the range of Rs.100 million to Rs.500 million will be provided to micro, small and medium enterprises interested in manufacturing EVs (India's Electric Mobility Transformation, 2019).

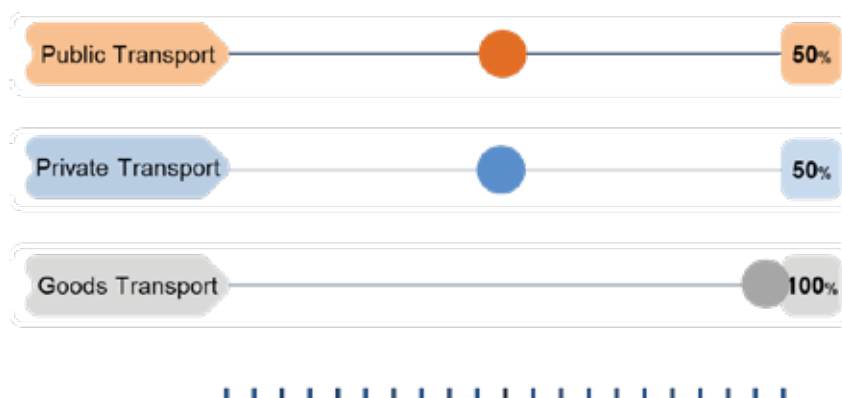
While states have separate policies, with key specific targets as mentioned in Table 5. It becomes important to learn from Andhra Pradesh, Delhi and others EV policies to make Karnataka to reach its targets by 2030.

iii. **Karnataka Electric Vehicle and Energy Storage Policy**

The state of Karnataka released its EV policy with the aim of transforming Karnataka as the preferred destination and for attracting investments worth Rs. 31,000 crores in EV manufacturing and to create employment opportunities for over 55,000 people, both on the supply and demand front. It envisioned creating a conducive environment for EV transition while augmenting R&D opportunity in E-mobility.

Karnataka has targeted public transport, private transport, goods transport, manufacturing and charging infrastructure sectors for achieving the 2030 vision.

Figure 10: Karnataka EV Target 2030



a. **Public Transport**

Bangalore Metropolitan Transport Corporation (BMTC), Karnataka State Road Transport Corporation (KSRTC), North Western Karnataka Road Transport Corporation (NWKSRTC) and North Eastern Karnataka Road Transport Corporation (NEKRTC) are to introduce 1000 EV buses within the policy period.

a. **Private Transport**

In Bengaluru: To achieve 50% electric mobility by 2030 in the segments: autorickshaws, cab aggregators, corporate fleets, school buses/van.

b. **Goods Transport**

3Ws and 4Ws mini goods vehicles in Bengaluru to move to 100% electric mobility by 2030 in phased manner. Ecommerce and delivery companies to replace their fleet of 2Ws/3Ws to 100% EV by 2030.

c. **Charging Infrastructure**

Fast charging stations or battery swapping apparatus to be provided at every 50 kms stretch on highways between prominent cities. Charging infra for 2Ws at parking stations to be set up by Bangalore Metro Railway Corporation Limited (BMRCL), BMTC, KSRTC, Bruhat Bengaluru Mahanagara Palike (BBMP); with adequate charging portals and covered parking areas in all government buildings.

d. **Manufacturing**

Targeting investment for setting up of 5 GWh of EV battery manufacturing capacity, 5000 direct jobs and 7500 overall jobs (India Smart Grid Forum, 2019).

4.3 Potential of Electric Mobility

High EV costs, challenges to battery technology, limited range of EVs, lack of charging infrastructure continue to pose as hurdles in EV adoption, however FAME II has attempted to address a few of these. As a report by Economic Times, India houses the potential to become one of the largest EV markets in the world, owing to its citizenry and vehicular population. However, high EV and lifestyle costs have slowed down the EV uptake. Lower manufacturing costs and affordability of e-scooters and bikes can instigate sharing platforms to switch to EVs.

As per the operating cost analysis, a four-wheeler needs to complete about 125km -150 Km on a daily basis while two-wheeler needs to do about 70km -80km per day for EV to become financially viable.

i. **Potential Segment**

- a. **Two - wheelers:** Two-wheelers have been identified as the early adopters in EV market. High vehicle utilization and ease of charging will drive the electrification in the commercial 2W segment. Two wheelers comprise the largest section in the Indian automotive industry, thus deriving its mammoth potential to contribute to green mile. With their high daily run and easy access to charging infrastructure, 2Ws, such as delivery bikes are opportune to commercialisation.

- b. **Three – wheelers:** 3Ws are widely used in India as an affordable means of public and goods transportation over short-to-medium distances. Having been given a head start in electric mobility by 3Ws, they can be expected to be secondary owing to low costs of running. Bengaluru has borne witness to 6.46% of EV adoption among 3Ws according to FY 2019. A necessary boost to the 3W sector by the government would help e-rickshaws to bridge the gap of first and last mile connectivity.
- c. **Four – wheelers:** Fleet operators are the early adopters in the four-wheeler segment. Their high vehicle utilization, route predictability and workplace charging can help corporate fleets take off earlier than private cars. Recovery of upfront cost for a fleet operator will be 5 years whereas for private owners it will take 11.5 years. Retail customers are expected to go for EVs only after battery prices decrease and EVs achieve economies of scale.
- d. **Buses** – Bengaluru intra-city buses represent a relatively small share in the on-road fleet, whilst contributing to a disproportionate amount of fuel consumption and emissions. Intra-city buses are likely to be electrified early, driven by the support provided by government-run transport undertakings, route predictability and easy charging at bus depots. After having piloted e-buses earlier, BMTC is now looking at converting their entire fleet by 2030. The Corporation is procuring 300 EVs under FAME II this year and 500 more for the next financial year. 90 EV feeder buses tender is out under the SMART City fund.

ii. **Potential use type/ Platform**

The growth in EV vehicles is likely to happen among fleet owners, public transport, employee transport, last mile deliveries and logistics rather than private owners. First and last mile connectivity is a major hurdle for EV, owing to the lack of public connectivity and integrated multi modal transport. EV is fast becoming a growing use case for short distance travel.

Currently, employees are provided with transport services as most of the cities lack effective and well-connected public transport. With respect to this, the business demand for clean mobility is already driving the use of EVs for employee transport. Companies like Amex, Accenture, Adobe, American Express, EY and Google have already deployed EVs for their employee transport requirements. (India Business Guide to EV Adoption, 2019)

Ridesharing and hailing are rapidly gaining momentum in India, significantly from growing two/ three-wheeler ride hailing services to solve last-mile connectivity. Given that these vehicles deployed on ride-hailing platforms often have the highest utilization rates, ride-hailing is an interesting prospect and an easy target for EV adoption. India-based ride-hailing cab aggregator Ola's experiment in Nagpur city, its creation of a dedicated company for EV adoption, Uber's deployment of EVs in Hyderabad in April 2019 with expansion plans to encompass last mile connectivity, showcase the early enthusiasm of ride-hailing platforms for green mobility (India Business Guide to EV Adoption, 2019). With a surge in e-commerce platforms and online shopping, the need for delivery vehicles has risen. These vehicles are creating a push for the adoption of EV, which will solve the greenhouse gas emissions. With

their predictable routes and ability to recharge quickly, commercial vehicles make the perfect choice for the switch to electric propulsion.

Some of the early adopters are likely to be for the following use cases:

- a. Fleet Operators, Platform based ride-hailing, Employee and customer transport
- b. 3 and 2 wheelers for people related travel and for food delivery, courier delivery, grocery delivery B2B and B2C players.
- c. Micro Mobility Vehicles for within campus employee movement, school buses and material handling in warehouses, factories, campuses and public workspaces
- d. Municipal Corporations using Electric Vehicles for garbage collection

The above-mentioned platforms have shown the highest potential for early adoption, however, continue to grapple with several milestone challenges. This has been established through the vehicle utilization potential within defined routes. While these vehicles have high potential in the above platforms, continues to grapple with its own set of challenges, that are elaborated in the next section.

4.4 Operation issues and challenges

EV being in the nascent stages of adoption and development in India, their market price is higher than conventional gasoline and diesel alternatives. However, as the scale of production increases and battery costs decline, the prices of electric vehicles are expected to fall (Electric Vehicles Guidebook for Indian States, 2019, ICCT). Evaluating the existing and future cost differences between electric vehicles and their ICE counterparts will help the state government determine the monetary incentives required to make electric vehicles cost competitive.

The two-primary challenges EV is posed with currently, is making the whole operation economically viable and overcoming range anxiety, which is anxiety about being stranded due to the vehicle's insufficient range to reach the destination. By addressing these operational issues and challenges with the right tools, commercial players will be able to purchase EV and acquire charging infrastructure to make it more efficient and affordable for Bengaluru to shift towards EV. This critically paves a way to reducing our oil dependency and meeting the goals of Karnataka EV policy.

This section covers the issues, barriers and challenges faced by these potential platforms in the adoption and operational processes. These are broadly divided into on the aspects of Vehicle & Design/Form; Battery & Charging/Swapping; Regulatory; Financing; Infrastructure.



**Vehicle and Design
Form**

- Limited Pool of EV Manufacturers
- Limited Form Factors for various use cases (especially logistics).
- EV adoption is more challenging for platform aggregators where vehicles are owned by individuals but operated for commercial as well as personal purposes. Personal use requires flexibility in distance travelled and because of range anxiety. Current design of vehicles doesn't possess the required vehicle strength and often fail on safety standards



**Battery & Charging/
Swapping**

- Need of better Battery technology for varying temperature conditions, speed, distance and payload
- Battery Swapping Stations yet to take off
- Less Availability of Charging Stations limits usage
- Use of lead-acid batteries, which need to be replaced within 7-8 months
- Commercial tariffs are still being imposed in states where EV tariffs have been proposed; there is a delay between policy and implementation.
- Land leasing costs for charging infrastructure on private/public lands are high Solution
- Long waiting times for charging and high opportunity costs are discouraging drivers from making the switch to EVs
- Rapidly changing technology, unfavoured operational conditions and high cost



Infrastructure

- The lack of proper parking facilities for EVs leads to damage of the vehicle and adversely affect the possibility of charging the vehicle
- Rental EV witness theft and vandalism



Financing

- Lack of proper financing models to support the upfront high cost of the vehicle.
- Resale value decreases as form of the vehicle is customised.



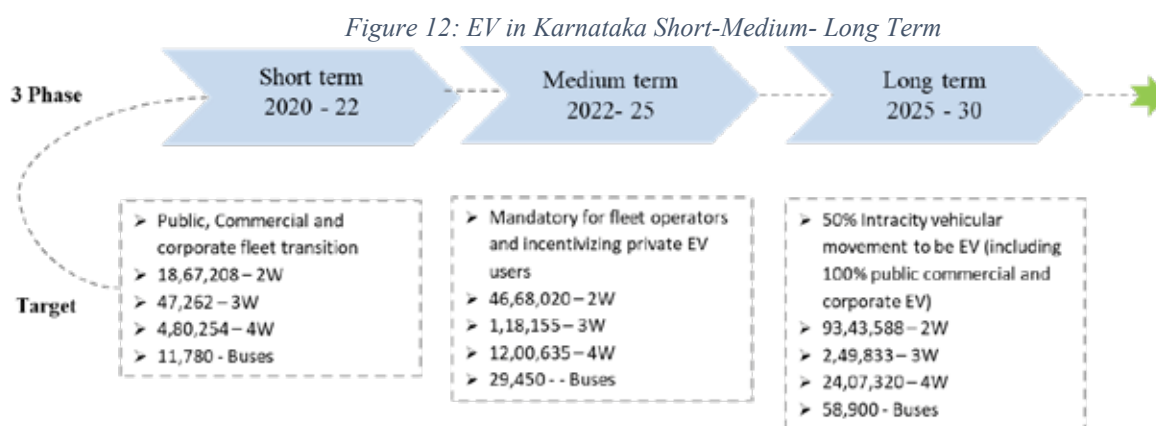
Regulatory

- Lack of comprehensive regulatory framework Absence of safety and compliance standards

4.5 Recommendations

The adoption process is driven by Karnataka's 2030 goal of transforming 50% of its fleet to EV, while making the state a preferred destination and manufacturing hub for the same. It is also necessary to identify short- mid - and long-term objectives and opportunities to achieve this goal. This can be done by garnering development opportunities from different perspectives.

For 2Ws to have around 9 million EV's by 2030, there needs to be a target set for reaching 1.8 million by 2022 and 4.6 million by 2025, Similarly for 3Ws , 4Ws and buses as shown in figure12 which is 20% by 2022 and 50% by 2025 to reach the 2030 target. (calculated based on CAGR method, Table 3)

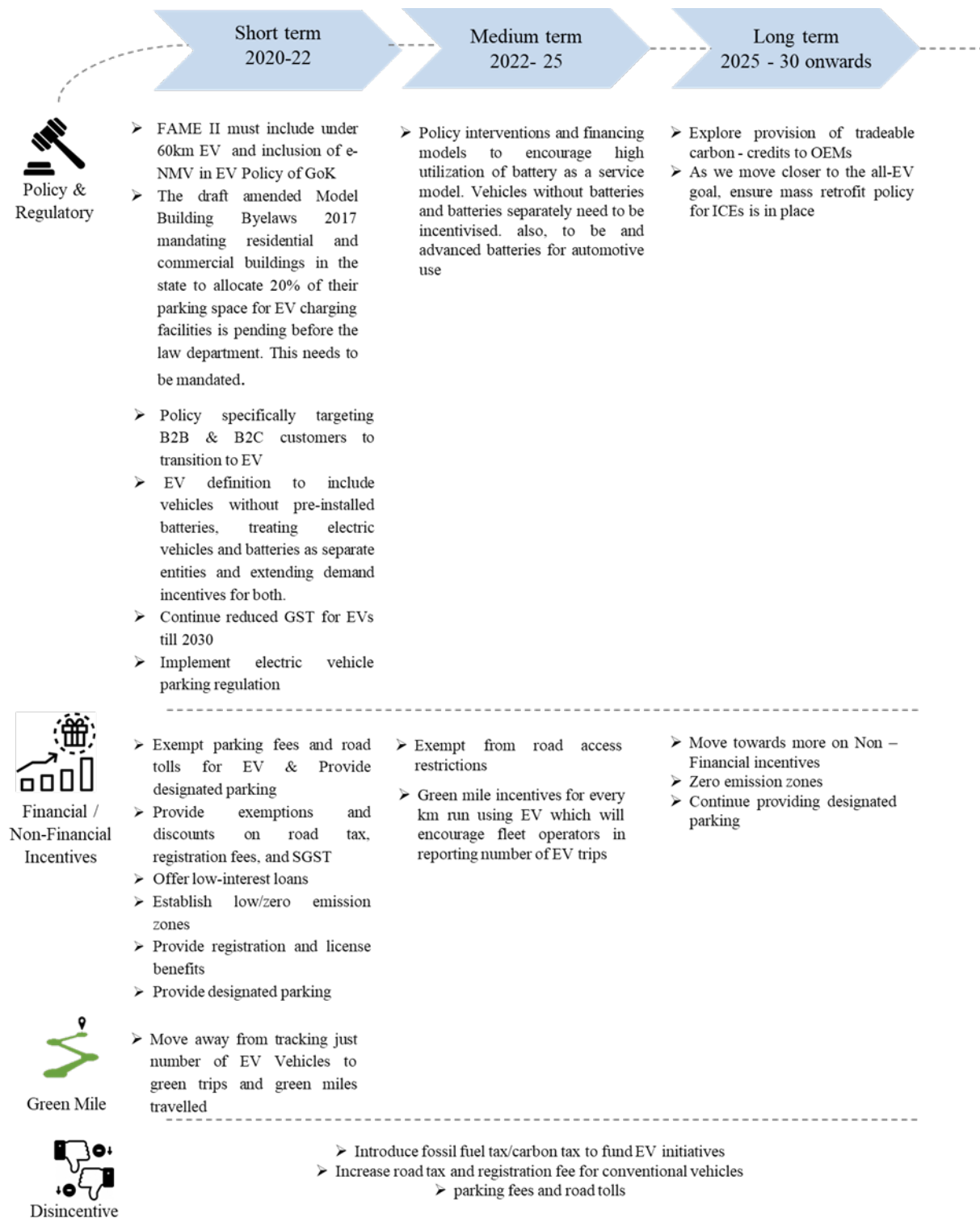


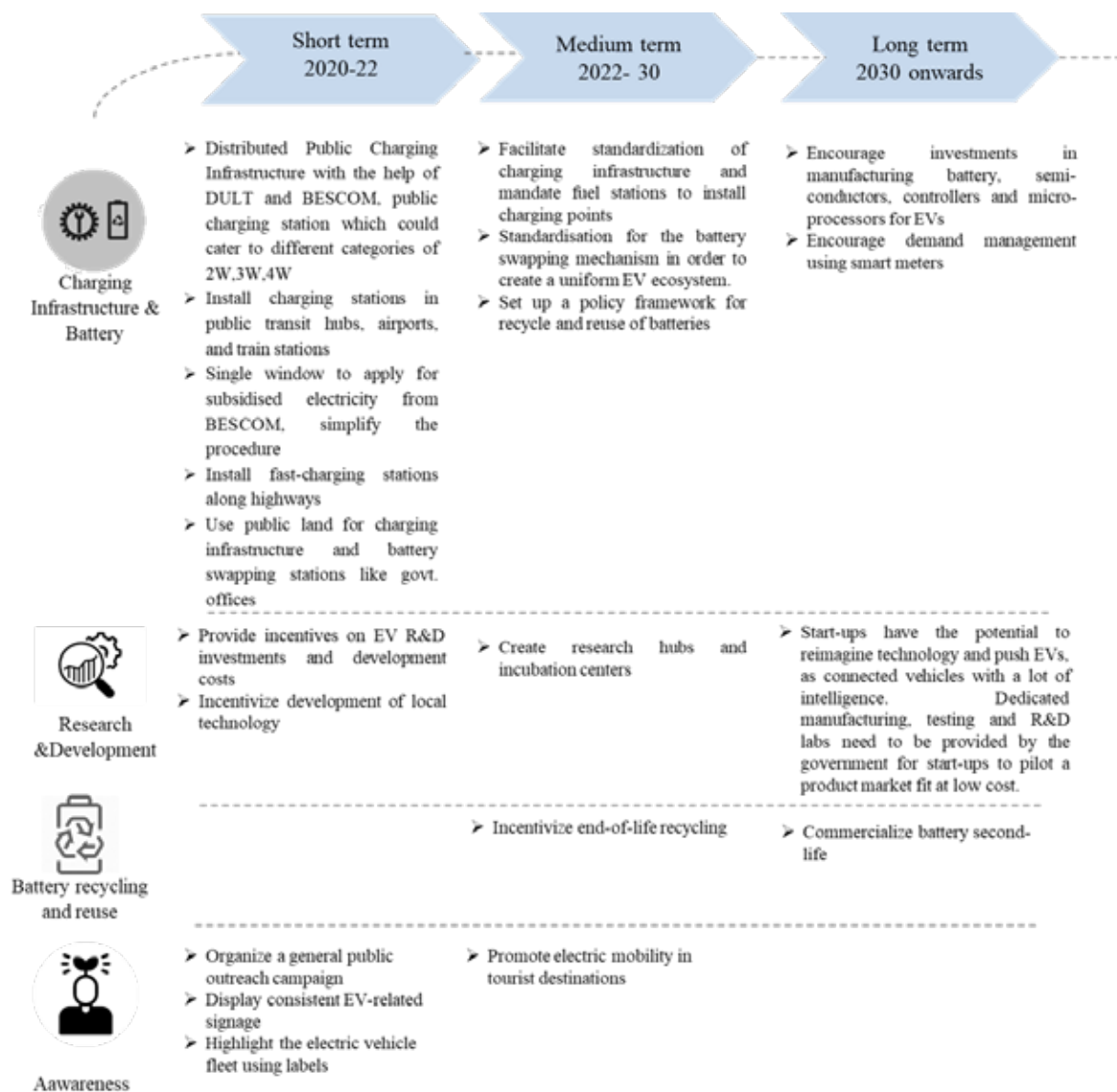
Cities from China, Europe, the United States, and Japan which can be counted as EV capitals, have accounted for over 96% of electric vehicle sales through 2019. These regions have clear regulations in place, that ensure increasing deployment of EV with phased out goals.

Under the “Action Plan for the Promotion and Application of New Energy Smart Vehicles in Beijing 2018-2020”, Beijing’s target is to double the fleet to 400,000 Battery EV units sold. To achieve this, the city plans on increasing EVs among taxis, public transport, and logistics, while pushing for electrification of buses and vehicles for postal services. (International Council for Clean Transport, 2019) Norway has decided that in 2025, all of their new automobiles will be zero emission vehicles, for which they have already laid the foundation, with electric car sales touching 42.2%.

This clearly shows that Karnataka needs to set interim goals to reach its 2030 target and make Bengaluru the EV capital. The learnings from FAME I and the interventions from FAMEII clearly state that the Government could potentially explore a policy with specified timeframe and magnitude of incentives to push EV adoption. As shown in the figure below, short and midterm focus should be on vehicle groups that have fast population growth and strong market demand, that the state has more control over and have good business and investment opportunities. They should also reflect consumer preference for electric vehicles over their fuel-driven counterparts. Identifying these will chart the direction of Karnataka’s electric vehicle policy goal.

Figure 14: Roadmap for Karnataka in adopting EV





The aforementioned table provides a detailed roadmap to make Bengaluru, EV Capital of India

i. Policy & Regulations

Policies that provide priority parking or charging infrastructure at select parking spaces for electric vehicles are ineffective if there are no penalties in place that hold violators accountable, like fines and towing to discourage combustion-engine vehicles from parking in spaces designated for electric vehicles. Absence of detailed parking regulations will fail to persuade individuals to buy EVs.

a. Amend building codes

A mandate is required that compels all newly constructed buildings to be EV-ready, so all new residential, commercial, and industrial buildings are equipped to install charging stations. Amend building codes to ensure that appropriately sized electric panels and conduits are set up near parking spaces so that charging stations can be added to the building later.

b. Implement electric vehicle parking regulations

Adopt regulations to enforce preferential electric vehicle parking. Assign responsible agencies to monitor and penalize the parking of non-electric vehicles or unconnected electric vehicles in parking spots specified for electric vehicles.

ii. Financial Incentives

In order to enter the mainstream market, electric vehicles must be largely viewed as affordable, convenient, and practical by prospective buyers. As EVs tend to face an upfront cost penalty compared to conventional gasoline vehicles, policies offering financial incentives can effectively encourage adoption. These can take the form of rebates, bonus payments, or vehicle tax discounts or exemptions for EV owners. These incentive programs are largely implemented at the national level rather than by cities, although regional and local governments play a part in some cases. Across the world, these incentives largely adopted in a set pattern:

- a. Purchase incentives
- b. Charging station incentives
- c. Provide exemptions and discounts on road tax, registration fees, and SGST- Road tax and vehicle registration fees are levied by the state at the time of purchase or charged as annual fees. SGST, charged at the time of purchase of any good, can be exempted if vehicles are manufactured and sold within the same state. State governments can leverage discounts for purchase of electric vehicles.
- d. Copenhagen slashed the registration tax to 40% on electric vehicles from 150% for conventional vehicles (European Alternative Fuels Observatory).
- e. Exempt parking fees and road tolls: Consolidate efforts of city and municipal authorities to provide fee cuts and exemptions on parking fees and road tolls for electric vehicles. Oslo has provided free street parking alongside exemptions from road tolls for electric vehicles. For conventional vehicles, the municipal parking charges could be as much as Norwegian krone (\$7) an hour and road tolls can be as much as 55 krone.

iii. Non-financial incentives

In addition to financial incentives, governments can increase the convenience of EV to make them more attractive than other vehicles. Nonfinancial incentives provide consumers with benefits like saved time and comfort. Leading cities around the world have created numerous programs in this vein to fit local context.

a. Provide designated parking

Government needs to provide designated parking spots for electric vehicles in municipality owned parking lots and at railway stations, metro stations and mandate provision of airport and commercial parking areas in Bengaluru to show a clear preference for EV.

b. Establish low zero emission zones

Create zones where access is unrestricted only to electric vehicles and vehicles conforming to stringent emission standards. Other vehicles can be allowed to enter the zone after paying certain fees.

iv. **Disincentivizing Conventional Vehicle Purchase**

a. **Introduce fossil fuel or carbon tax**

- Introduce a fossil fuel or carbon tax on the sale of diesel or gasoline fuel to disincentivize purchase of conventional vehicles. The proceeds of which could help fund the state's electric vehicle initiatives.
- Delhi has proposed to enact a pollution tax on diesel fuel. The funds collected would be allocated to the state EV fund.

b. **Road tax and registration fees for conventional vehicles:** Alternatively, apply an additional fee on the purchase of conventional vehicles to reduce demand.

Delhi has proposed a higher road tax for diesel and gasoline vehicles.

c. **Levy parking surcharges:** Charge an additional fee for parking conventional vehicles in public parking facilities.

Delhi has proposed a parking surcharge for conventional vehicles in public and on-street facilities

v. **Charging Infrastructure & Battery**

Charging and battery performance are the two biggest factors that will determine the success of EV adoption. The biggest competition for charging infrastructure comes from petrol filling stations. Large scale adoption will happen only when time taken to charge is less than 10 minutes and charging infrastructure is as ubiquitous as a petrol pump. Therefore, developing a well-planned charging infrastructure network is really crucial as it will enable EV drivers to take longer trips and will increase the attractiveness of owning an electric vehicle.

Due to the complexities involved in developing a comprehensive network, it is important for the state government to first invest in such infrastructure comprehensively in Bengaluru and other major cities before spreading itself thin across multiple cities. There is also a need to standardise charging protocols so that charging infrastructure can be used across vendor products. BESCO is setting up public charging infrastructure and partnerships, while also supporting the installation of home and workplace charging facilities.

There is also the need to examine suitability of newer technological advancements, like flash charging for e.g. ABB's TOSA (Trolleybus Optimisation Systeme Alimentation) technology which has been in operation in Geneva for over a year. The flash charging technology tops up battery in mere seconds while passengers get on and off the bus and has completed 500,000 Kms. Such technology advancements could be transformative since it avoids halting the service of the vehicle for recharging every few hours or having a replacement battery leading to better fleet utilisation. If the technology is suitable to India it could pave the way for the next generation of silent, flexible, zero emission urban mass transit buses.

Once the issue of availability of charging infrastructure is resolved, the operators need to focus on better customer experience which would include online notification of charging availability, working condition of charging infrastructure etc.

Battery is the most expensive part of the EV and today the world's manufacturing capacity of Lithium Ion batteries is with China. India must develop significant battery manufacturing capacity to be competitive, but availability of Lithium is going to be a challenge. These are issues that require larger discussion as the EV narrative evolves.

vii. **Battery Recycling and Reuse**

Batteries used in EVs contain expensive materials that are also toxic. Recycling batteries can recover expensive materials while avoiding the environmental cost of disposal of hazardous materials. At the end of their service life, EV batteries retain 70%–80% of their initial capacity. Used batteries can be repurposed and reused in stationary storage applications. The resusal helps to reduce the lifecycle cost of batteries, lowering the cost of electric vehicles and increasing their cost competitiveness. Investment subsidies can prove to be attractive incentives, along with end-of-life batteries purchased for recycling. Collaboration with private players, Original Equipment Manufacturers and battery manufacturers can yield projects for second-life commercialization. Provide monetary benefits for projects demonstrating promising efforts.

vi. **Research & Development**

Research must be duly encouraged by providing funding and subsidies to businesses and appropriate government or civic agencies. This can also be done by creating working groups and hosting technical events where stakeholders can discuss market barriers and come up with innovative solutions.

Adequate funding provision for the creation of government-owned research hubs and incubation centres dedicated to research and development of EV technology. Investment subsidies must be provided to private actors that set up research facilities and procure equipment for industrial research.

viii. **Awareness**

In order to reach the 2030 target, awareness among the wider public is need of the hour. Aware and informed audience is fundamental in the switch to electric — first people need to know, accept, and become users

4.6 Conclusion

This paper provides an overview of the acts, schemes and policies by the Central Government and the Karnataka state government which enhance the need for electric mobility adoption faster in order to make Karnataka EV hub and preferred manufacturing destination of India. The Government needs to mandate transition to EV in a phased manner to commercial operators of passenger and goods c operating within the city on defined routes, as these use cases will recover costs faster and will not suffer from the same range anxiety issues that the individual EV owner is likely to face.

WAY FORWARD

In previous sections the problems encountered in the current climate of urban mobility, with special reference to Bangalore, have been discussed. These have emerged in the form of challenges faced by commuters of public transport, absence of regulation, infrastructure and governance, thus contributing largely to the disfavour of public transport.

As elaborated in the paper, the government needs to encourage shared mobility and public transport among the citizens and oversee the shift from private to public modes of commute. In order to achieve this, it will have to eliminate the existing roadblocks that are halting the process and development of new age mobility solutions. Enhancing the service quality of public transport will give the initial push for citizens to shift from private to public, whereas creating a sustainable infrastructure and appropriate first and last mile connectivity will help people make public and shared mobility their first choice.

The government should also set a specified time frame and location for their projects. As per Karnataka's Electric Vehicle policy pioneered by the state, they intend to convert 80% of their entire fleet to EV by 2030. This can only happen with clearly articulated medium term goals and mandates to fleet owners of passenger and goods to convert to EV in a phased manner and other sustained interventions described above to incentivise use of EV.

Measurements, Monitoring and Reporting:

The success of any implementation can be ensured only if it is regularly measured, monitored and reported to the citizens.

Sustainable mobility in Bengaluru, should be measured along the lines of broad principles listed below:

- **Universal access:** Providing multiple choices of public transport with different price points, to meet the requirements of all socio-economic sections.
- **Transition to sustainable mobility:** measuring success rate and improvement of public transport based on accessibility, efficiency and affordability of last and first mile connectivity options.
- **Efficiency:** Reducing the time spent in traveling, congestion, and cost of travel in a sustainable way.
- **Safety:** 95% of the fatalities are caused globally due to road transport. Reduction in the number of private vehicles on the road will also cause the accidents to decrease.
- **Green mobility:** Set interim goals to reach 20% target by 2022 and 50 % by 2025 to reach the EV target of 2030. Bengaluru's short and midterm focus should be on vehicles that have higher population and strong market demand. In the long run, ensure a mass retrofit policy for ICE.

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