NITI Aayog

MOVE

GLOBAL MOBILITY SUMMIT

SEPTEMBER 7 & 8, 2018

TRANSFORMING INDIA'S MOBILITY

A Perspective

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ACKNOWLEDGEMENTS

The authors would like to thank Dr. Rajiv Kumar, Vice Chairman, NITI Aayog and Mr Amitabh Kant, CEO, NITI Aayog for their support that made this report possible.

SUGGESTED CITATIONS:

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The Boston Consulting Group,
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CONTENTS

EXECUTIVE SUMMARY

The rapid growth in India's urbanization, population and wealth over the last few decades has had a marked effect on the mobility of its citizens. India's transport demand has grown by almost 8 times since 1980 – more than any other Asian economy[1].

This large growth has been positive in many ways, including development of a thriving auto industry and allied economic growth. However, there are a set of challenges to be addressed. A recent WHO study has fourteen Indian cities featuring in the top fifteen most polluted cities in the world[2]. This challenge leads to significant health and welfare losses, currently estimated by the World Bank at 7.7% of India's GDP (PPP adjusted). Additionally, major Indian cities are also now consistently ranked amongst the world's most congested cities. The average speed for vehicles in some metros are reported as low as 17 km/h[3]. These high levels of congestion have huge cost in form of reduced productivity and fuel waste; a high-level estimate of the economic loss of congestion, for our top four metros, is over USD 22 billion annually[4].

It is worthy to note that multiple efforts – at the city, state and national level – have been made to alleviate these challenges. For rural India, the Pradhan Mantri Gram Sadak Yojana (PMGSY) is perhaps the best example. The reinvigoration of this scheme in the last 3 years has led to record highs of building all-weather roads at a rate of 130 km/day[5]. For urban India, in order to address the twin challenges of pollution and congestion, a number of initiatives have been launched. At the national level, multiple policies such as the National Urban Transport Policy & the National Electric Mobility Mission Plan 2020 have been designed as well. While there are multiple examples of such initiatives, the magnitude and complexity of our mobility challenges requires a comprehensive action-agenda that addresses the issue holistically. The high population density, growth, coupled with our economic growth aspirations warrants a tailored approach, unique to our context.

Basis an exhaustive study of global examples and learning from India's past efforts, a holistic framework for 'Transforming India's Mobility' is proposed, as detailed in the figure.

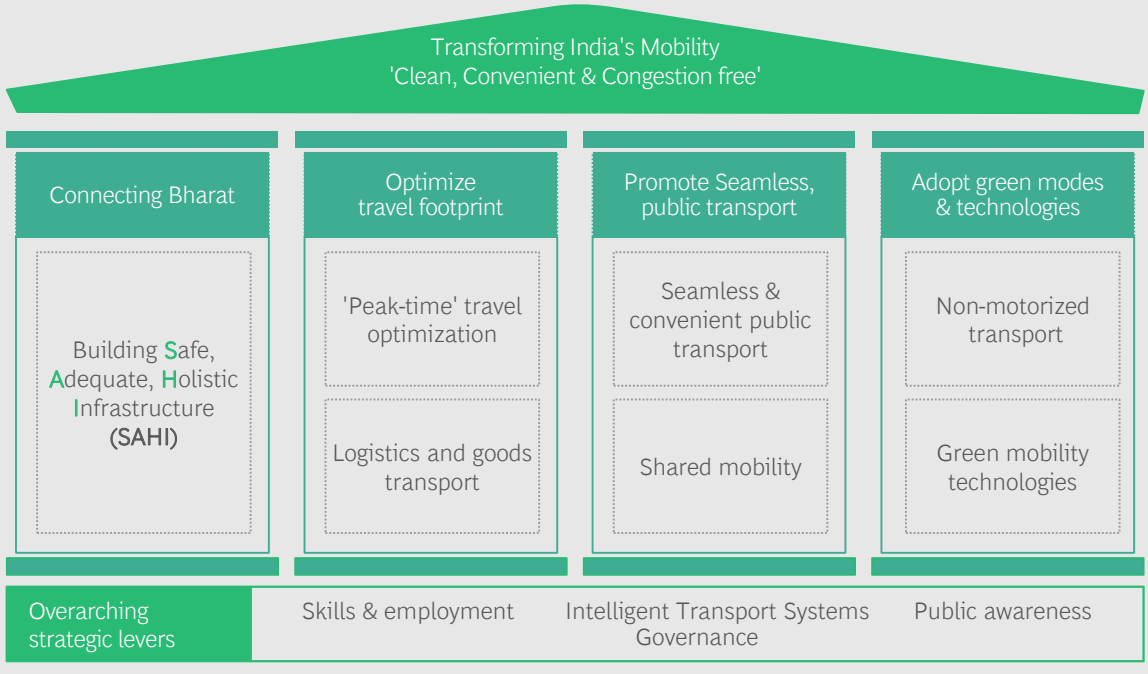
The crown of the framework defines the overall objectives (3C)

- Clean: Pollution-free, leading to clean air and hence better health and living standards
- Convenient: Seamless, safe, affordable, accessible for all sections including the elderly & disabled and connected – both in terms of technology as well as connecting key rural and urban centers
- Congestion-free: Minimum congestion levels, and hence enhanced economic efficiency

To achieve the objectives, following action-agenda is advocated around four key pillars, namely, (a) Connect Bharat, (b) Optimize travel footprint, (c) Promote seamless, co-operative transport, and (d) Adopt green modes and technologies. These pillars have to be well supported by a common set of enablers – Skills and employment, Intelligent Transport Systems, Public Awareness, Governance and Financing.

Connect Bharat

One clear imperative for our mobility paradigm is to build Safe, Adequate and Holistic Infrastructure (SAHI) for all our citizens, including women, elderly and disabled. Also, the infrastructure network needs to solve for all types of connectivity - urban-to-urban, urban-to-rural and rural-to-rural. Multiple current schemes such as Pradhan Mantri Gram Sadak Yojana (PMGSY), Pradhan Mantri Jal Marg Yojana (PMJMY), and UDAN (Ude Desh ka Aam



Naagrik). There is a need for continued action and focus on this, aided with few elements as detailed below.

- Increased emphasis on safety and accessibility
- Leveraging multiple modes of transport – road, rail, coastal and inland waterways, small regional airports, ropeways etc.
- Higher usage of data for holistic mobility needs

Optimize Travel Footprint

Another focus area is to reduce congestion caused by passenger and goods flow, especially in urban context. This reduced congestion would also significantly help the cause of clean air.

Our cities have one of the highest peak-time congestion amongst Asian cities - our citizens spend almost 1.3-1.6x additional time in peak traffic for our top four metros, compared to 0.6x for Singapore and Hong Kong[6]. This can be greatly reduced through concerted focus along following dimensions.

- Integrated land use
- Focused policy based measures for optimizing travel
- Data-based measures such as intelligent transport systems

Further, a comprehensive logistics framework that minimizes impact on the city's internal traffic, through measures such as timing, zoning, and optimal planning of warehouses is required. This also needs to be supported by building more bypass routes (where needed) and encouraging multiple modes transport modes. Also, latest technological advances and ubiquitous connectivity needs to be leveraged. The considerable amount of post-harvest losses in India can be reduced through effective logistics management, integrated crop management systems, cold chain networks and demand aggregation. Initiatives such as the national logistics action plan (NLAP) being drafted by the Ministry of Commerce are steps in the right direction.

Promote Seamless, Public Transport

An efficient and convenient public transport (PT) will go a long way in answering the twin problems of pollution and congestion. There is a need to improve both the adequacy and adoption of PT in India, and this would need holistic focus across multiple dimensions

- Data-driven planning and urban transport, with a clear hierarchy amongst different modes
- Focus on multi-modal systems
- Make PT attractive for urban India, to increase adoption

Further, our mobility solutions need to be harmonized with the global shared mobility revolution.

Adopting Green Modes and Technologies

The final pillar focuses on adopting green modes and technologies such as electric vehicles and non-motorized transport (NMT). For improving adoption of non-motorized transport, the routes and paths should be planned so that they integrate seamlessly with public transport. Lastly, ensuring safety for NMT users by outlining norms & dedicated traffic signals should be a key priority.

Further, a clear push towards cleaner technologies is need of the hour. This has to be enabled through ecosystem development which includes domestic manufacturing, deployment of charging infrastructure etc. The goal should be to holistically reduce well-to-wheel emissions.

Overarching Strategic Levers

To ensure effective execution of these key pillars, a number of supporting enablers need to be put in place for laying the foundation.

- Skills and employment: The vast agenda calls for a number of new skills that will be required at a local and national level. Timely skill gap assessment and requisite planning can ensure high employability while addressing the potential resource demand.

- Intelligent Transport Systems: There is a need to leverage ongoing technological developments to build more connected and data centric mobility systems.

- Governance: There is a need for a well-defined Governance mechanism involving different stakeholders.

- Public awareness: A strong public awareness and communication campaign would help include the beneficiary citizen as an equal stakeholder in success.

If the suggested 3C approach along with key pillars and enablers is executed effectively, the results can be transformative for India's mobility landscape. Improvement in rural connectivity can help in increased connectivity of villages with high adoption of public transport. PM2.5 emissions can reduce significantly across Indian cities. Additionally, the speed on arterial roads of major cities can be improved significantly. This holistic advancement should support India to have a target mobility landscape that is Clean, Convenient & Congestion free.

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CONTEXT AND APPROACH

PURPOSE OF THIS REPORT

INDIA HAS WITNESSED REMARKABLE growth over the last few decades. However, the mobility infrastructure has not kept pace with the demand. In this growth-driven journey, it is imperative for the topic of mobility to be addressed holistically. The role of mobility in boosting the national economy is well documented. The purpose of this report is to address this critical subject in a holistic manner – acknowledging the efforts made so far, highlighting worthy global examples and recommending strategic levers to help India realize its mobility vision.

India's Rapid Transport Growth Journey

India's rapid growth in population and wealth over last few decades has led to considerable strain in its transport infrastructure. Since 1980, the country's population has nearly doubled (~90% growth), and India is set to become the world's most populous country in the next decade[7]. In the same period, its Gross Domestic Product (GDP) per capita grew by more than 5 times, with most of the growth recorded in the period post 2000[8]. Based on research examining the relationship between transport demand, population and wealth – transport demand has increased by almost 8 times since 1980[9]. As seen in Figure A, this growth in unprecedented and much higher relative to any other Asian economy. This large growth, in the absence of a widespread public transport system, has caused a rapid increase of private car ownership in India. The number of registered motor vehicles has gone up from 5.4 million in 1981, to 210 million in 2015, a 40-fold increase.

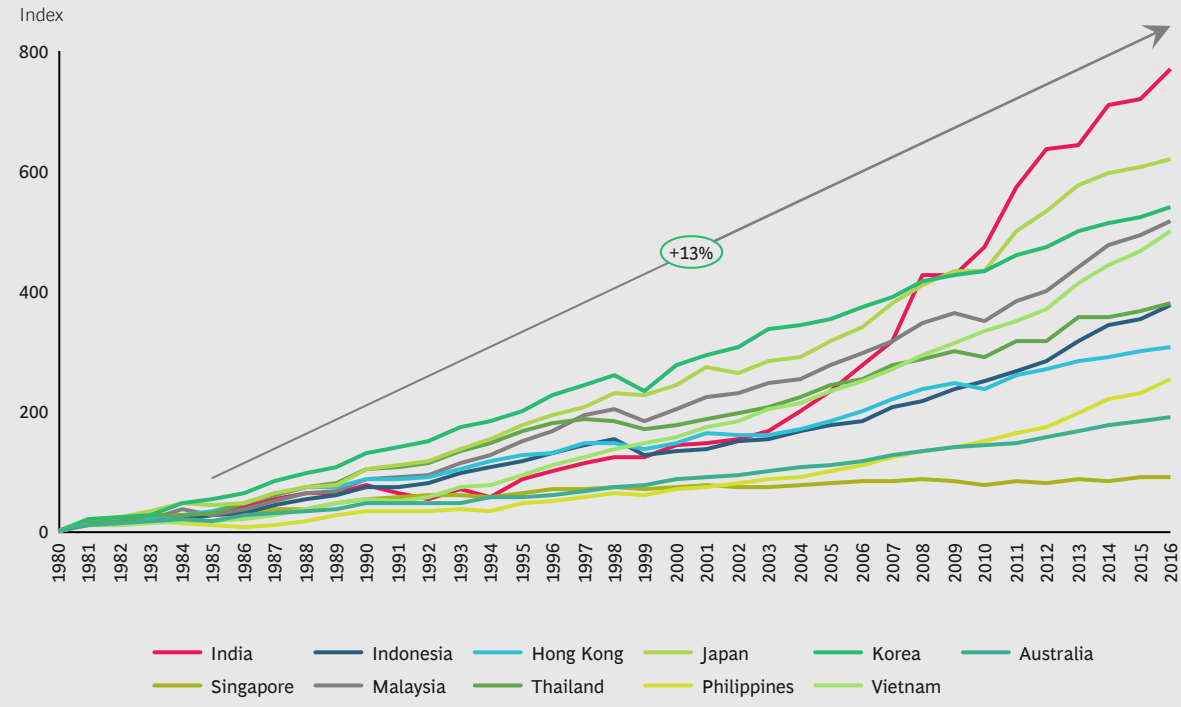
Urban areas have seen rapid growth. However, due to lack of integrated mobility planning, it has resulted in making our cities amongst the most polluted & congested. This is a key challenge which has to be addressed. (As shown in Figure A).

Rural Connectivity

The importance of connectivity for India's rural areas cannot be underestimated. It has been well established that building reliable access to rural transportation is a major enabler for social and economic development[10]. Rural roads account for almost 70% of the total roads in India (as of March 2016[11]) and it is imperative to ensure that the quality and connectivity of these roads is holistic and maintained up to specific standards.

There have been multiple initiatives, historically and ongoing, for improving the connectivity of villages through a well-maintained road network. Perhaps the most prominent one so far is the PMGSY (Pradhan Mantri Gram Sadak Yojana), which was initiated in 2000 and has been reinvigorated

FIGURE A | Indexed estimated growth in travel demand (1980=100)



Sources: World Bank; OECD; National center for Sustainable transportation; BCG analysis.

in the last 3 years. The average daily construction rate of rural roads has already seen a record high since Independence of 130 km per day[12]– with an added advantage of creating roads, which are specifically engineered for rural, all-weather conditions.

The challenges faced in basic mobility for rural India range across accessibility to urban markets, safety issues in local journeys etc. It is estimated[13] that over 30% of farmers' produce is spoilt post-harvest due to poor storage and transport infrastructure.

Urban Pollution: Urgent Call for Action

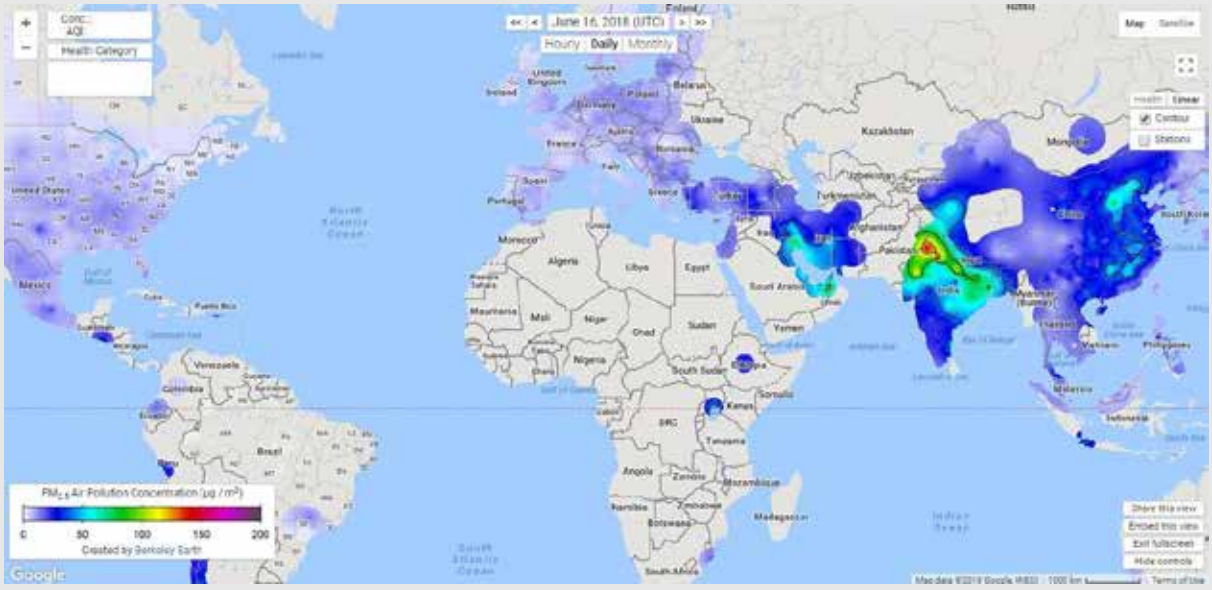
India's cities are under considerable risk due to air pollution. As per a WHO study, fourteen out of the top fifteen most polluted cities in the world belong to India[14]. Polluted air significantly reduces the quality of life and increases the risk of diseases such as lung cancer, stroke, heart disease, and chronic bronchitis. Apart from the health risks, urban pollution has a major economic impact on cities, which are the engines of India's economic growth. As per the World Bank, India's welfare losses due to air pollution are currently estimated at 7.7% of GDP (PPP adjusted). This number can increase exponentially in the coming decade if urban pollution is not significantly addressed. (As shown in Figure B).

India's urban pollution as measured by PM2.5 level (a key indicator) is already about 40% above the safe limits across major Indian cities (such as Delhi, Mumbai, Kolkata, Pune etc.). (As shown in Figure C).

Alarmingly, our PM2.5 levels are also showing increasing trends, when most other countries have stabilized at a level significantly below ours. (As shown in Figure D).

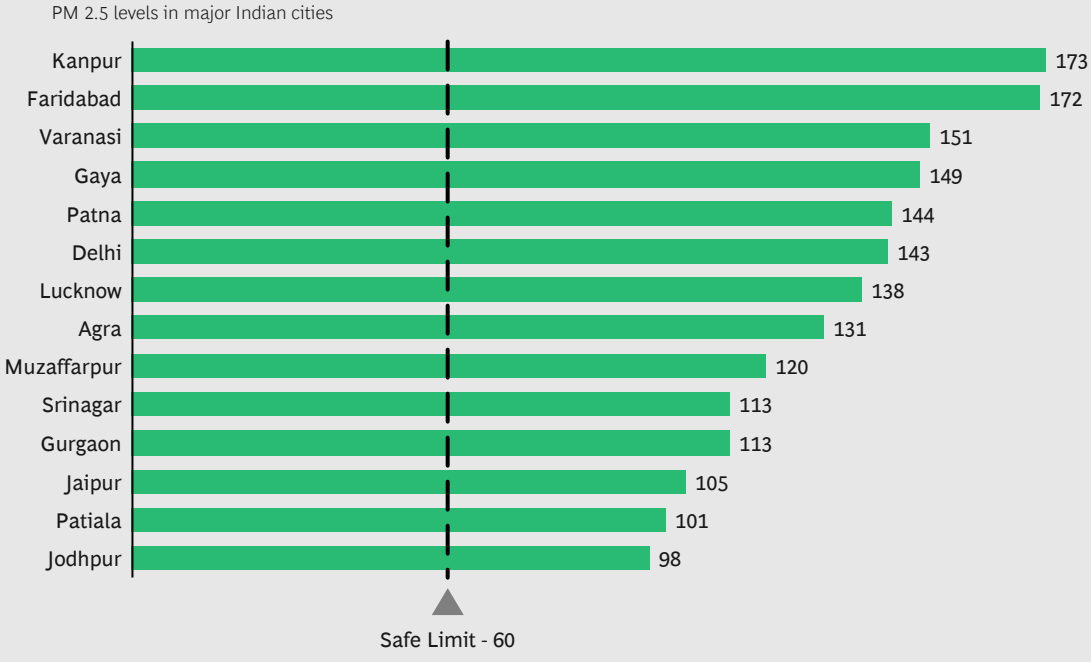
70-80% of PM2.5 is contributed by vehicular pollution, domestic activity,

Figure B | Heat-map of Air Pollution Concentration in the World



India's urban pollution as measured by PM2.5 level (a key indicator) is already about 40% above the safe limits across major Indian cities (such as Delhi, Mumbai, Kolkata, Pune etc.).

Figure C | Pollution level in Major Indian Cities (PM 2.5 Level)



Sources: Press releases, BCG-Uber report on car sharing and traffic congestion.

construction activity, road dust and industrial activity. A multi-pronged approach is needed to address the problem of PM2.5 in a comprehensive manner. However, tackling vehicular emission needs to be at the core of this agenda given that vehicles today are a significant contributor, accounting for 30-35% of PM 2.5.

Urban Congestion: Unlocking the True Potential of our Cities

Emerging-market cities will play an increasingly large role in the global economy. Cities are an important engine for driving India's economic growth as well. They provide 60-65% of India's GDP and 45-50% of consumption. As per a WEF study, the number of Million-plus urban agglomerations has increased from 35 (2001) to 53 (2011). By 2030, the number is expected to grow to 87.

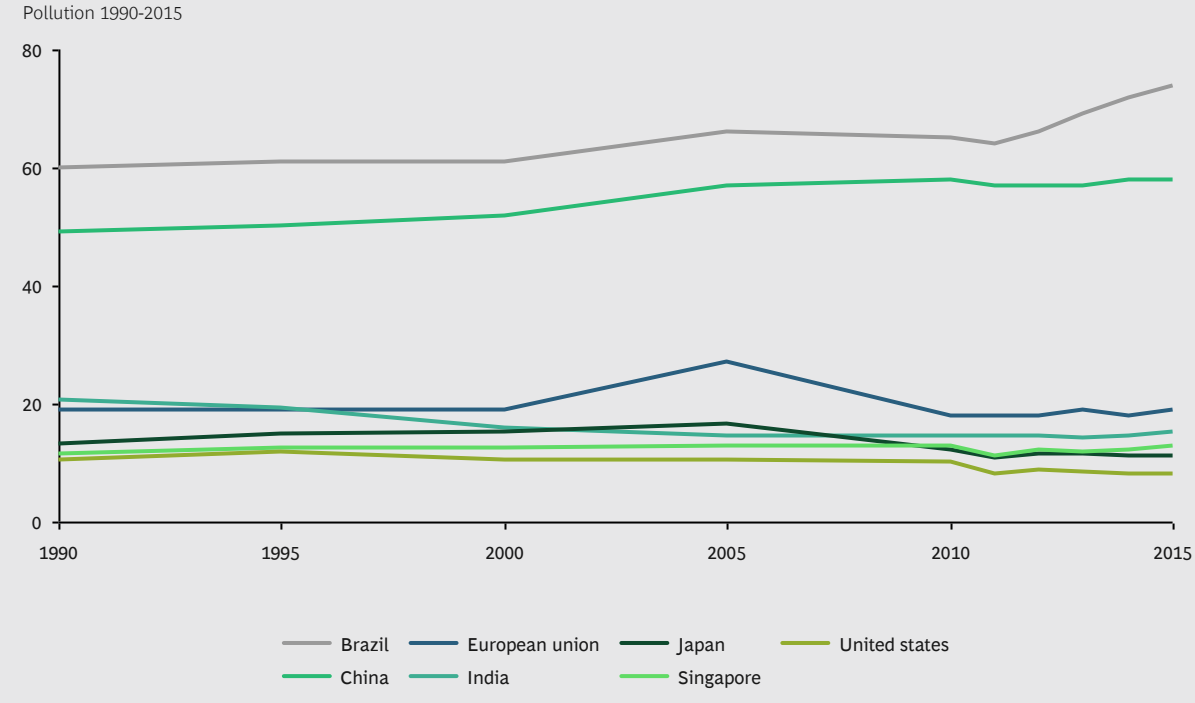
Major Indian cities are now consistently ranked amongst the world's most congested cities. Average speed for vehicles in Bengaluru is reported as 17 km/h[15]. The off-peak speed for 13 arterial roads in Delhi has been recorded at 27 km/h, 50-60% lower than design speed[16].

These high levels of congestion have huge cost in the form of reduced productivity, fuel waste, and accidents. As an example, recent estimates from the Bengaluru Development Authority, released as part of Master Plan 2031, suggests that 1.18 crore citizens' waste 60 crore person-hours annually and almost 2.8 lakh litres of fuel are wasted per hour in the Bengaluru city because of congestion.

The combined costs for four cities of Delhi, Mumbai, Kolkata and Bengaluru is over USD 22 billion annually. For Delhi alone, the congestion was estimated to cost the city USD 10 billion annually (As shown in Figure E)[17].

This congestion also manifests in form of logistics and freight inefficiency. A recent

FIGURE D | PM 2.5 Level increase across Major Countries (1990-2015)



study estimated huge loss of USD 21.3 billion annually on account of delays and additional fuel consumption due to poor road conditions and frequent halts[18]. However, multiple initiatives in terms of public transport, non-motorized transport and ride-sharing would address this issue.

'Transforming India's Mobility': Path to the Future

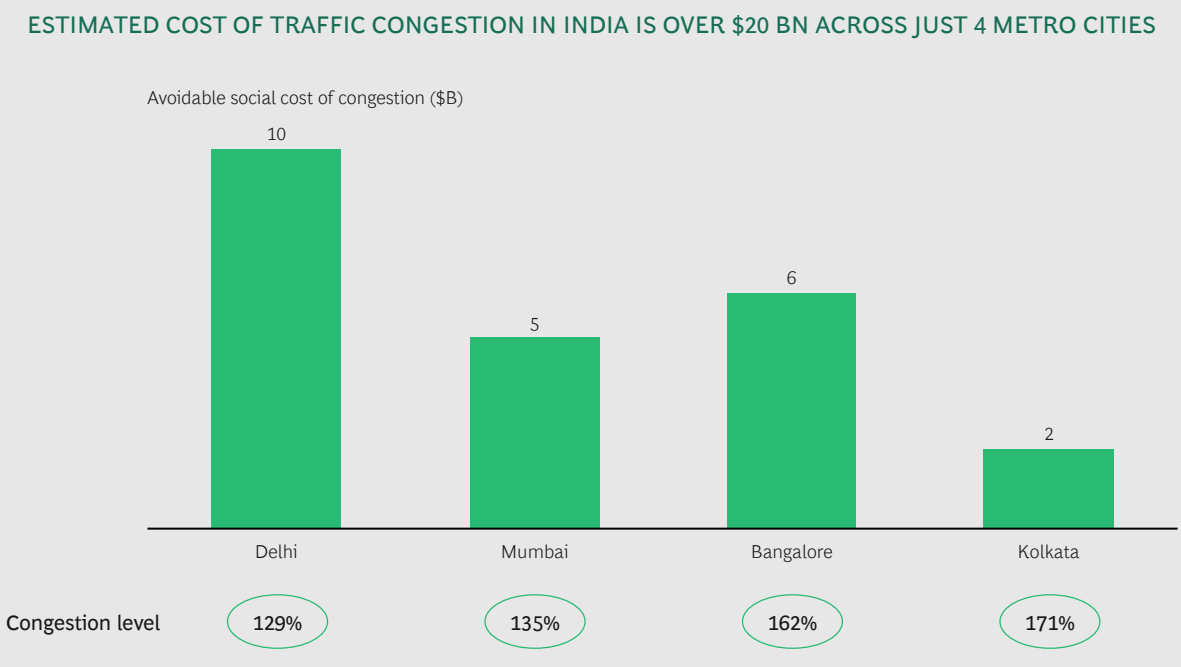
The magnitude and complexity of our mobility challenges requires a comprehensive framework that addresses the issue holistically. The high population density, growth, coupled with our economic growth aspirations warrants a tailored approach, unique to our context.

It is worth noting that both the central and local Governments have come out with various initiatives like National Urban Transport Policy, the Auto Fuel and Vision Policy & the National Electric Mobility Mission Plan 2020. There are also multiple examples (highlighted later) of local Governments experimenting and, often succeeding, with localized solutions.

Learning from these past efforts as well as global best practices, a multi-pronged approach is proposed, as detailed in Figure F. The framework proposes imperatives around four key pillars, (a) Connect Bharat (b) Optimize travel footprint, (c) Promote seamless, co-operative transport, and (d) Adopt green modes and technologies. These pillars have to be well supported by a common set of enablers – Skills & Employment, Intelligent Transport Systems, Public Awareness, Governance & Financing.

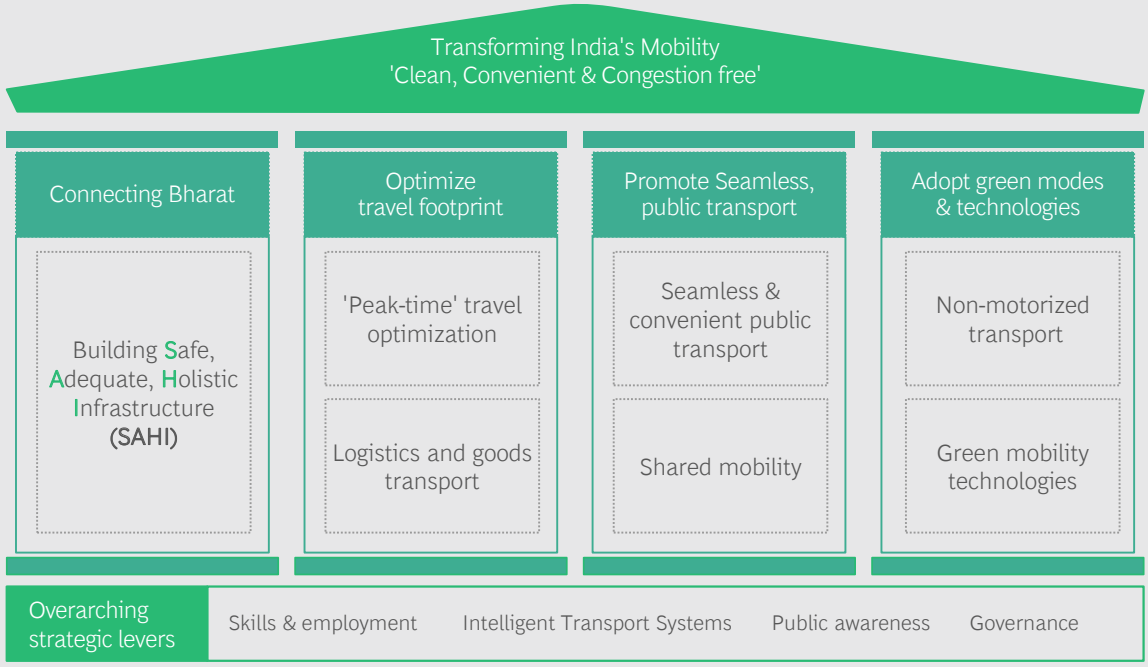
If the suggested 3C approach along with key pillars and enablers is executed effectively, the results can be transformative for India's mobility landscape. Improvement in rural connectivity can help in increased connectivity of villages with high adoption of public transport. PM2.5 emissions can reduce significantly across Indian cities. Additionally, the speed on arterial roads of major cities can be improved significantly. This holistic advancement should support India to have a target mobility landscape that is Clean, Convenient & Congestion free.

FIGURE E | Cost of Congestion for Top Indian cities



Sources: Press releases, BCG-Uber report on car sharing and traffic congestion.

FIGURE F | Transforming India's Mobility – 3C Framework



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SAFE, ADEQUATE AND HOLISTIC INFRASTRUCTURE (SAHI)

There is a strong need for developing connectivity for India's rural and urban areas. It has been well established that building reliable access to transportation is a major enabler for social and economic development[19]. Rural roads, for instance, account for almost 70% of the total roads in India (as of March 2016[20]) and it is imperative to ensure that the quality and connectivity of these roads is holistic and maintained up to specific standards (being addressed through existing initiatives).

In the urban context, connectivity needs to be addressed via an intermodal approach utilizing roads, rail, air and water. India's tremendous network of inland waterways connect a vast majority of urban and rural areas – and can be very cost affordable for boosting connectivity. The most well connected and utilized mode – railways – can be strengthened further through effective feeder networks to enhance connectivity. Through novel initiatives like the Regional Connectivity Scheme (UDAN), other modes are opening up beyond just highways for urban-to-urban center connectivity. It is also imperative to study the ways and means in which rural India travels and provide buses, rickshaws & NMT (non-motorized transport) infrastructure to alleviate the issues faced by the country's largest population segment.

Appreciation of Efforts so Far:

It is pertinent to note that various schemes have been implemented by the central government to address the issue of core connectivity in rural and urban regions. A few initiatives have been listed below:

- The Pradhan Mantri Gram Sadak Yojana[21] was launched in 2000, with the aim of providing good all-weather road connectivity to unconnected villages across India. Of the 178,184 habitations with a population of above 500 in the plains and above 250 in the hilly areas, 88% were already connected by Jun 2018. The scheme has successfully integrated isolated hamlets into the larger economy[22] [23].

- An amendment to the National Waterways Bill was passed in 2015 to develop convert an additional 110 rivers in waterways[24] under the Pradhan Mantri Jal Marg Yojna to increase the modal share of passenger and freight traffic, through cheaper transportation and improved regional connectivity. National waterway-I, from Haldia to Allahabad across the Ganges is being developed spanning more than 1,600 km is being developed with Varanasi, Sahibganj and Haldia to be developed as multi-modal terminals close to 10 Million Tonnes cargo capacity being built across these three hubs[25].

- The Pradhan Mantri Gram Parivahan Yojana[26] was launched in 2016 to improve rural mobility by plying subsidized public transport (10-12 seater vehicles) on rural roads. The scheme is aligned with Pradhan Mantri Gram Sadak Yojana and is aimed at regulating rural transport services.

- The government has launched the Aajeevika Grameen Express Yojana (AGEY) wherein self-help groups under the National Rural Livelihoods Mission (NRLM) will operate safe, affordable and community monitored road transport services to connect remote villages with key services and amenities (such as access to markets, education and health)[27]

- The UDAN (Ude Desh ka Aam Naagrik)[28] was launched in 2017 to provide low-cost connectivity in currently underserved/ unserved areas both for semi-urban and core rural regions. The scheme aims to operationalize hundreds of new routes by the end of 2018-19

In summary, it is clear to see that in the last 2-3 years, the focus on boosting connectivity has been much more pronounced. Some of these schemes, especially the PMGSY, have registered tremendous growth and impact. Going forward, the focus should be on ensuring last-mile implementation and standardization of these schemes – as well as ensuring that what is built is maintained and developed over time as well.

Potential Options and Associated Strategic Levers

In order to address the challenges through a concerted effort, our proposed solutions are organized across a set of core themes as follows:

1. Safe Infrastructure: Ensuring well-engineered, safe infrastructure for travel

2. Adequate: Ensuring multiple modes of connectivity

3. Holistic: Data driven planning, including integrated planning to reduce need to travel

Each theme and its supporting initiatives are outlined below, supported by the required strategic levers and relevant global benchmarks across developed and developing economies.

Theme 1: Ensuring well-engineered, safe infrastructure for travel

- In order to address both on-road & off-road safety challenges especially in rural areas, the key strategic lever is outlined as below:

  - Strategic lever: Clear guidelines promoting usage & deployment of women-only buses along with emergency services-equipped sidewalks and pathways for NMT users is required. This will provide a sense of safety after dark. In addition, tailoring the routes of public transport options so that women can get down closer to their destination can improve the sense of safety. The policies should be focused on using technological interventions for improved use of infrastructure.

Theme 2: Ensuring multiple modes of connectivity

- Connect rural villages/hamlets by building durable & paved all-weather roads to integrate the hinterland with urban areas. Upgrade existing internal roads within villages/hamlets to improve accessibility to all-weather roads.

  - Strategic lever: The Pradhan Mantri Gram Sadak Yojana[29] (PMGSY) has now connected around 88% of rural habitations with access to an all-weather road. Existing roads should also be brought up to the standards of all-weather roads.

  - Global example: In the last 5 years[30], China has built or renovated 1.28 million kms of rural roads, with 99.24% of townships and 98.34% of villages now connected by asphalt or cement roads.

- Utilize the railway network to boost rural-to-rural, rural-to-urban and urban-to-urban connectivity

- Strategic lever: Railway adoption and connectivity could be enhanced through a better network of feeder, inter-modal routes providing last-mile connectivity.

- Global example: China is aggressively expanding its railway network[31] through focused PPP partnerships, JVs and inter-modal support to ensure coverage to 80% of its cities and rural regions.

- Develop inland waterways to reduce transportation and freight cost[32]. Integrate waterways with existing public infrastructure to increase utilization

  - Strategic lever: The Pradhan Mantri Jal Marg Yojana[33] (PMJMY) envisages the creation of 110 new waterways to increase passenger and freight traffic through multi-modal connectivity. This needs to be leveraged to full potential.

  - Global example: UK[34] (Eng. And Wales) has a network of 5000 km of fully navigable waterways, with clearly defined responsibilities for local/ national bodies, policies for developing integrated multi-modal riverside transport hubs, and initiatives to promote green tourism and transport.

- Strengthen availability and adoption of public transport in rural areas

  - Strategic lever: Every state / district should be directed to measure the usage and adoption of current public transport connecting rural hubs. This measurement can be done on a periodic basis and should be used for improved public transport connectivity. Additional buses / autos / public transport vehicles should accordingly be deployed on select routes

  - Global example: Switzerland[35] has one of the highest usage rates of public transport – especially in its rural areas. Under a nationally coordinated plan named Taktfahrplan, scheduling and availability of buses & public transport has been planned in order to ensure maximum utilization and customer satisfaction.

- Expand air connectivity to connect regional, remote areas

  - Strategic lever: Central government has introduced UDAN (Regional Connectivity Scheme) to provide low-cost air connectivity to tier-2 and tier-3 towns. Financial support to improve airport infrastructure has been provided.

  - Global example: The US Department of Transport (DoT) runs the EAS[36] (Essential Air Services) scheme to provide subsidized airfares to 175 small communes across the US. EAS is further supported by Small Community Air Service Development Program (SCASDP) & Airport Improvement Program (AIP), with further initiatives to increase trained staff supply.

Theme 3: Data Driven planning including integrated land use planning

- Collect data on rural and urban mobility patterns

  - Strategic lever: A clear framework for assessing unique mobility needs in rural and urban settings should be used in the planning stage. A mechanism to collect the data should be institutionalized to periodically survey, collect data on transport trends, routes, and traffic flow.

  - Global example: Texas[37] has a dedicated rural transport planning handbook where it sub-categorizes rural areas into: Basic Rural Area, Developed Rural Area & Urban Boundary Rural Area to better understand the specific needs of each area.

- Utilize PPP to deploy 'Mobility as a Service' (Maas)[38] to connect rural transport providers with user demand

- Strategic lever: The Pradhan Mantri Gram Parivahan Yojana (PMGPY) aims to improve financial viability for rural transport providers through interest free commercial loans[39] to women self-groups. This initiative can be bolstered with technology interventions of ridesharing/pooling.

- Global example: The village of Blauen, Switzerland has developed the FahrMit[40] system where inhabitants can use an online application to find on-demand rides and provides travel information on connecting services at nearest transit hub.

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‘PEAK TIME’ TRAVEL OPTIMIZATION

EXPERIENCE OF PEAK HOUR travel on roads in urban India is marred with problems of both congestion and pollution. Addressing these challenges is critical, and solutions under this theme will help target the twin issues of urban pollution and road congestion.

Indian cities are the most congested during peak hours amongst any other in Asia[41]. Traffic index is 129% for Delhi and 162% for Bengaluru compared to 67% in rest of Asia Pacific major cities. Due to this congestion, traffic during peak hours in major cities’[42] arterial roads (13 in Delhi) is plying 50-60% slower than the speed these roads were built for. While private car ownership[43] in the last 10-15 years has been growing at ~8% CAGR, road length has only grown at ~3.5% CAGR. (As shown in Figure G).

These symptoms stem from a number of sources beyond the fact that we have too many cars and not enough roads. Chief among them are a lack of data-based decision making for dynamic traffic situations, poor on-ground enforcement and lack of adequate financial resources and technical capabilities for execution. This initiative should not be looked at in isolation from other interventions such as public transportation and last-mile connectivity – this initiative is a critical part of a holistic solution.

Appreciation of Efforts so Far

It is pertinent to note that numerous localized, experimental efforts have been tried already with varIt is pertinent to note that numerous localized, experimental efforts have been tried already with varying degrees of success. A few such initiatives are outlined below:

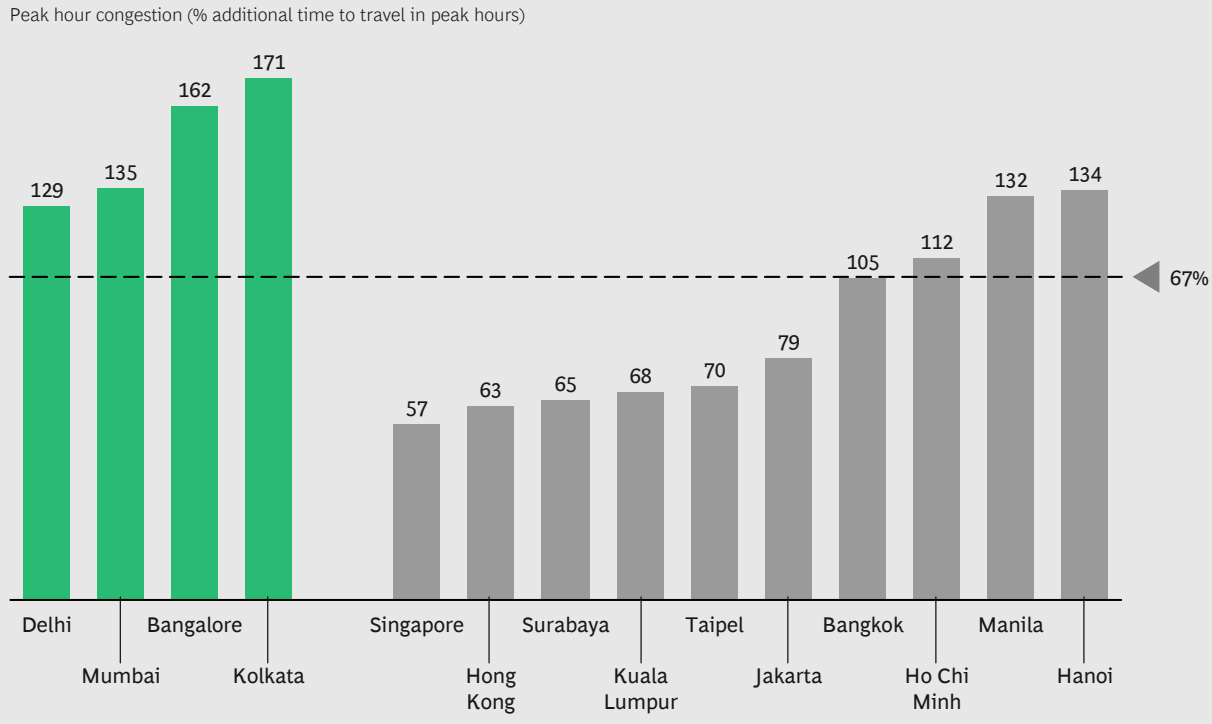
- Odd-Even scheme[44] was implemented in Delhi during 2017, where cars with license plates ending in odd and even numbers were allowed to ply on alternate days. The initiative had significant success in reducing pollution and traffic congestion[45] in the national capital.

- In Mumbai, Traffic signal synchronization[46] has been carried out at busy corridors through real-time monitoring of traffic through CCTV cameras. At places like Haji Ali, the signal cycle time has reduced by over 25 percent, helping to streamline traffic flow and reduce congestion.

- The Eastern Peripheral Expressway[47] was inaugurated in 2018, and is intended to act as a dedicated corridor for commercial vehicles. On its completion, it is expected to divert two lakh commercial vehicles, daily from Delhi.

- Intelligent traffic systems have been implemented in cities such as

FIGURE G | Traffic index- Peak hour congestion (% additional time to travel in peak hours)



Ahmedabad. An ITMS[48] (Intelligent Traffic Management System) is to be rolled out in Delhi by 2019.

- Automated vehicle ID and fining[49] is being carried out in cities like Delhi, Bengaluru and Chandigarh.
- The Delhi government has collaborated with Maruti Driving School[50] to set up 12 automated driver testing centers with scientifically laid tracks, advanced high definition cameras and an integrated IT system, in a bid to improve on-road driver performance and discipline.
- A fully automated Smart Parking[51] pilot facility was set up in 2014 in Connaught Place (Delhi) as a measure against congestion.

Potential Options and Associated Strategic Levers

In order to address the challenges through a concerted effort, the proposed solutions are organized across a set of three core themes as following:

1. Re-invent the need to travel during peak hours
2. Discourage private car ownership & usage
3. Manage traffic flow

Each theme and its supporting initiatives are outlined below, supported by the required strategic levers and relevant global benchmarks across developed and developing economies.

THEME 1: RE-INVENT THE NEED TO TRAVEL DURING PEAK HOURS

- Integrate land planning with transport infrastructure to limit travel distance and time
  - Strategic lever: Guidelines for planning cities with integrated land planning should be formulated.
  - Global example: Vauban, Freiburg[52], Germany was designed and planned to ensure that local facilities and local workplaces are within easy reach of walking / cycling – implementing the

idea of a "a district of short distances". As a result, car ownership levels in Vauban are dramatically lower (44% less, at 150 cars per 1000 residents compared to 270 per 1000 for an otherwise similar development on the other side of Freiburg)

Theme 2: Discourage private car ownership & usage

- Implement dynamic pricing for tolls, parking etc. to ease congestion and improve use of public transport
  - Strategic lever: A clear roadmap for dissuading private car ownership and usage should be laid out.
  - Global example: Singapore[53] has adopted an electronic road pricing mechanism as well, as a usage-based taxation mechanism, reducing traffic by ~25,000 vehicles during peak hours in the city and increasing average road speeds by 20%.
- Introduce measures to systemically reduce additional private vehicle ownership – such as private car ownership tax or restriction on the number of licenses given out.
  - Strategic lever: Guidelines encompassing fiscal measures and enforcement mechanisms to limit number of new vehicular licenses could be explored.
  - Global example: Beijing[54] has implemented a system for allocating number plates, which aims to tackle the city's congestion problems. Under the scheme, the city imposes annual quotas on the issuing of new license plates and buying a car requires proof that one is in hand. As a result, the number of new cars on road each year has decreased from 120,000 in 2015 to 90,000 in 2016.

Theme 3: Streamline traffic flows & improve driver discipline

- Implement ITS (e.g. Singapore intelligent transport system[55]) along with the supporting resources and infrastructure (traffic engineers, data scientists, central monitoring rooms with inductive loops, street-level detectors, supporting software, hardware) in key cities to gather real-time data and manage traffic situations in real-time (dynamic lights etc.)
  - Strategic lever: Specialized central agencies to develop a holistic framework for implementation of ITS in cities
  - Global example: The Los Angeles Department of Transportation[56] has developed a system for adjusting signals in response to real-time traffic demands. As a result – at intersections, arterial roads, and downtown grid networks – the city was able to cut travel times by 13 percent, stopping by 31 percent and delays by 21 percent.
- Strengthen the licensing process[57] by making it a multi-phased process with drivers graduating from a learner's license to a permanent license over a defined time period, with stringent testing at each step to improve on-road driver performance and discipline.
  - Strategic lever: A standardized multi-phased licensing approach should be adopted.
  - Global example: Austria[58] introduced a multi-phase driver license program in 2003 for the high risk 18-20 year age group. It consists of an initial safe driving course, psychological group discussion, and two feedback drives with a driving school instructor (advanced driving) in the first year after gaining the license. This was introduced in addition to a 2-year probation period for gaining an unrestricted driver's license. Studies showed that, personal injury crashes among 18 & 19 year olds involved in the program decreased by 11.2%
- Scale up automated identification of vehicles

- Strategic lever: Guidelines to be developed to scale up the deployment of plate-recognition software aided by effective CCTV footage. This may be used for automated generations of e-challans.

- Global example: Germany adopted an automated traffic penalty points system in 2014 to improve driver discipline, road safety and congestion. Under this system[59], once a driver accumulates four to five points, he or she will receive a warning, along with information about the points system. With six to seven points, a driver must attend two 90-minute seminars within three months of notification. With eight or more points, the driver's license is revoked. Example of one-point offenses include speeding, obstruction of emergency vehicles etc. These points are in addition to any fines, penalties or damages that may result from an infraction. The fines themselves are prohibitive as well – ranging from 10 to 600 Euros for speeding offenses.

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LOGISTICS AND GOODS TRANSPORT

THE LOGISTICS AND GOODS sector needs to influence mobility in two ways. Firstly, there is a need to provide effective peripheral road networks to commercial vehicles that travel through a city only to head to another destination. Secondly, there is a need to redesign the warehouse network in urban areas so that congestion due to commercial vehicles entering the city due to the current location of warehouses and modal transit points can be avoided. One example is Azadpur & Sahibabad in Delhi, which have been amalgamated with the city's stretching limits – resulting in greater congestion as trucks cross busy city roads. An additional issue is large commercial vehicles driving through urban roads and expressways during "no-entry" timings. Solutions under this theme therefore aim to address the current and emerging challenges in logistics and goods transportation.

Globally, freight accounts for 10-15% of vehicle equivalent kilometers traveled in urban areas. Taking the example of Paris, freight deliveries in[60] Paris contributed to 20% of road traffic, 25% of CO2 emissions, 35% NOx emissions. Furthermore, urban freight costs for intra-city travel are more than twice as expensive as long distance freight[61] as shown in Figure H below. Freight transport needs to be meticulously planned within urban transport.

The key reason behind increased congestion & high costs of logistics is that little consideration has been paid to urban freight transport, primarily because of lack of a single institution or department to streamline policies for urban freight[62]. Furthermore, development control norms on freight activity such as warehouses, logistic parks, inland container depots, SEZs, logistics hubs etc. need to be strengthened in order to optimize city spaces. Data regarding urban freight also needs to be systematically collected and consolidated. In order to draw solutions for urban freight issues, it is crucial to take these factors into due consideration.

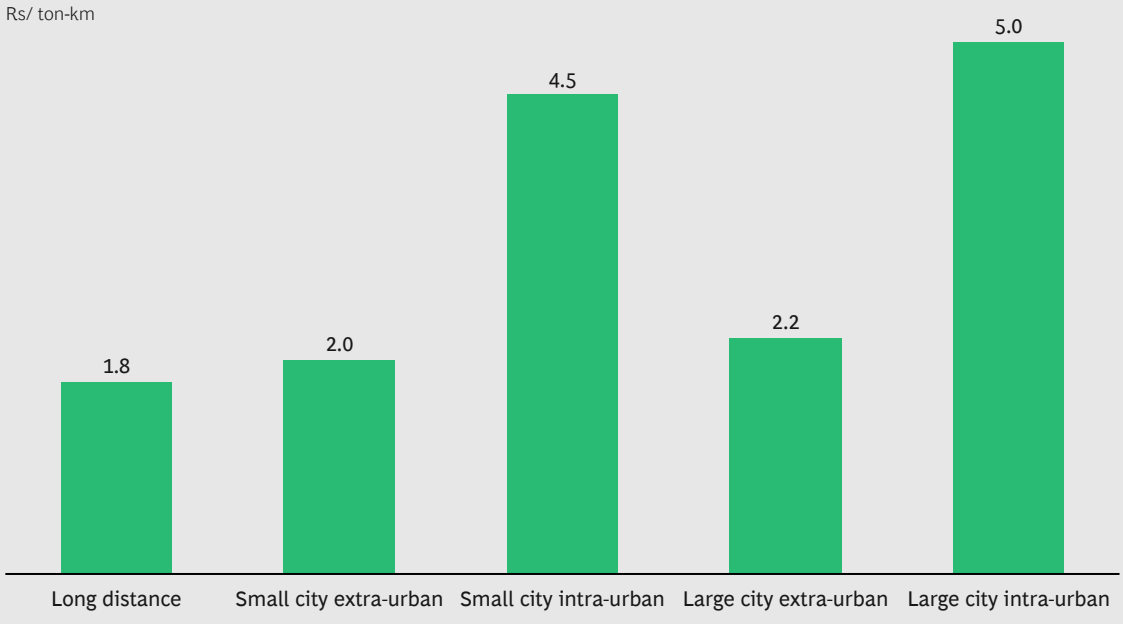
Appreciation of Efforts so Far

It is worthwhile to note the below efforts to streamline urban goods movement across various Indian cities by both public bodies and private players.

- Delhi: The government recently launched Eastern Peripheral Expressway (EPE)[63], which connects two Haryana cities via Ghaziabad and Noida in UP – cutting down the journey time of passenger and commercial vehicles on that route from 4 hours to 72 minutes.

- Mumbai: Measures taken to alleviate traffic congestion within city limits due to urban freight:

FIGURE H | RELATIVELY HIGH URBAN FREIGHT COSTS COMPARED TO LONG DISTANCE TRANSPORT COST



  - Commissioned the Comprehensive Transportation Study[64] (CTS) to determine the expansion and planning of new truck depots. 5 major and 11 mini depots planned taking into consideration closeness to the planned Dedicated Rail Freight Corridor. A new truck terminal is being built in Wadala close to city outskirts to shift freight away from and decongest the Masjid-Bunder area.

  - Time and route restrictions on an hourly and weekly have been deployed by the Mumbai Traffic Police to control the movement of freight vehicles.

- Jaipur: Urban Delivery Van Network[65] is a collaborative platform, which connects urban freight needs of retailers with local service providers.

Potential Options and Associated Strategic Levers

In order to address the challenges through a concerted effort, the proposed solutions are organized across a set of three core themes as following:

1. Optimize vehicle flow through populous urban areas
2. Design optimal warehousing & inter-modal network
3. Maximize load utilization

Each theme and its supporting initiatives are outlined below, supported by the required strategic levers and relevant global benchmarks across developed and developing economies.

THEME 1: OPTIMIZE VEHICLE FLOW THROUGH POPULOUS URBAN AREAS

- Timing and zoning: Identify and enforce norms around freight movement, e.g. dedicated freight routes

  - Strategic lever: Model framework for optimizing freight movement across the country should be developed and cities must adopt this framework with suitable regional considerations.

  - Global example: France's CERTU (Center for networks, transport, and urban planning) issued a guideline to

assist local bodies to develop dedicated loading & unloading zones in 2009. The method proposed a rough quantification of the needs for such spaces and a set of recommendations, including time zones, for improving their utilization.

- Effective feeder network using effective and green last mile connectivity: Traditional shippers are increasingly towards green freight for last mile delivery. These vehicles have lower emissions, and can enter into narrow city lanes.
  - Strategic lever: Central guidelines should be formulated for recommending shippers to deploy a certain percentage of fleet as green vehicles for last-mile delivery.
  - Global example: Multiple cities (Portland) and organizations (DHL, B-line) have piloted powered and non-powered tricycles for last mile delivery.

Theme 2: Optimize warehouse locations and inter-modal network

- Warehouse location strategy: Develop large shared warehouses to serve as consolidation centers
  - Strategic lever: Specific guidelines to enable cities and states to design their customized warehousing strategy should be developed.
  - Global example: Bristol[66] built an Urban Consolidated Centre (UCC) on the north western edge of Bristol to consolidate freight movement into the city
- Well-planned, adequate multi-modal logistics and interchange facilities: To further minimize the interaction between commercial and passenger traffic, additional modes such as rail and waterways should be actively utilized. These warehouses should accordingly provide infrastructure for smooth trans-shipment of freight.
  - Strategic lever: State and city governments to develop multi-modal parks.
  - Global example: Interporto Bologna[67], Italy, is a large "freight village" spread over 1000 acres outside city limits, which handles ~5 MT / year through rail and road modes.

Theme 3: Maximize load utilization for all categories of goods

- Build digital, shared platforms for improving utilization
  - Strategic lever: Enable the creation of a centrally driven shared platform supported by the Government – which aggregates demand across platforms and helps provide fleet transporters as well as farm produce transporters in rural settings to improve their utilization.
  - Global example: Fleetboard nxtload[68], is a platform aggregator, that aggregates multiple logistics platforms.
  - Strategic lever: Create a regulatory framework for allowing freight exchange and aggregator platforms to thrive in rural and urban settings. Set guidelines, which include financial support, subsidies, and public awareness campaigns among other enablers to improve adoption of aggregation platforms.
  - Global example: Convoy, a leading freight platform company in USA serving as 'Uber for trucks', raised $80 Mn and is growing fast; Cinatis is a pure technology company based in France, creating tools such as Cinatis pooling[69] for consolidation of full truck load cargo.

However, it is worth pointing out that optimization of logistics and goods transport is a broader topic – of which this chapter has primarily dealt with the aspects where passenger mobility and logistics converge.

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SEAMLESS, CONVENIENT PUBLIC TRANSPORT

To ensure that Public Transport (PT) becomes the preferred mode, it is imperative to recognize the challenges of the Indian public transport system. India has 1.2 buses[70] per 1000 people, below developing nation benchmarks[71], with a vast disparity between states - 3.9 in Karnataka vs 0.02 in Bihar. Only 63 of 458 Indian cities[72] of more than 100,000 citizens have a formal city bus system. Within this, only 15 cities have a bus or rail based mass rapid transit system.

A strong, well-connected, capable public transport network is considered an essential service, and in India the usage needs to be significantly improved. This theme focuses on making public transport the preferred choice for urban commuting and simultaneously addressing the twin problems of pollution & congestion. (As shown in Figure I).

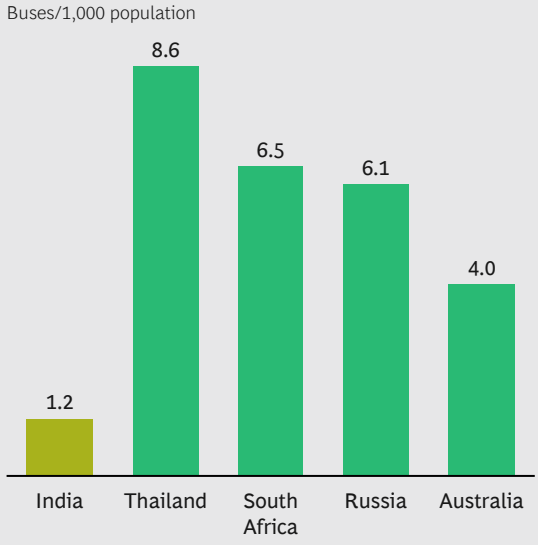
Appreciation of Efforts So Far

Public transport is a core focus areas for city, state and national bodies engaged in various mobility activities. These bodies have taken numerous steps which are mentioned below.

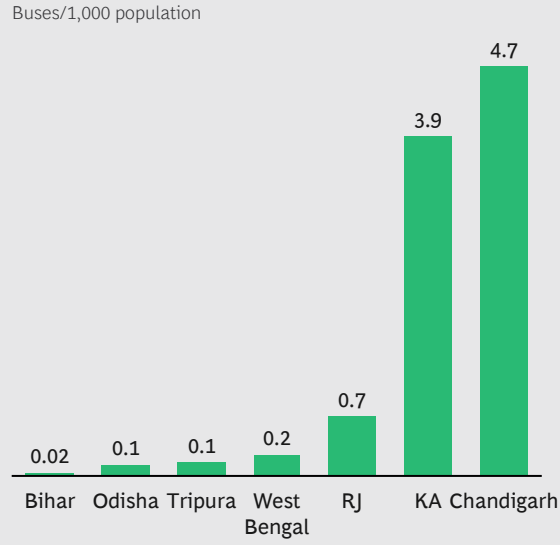
- Transport plans: Certain cities have drafted long term transport plans to drive improvement in public transport facilities, such as MUTP for Mumbai Transport and Traffic plan for Bengaluru.
- Innovative financing: Delhi Metro successfully introduced the concept of branded stations[73].
- Quality improvement: Mumbai local rail system has introduced air-conditioned wagons and has seen good response[74] but it has only 18 daily services. BMTC's Vajra chain of AC buses (Bengaluru) have significant uptake[75], and BMTC is piloting WiFi in buses[76].
- Trip planner and digital visibility: BMTC (Bengaluru) has launched an app for bus services[77]
- Integrated payments: Mumbai[78] is planning a smart card, which will work across 4 transport modes
- Feeder infrastructure: Bengaluru introduced Metro feeder buses[79]
- Bus Rapid Transit: BRT[80] corridor in Bhopal has been successful.
- On-demand public transport: App-based bus or van services such as Shuttl have begun operations in Mumbai & Delhi NCR in the past 2 years.

FIGURE I | Number of buses per 1,000 population across countries & Indian states

INDIA LAGS IN PER CAPITA BUS FLEET



SIGNIFICANT DISPARITY IN PER CAPITA BUS FLEET BETWEEN STATES (SELECTED INDICATIVE SET OF STATES IN CHART BELOW)



Potential Options and Associated Strategic Levers

In order to address the challenges through a concerted effort, the proposed solutions are organized across a set of three core themes as following:

1. Design city-specific PT roadmaps including choice of primary mode
2. Create a smart multi-modal network with last mile connectivity
3. Make PT attractive for urban India

Each theme and its supporting initiatives are outlined below, supported by the draft strategic levers and relevant global benchmarks across developed and developing economies.

THEME 1: DESIGN CITY-SPECIFIC PT ROADMAPS WITH CLEAR HIERARCHY AMONG DIFFERENT MODES

- Collect relevant and accurate data related to mobility for designing comprehensive, long-term strategies
  - Strategic lever: Data on commuters should be collected using technology based techniques (GPS and smartphones) & household based techniques.
  - Global example: Singapore's Future mobility survey (FMS) is[81] a smartphone and GPS-based survey created by MIT and used by Singapore transport authority to collect data on traffic flow and mobility trends.
- Design and plan for a PT system with a well-defined hierarchy of modes, along with the feeder network supporting the main network.
  - Strategic lever: Long-term transportation plan should define the primary mode of transport and the supporting modes of transport by city type (Metro vs. Tier 1 vs. Tier 2…).
  - Global example: In Curitiba[82], Brazil, the master plan directed growth along the BRT system, which defined five structural axes. In Helsinki's plan[83], Rail

is defined as the primary axis, with bus system providing a supplementary and feeder role.

Theme 2: Create an integrated multi-modal PT network supported by last mile connectivity

- Ensure seamless connectivity between the different modes of transport
  - Strategic lever: The long term transportation plan should focus on intermodal infrastructure and defining a Governance framework for its execution.
  - Global example: Hong Kong has six modes of travel[84] within the city limits with seamless connections between modes. Hong Kong's Octopus card[30] can be used across six modes and for retail transactions. 95% of people in Hong Kong aged 16 to 65 use Octopus to travel, shop and dine. Octopus card has covered multiple modes since 1999[85]. Helsinki has rolled out the 'Whim app'[86], which also includes private taxis, and looks to offer 'mobility as a service'. Sydney's Opal app provides a transfer discount for changing modes when traveling on public transport[87].
- Encourage development of digital platforms which provide access to multi-modal public transport.
  - Strategic lever: The contours of a basic multi-modal transport platform should be created and made available to local transport authorities, to utilize as starting point in their efforts.
  - Global example: Sydney's Opal app provides journey planning across multiple modes[88].

Theme 3: Make PT attractive for urban India

- Use principles of transit oriented development (TOD) to ensure commercial activity around transit hubs
  - Strategic lever: Guidelines for integrated public transport and commercial development should be created.
  - Global example: The Oculus station in New York City inaugurated in 2018, aims to be a hub[89] for lower Manhattan with restaurants, consumer goods, boutiques, household services and professional services. Other examples of such development include Raffles Place in Singapore, Covent Garden in London and Shinjuku in Tokyo.

Notes:

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SHARED MOBILITY

The rise of internet and digital tools has enabled the sharing economy to spread across multiple industries including mobility. Privately owned vehicle have an inherently low asset utilization, which can be improved through ride sourcing, ride sharing and carpooling. Shared mobility reduces the number of private vehicles on the road, thus tackling both congestion and pollution. This theme focuses on an approach to enable India to effectively harness the advantages of shared mobility at scale.

Asset utilization today on private cars today is just ~5%[90]. Further, there is lower utilization of seats in 2-5 seater category of cars. Various privately run, digitally powered, private aggregator platforms have emerged with healthy levels of adoption in India, which address this issue through different offerings (E.g. ride sourcing, ride splitting, ride sharing). However, two service offerings have seen increased traction:

- Ride sourcing e.g. Ola, Uber
- Ride sharing e.g. Ola Share, Uber pool

Ride sourcing and ride sharing achieve a high level of efficiency due to multiple advantages inherent in their business model: flexible supply base, smart communication system through smart phones, dynamic pricing, network effect, dynamic routing, demand pooling (for ride share), and digital feedback and management systems. Addressing safety concerns in ridesource/share is an important factor, which can further improve the adoption.

Potential Options and Associated Strategic Levers

In order to address the challenges through a concerted effort, the proposed solutions are organized across a set of two core themes as following:

1. Encourage ride-sharing and ride-sourcing through digital means
2. Enable private vehicle sharing

Each theme and its supporting initiatives are outlined below, supported by the required strategic levers and relevant global benchmarks across developed and developing economies.

Theme 1: Encourage ride-sharing and ride-sourcing through digital means

- Address safety concern with regards to shared mobility by designing clear guidelines for various stakeholders
  - Strategic lever: There is a need to define a holistic safety framework encompassing needs of all stakeholders

  - Global example: All incidents that come to the light of Aggregator Company are to be reported to police, as has been instituted for Uber in London[91].

- Provide a clear transition roadmap for existing closed-license taxi owners to compete effectively

  - Strategic lever: An enabling ecosystem for existing closed-license taxi owners must be defined. Existing initiatives from Digital India could be leveraged towards this.

  - Global example: A hardship fund to be funneled towards closed-license taxi drivers was proposed by Uber in New York City[92]. In Los Angeles[93], the process was democratized as all taxi drivers were asked to use an app allowing customers to hail a cab from their phones.

Theme 2: Enable private vehicle sharing

- Introduce high occupancy lanes to encourage car pooling

  - Strategic lever: A detailed policy framework needs to be laid out by central Government to help local authorities decide routes and pilot the initiative. Certain trunk routes for work should be identified for rolling out HOV and encouraging carpooling.

  - Global example: US, UK (Leeds), Netherlands (Amsterdam), Spain (Madrid), New Zealand, Australia, Indonesia (Jakarta) have well defined lanes for the use of HOV, with minimum occupancy of 2 or 3, designed to discourage single or low occupancy car use[94]. Jakarta[95] had implemented the concept of HOV in 1992 for specific roads, specific hours. However, after rolling back the policy in 2016 (due to jockeys who rode along for a small fee) – Jakarta's peak hour traffic speed declined from 17 mph to 12 mph in mornings and from 13 to 7 mph in evenings. Travel delays worsened by 46% in morning rush hour and 87% in evening rush hour.

Notes:
90. BCG-Uber focus report on shared mobility in India, 2017
91. https://www.businessinsider.in/Uber-will-now-report-crimes-directly-to-the-police-in-a-radical-effort-to-show-it-takes-safety-seriously/articleshow/62948134.cms
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NON-MOTORIZED TRANSPORT

Non-motorized transport enjoys both economic and environmental benefits along with enabling last-mile connectivity to the public transit systems, especially in low-income or high-density urban spaces. However, the usage of NMT in India has significantly declined over the last 4 decades[96].

NMT has considerable positive synergies on pollution, congestion and hence directly impacts the health of the citizens. This theme therefore leverages the healthy and traditional solutions of walking or cycling to address the new age problems of congestion and pollution. (As shown in Figure J).

Low usage and adoption of NMT modes in India stem from the lack of dedicated infrastructure (uniform pedestrian pavements, cycling paths) coupled with its poor maintenance and upkeep. Further, another reason for the low usage of NMT is its lack of safety, given that cyclists and pedestrians have the highest share of fatality rates in traffic accidents. According to Delhi Police data, of the total road fatalities every year, nearly 70% are cyclists and pedestrians[97].

Potential Options and Associated Strategic Levers

In order to address the challenges through a concerted effort, the proposed solutions are organized across a set of three core themes as following:

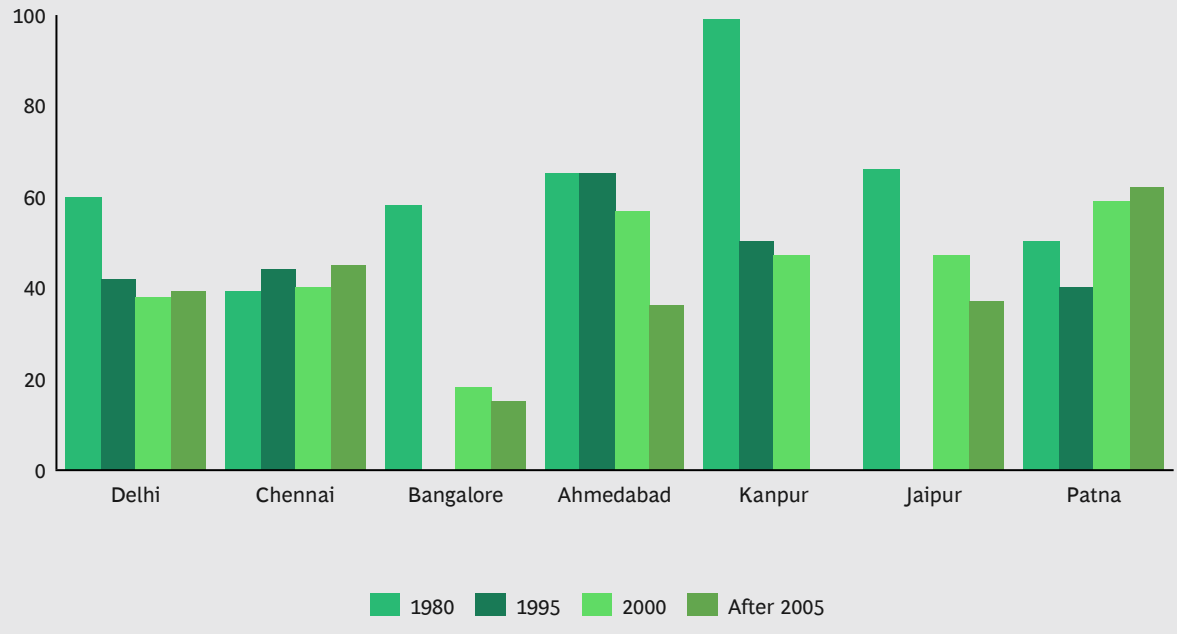
1. Integrate seamlessly with public transport
2. Ensure safety for NMT users
3. Design for comfort and accessibility

Each theme and its supporting initiatives are outlined below, supported by the required strategic levers and relevant global benchmarks across developed and developing economies.

Theme 1: Integrate seamlessly with public transport

- Build NMT paths, which offer seamless connectivity with other modes of transport
  - Strategic lever: Urban planning and design should consider NMT infrastructure at its heart
  - Global example: Amsterdam[98] has over 1,200 small- medium bridges over its crisscrossing canals and waterways that enables NMT commute through dedicated cycling paths / pedestrian walkways.
  - Global example: The Strasbourg-Kehl Tram[99] Bridge over the Rhine also

FIGURE J | Share of Non-Motorized Transport in cities as a % of overall modal trips



consists of two dedicated cycling paths (2.5 m wide) and walkways (2 m wide).

- Analyze data via NMT smart planning system to design footpaths and cycle paths for maximum usage – especially with the objective of integrating it as feeder routes to public transport hubs
  - Strategic lever: Institutionalize a framework to analyze the data, and define parameters to use the data to plan & design NMT so that it is a main feeder network to the PT hubs
  - Global example: Singapore (Future Mobility Survey)[100]- FMS data will be used to develop future infrastructure for NMT by Singapore Land Transport Authority (LTA).

THEME 2: ENSURE SAFETY FOR NMT USERS

- Outline guidelines for safety of NMT users
  - Strategic lever: Standardized guidelines, adhering to global best practices for development of NMT infrastructure with a focus on ensuring safety for users should be outlined.
  - Global example: The New South Wales (Australia) Government has well defined standards and norms for designing and building footpaths and cycle lanes[101]. Cycling infrastructure in Netherlands was developed following an award-winning standard called CROW[102], which specifies speed limits, width of cycle paths and intersection/ junction rules. Today, 19% of the trips in Netherlands are through bicycles.

THEME 3: DESIGN FOR COMFORT AND ACCESSIBILITY

- Build sheltered walkways & cycling paths, which protect pedestrians/cyclists from extreme weather, keeping in mind the comfort of commuters. This includes simple steps such as sheltering walkways from rain/sun, use of non-slippery materials and wide paths.
  - Strategic lever: Central guidelines should be issued to local bodies to

follow a comprehensive "comfort" checklist (covered/uncovered, materials used etc.) tailored for local conditions like weather. This checklist should be incorporated within NMT design/ planning.

  - Global example: In Winnipeg, Canada, the Weather Protected Walkway System[103], created a massive system of indoor pedestrian walkways. It connects 38 buildings with a total 11 million square feet of space and 21,000 employees. Beyond providing climate control- you can walk 2 kilometers without being exposed to the cold, the walkways have made a winter city far more accessible for people with disabilities.

- Ensure accessibility for elderly and specially abled

  - Strategic lever: The Government should institute guidelines and norms that ensure that the needs of elderly and differently abled are considered within NMT design/planning.

  - Global example: Winner of Access City Award 2016, Milan[104] has gone to great efforts towards making its historical, cultural and artistic routes accessible for people with physical disabilities.

- Incorporate urban green space development within NMT design and planning. The infrastructure should be designed and integrated with the environment so that cycling and walking becomes attractive.

  - Strategic lever: Urban green space development should be considered within NMT design/planning.

  - Global example: Paris Promenade Plantee[105]: At 10 meters above street level, this free, scenic three-mile stroll from the Bastille to the Bois de Vincennes was the world's first elevated park walkway and is one of Paris's most cherished attractions.

NOTES:

96. http://www.unepdtu.org/-/media/Sites/Uneprisoe/Publications%20(Pdfs)/India-Transport/Case-Studies/NMT-Infrastructure-in-India-Investment-Policy-and-Design.ashx?la=da

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GREEN MOBILITY TECHNOLOGIES

Given the core issues of global warming and pollution across the world, green technologies have emerged as a potential solution. In this context, it is imperative for India to enable the growth of zero emission technologies to target these issues.

Green mobility technology has significantly matured over the last few years. Current adoption of green mobility technology is increasing across many countries as shown in Figure K.

Potential Options and Associated Strategic Levers

It is imperative to acknowledge that select policy initiatives have been designed and pilots have been rolled out in order to support the adoption of green mobility technologies. Most notable among them, is the FAME India Scheme aimed at supporting hybrid and electric vehicles' market development and manufacturing ecosystem. Pilots across cities by both public and private stakeholders such as Indian Oil, Ola have been attempted as well to develop charging infrastructure and promote adoption of green mobility technology. These initial steps are crucial to absorb lessons from, so that a holistic, comprehensive approach may be designed for active promotion and adoption of green mobility technologies.

In order to address the challenges through a concerted effort, the proposed solutions are organized across a set of two core themes as following:

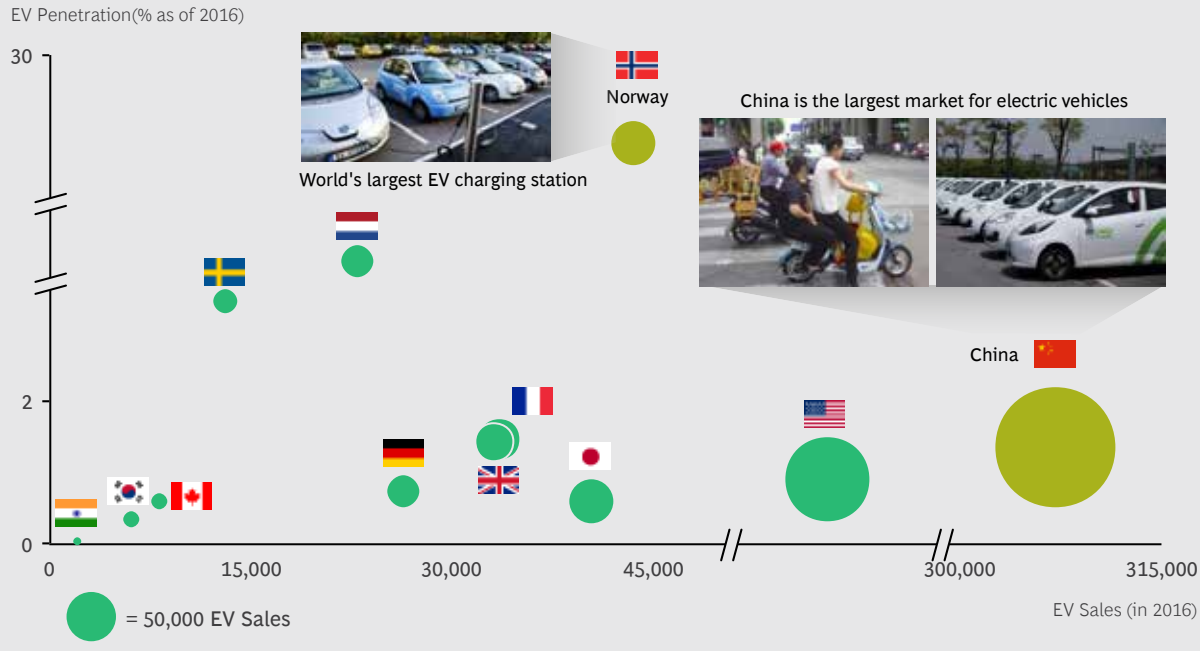
1. Enforce supply-side restrictions to promote clean technology
2. Provide supporting infrastructure

Each theme and its supporting initiatives are outlined below, supported by the required strategic levers and relevant global benchmarks across developed and developing economies.

Theme 1: Devise pollution control norms to promote clean technologies

- Impose supply side regulations on OEMs to increase production of zero emission vehicles through market based incentives like Corporate average fuel economy (CAFÉ) and ZEV (Zero Emission Vehicle) production credits
  - Strategic lever: Align with CAFE norms by developing regulations to penalize OEMs not adhering to the norms.
  - Global example: Most Western countries are adopting enforceable CAFE norms to ensure supply of EVs; China has mandated OEMs to produce minimum of 10% EVs.

FIGURE K | EV Sales and Penetration across the World



Sources: EV penetration – Global EV Outlook 2017 (International Energy Agency), EV Sales – MarkLines research.

- Use feebate mechanism to incentivize use of green mobility technologies
  - Strategic lever: Identify potential mechanisms and develop regulation for incentivizing green mobility technologies with a feebate mechanism.
  - Global example: London city imposes congestion charges during weekday working hours to vehicles entering the city center

THEME 2: PROVIDE SUPPORTING INFRASTRUCTURE TO DRIVE ADOPTION

- Set up public charging infrastructure
  - Strategic lever: Government to facilitate the setting up of public charging infrastructure – an important enabler for adoption of green mobility technologies (Ministry of Power has already initiated action in this respect). PPP in this space and utilization of existing infrastructure like petrol pumps are also being explored.
  - Global example: Globally, public charging infrastructure is subsidized by the government while the utilities are the primary owners. The Chinese Government set up 16,000 charging points across the country in 2012 to drive adoption with the help of State Grid Corporation of China (SGCC); China also has plans to set up 4.8 Mn charging points with USD 18-20 Bn investment outlay by 2020.

OVERARCHING STRATEGIC ENABLERS

THE PREVIOUS CHAPTERS OUTLINED various key ideas and initiatives to help realize the vision towards clean, convenient and congestion free travel. However, these initiatives can be effectively realized only with key overarching strategic enablers in place. These enablers are outlined below:

Skills and Employment

The new wave of mobility initiatives will result in a swathe of requirements for new age skills and opportunities for employment. Successful planning and execution of these initiatives will depend on the available capacity in terms of both personnel & skills. In India, multiple bodies offer capacity building programs and these efforts need to be synchronized for effective outcomes. Skills on IoT, Big Data & Analytics tools would be needed in addition to traditional skills like integrated land planning.

Unified transport authority

The most pressing concern in terms of executing an urban mobility plan for India is dis-aggregation of stakeholders pertaining to various aspects of mobility. There is a critical need for a unified body covering multiple dimensions of mobility at central and state level. A coordination mechanism with all key stakeholders needs to be established.

Intelligent Transport Systems

Accuracy & reliability in traffic data collection is fundamental in understanding our current mobility needs and planning future initiatives and infrastructure, as has been pointed out across almost all sections. Therefore, standardized guidelines for data collection – type and methodology – need to be developed. The right infrastructure and technology for data collection also needs to be installed to enable informed decision making. This can include smart traffic sensors, CCTV cameras, and innovative technological interventions using IoT (Internet of Things). In addition, commuters can also volunteer data off-line through surveys as well as online methods such as through smartphone apps and share real-time traffic and road information. Existing data sources such as utilizing inter-city train capacity utilization statistics can also be leveraged to provide insights on the routes which need to be prioritized for improving public transport, NMT and shared mobility planning. The tremendous amount of mobility data should be subject to personal data privacy laws & considerations.

To use this combination of historic and real-time data, a centralized informatics hub deploying Big Data tools like Hadoop, Kinesis and SAS would be needed to mine data and present actionable insights to traffic

operators. Due to sophisticated analytical modeling involved in simulating passenger or freight flows, it is critical to deploy the right vendors with proven capability in global projects. While proprietary solutions from private players like Watson Analytics (IBM) or City Brain (Alibaba) can be quickly on-boarded to scour traffic data and provide interactive dashboards and 'command center rooms' to operators, it is imperative to set up and build in-house analytics capabilities across states and core urban regions as well as at a central level to effectively engage with vendors before selection and during operations. Innovative solutions like Intelligent Traffic Management Systems (ITMS) using artificial intelligence to control traffic should also be explored.

Public Awareness and Communication

Behavior change is a critical lever for initiatives to succeed, and a visible and coherent communications strategy is essential to drive behavior change. For example, Reykjavik (Iceland) boosted BRT ridership by 25% despite increasing fares, and attributed it partly to an effective communications campaign, which focused on three core values of cheap, convenient and safe. Marketing spots on buses and other facilities, which previously had been sold to external advertisements, were utilized for own marketing. While advertising revenue decreased in the short term, it led to long-term behavior change in the commuters .

New initiatives tend to succeed when public will is behind it, and for that, it is critical that the Government demonstrates its will to execute the project. Reputable brand agencies should be deployed, especially to drive large-scale changes, which may require either behavior change or public acceptance. For example, Hong Kong tramways employed Stepworks , which defined a new brand logo and tagline "Catch a ride, Catch a smile" .

Reaching out to the modern commuter has also become easier through social media platforms like Twitter, which has been put to great use by the Mumbai Traffic Police which regularly shares memes to remind followers of traffic rules, give updates on traffic snarls and share information on new initiatives.

Using the credibility of opinion leaders can also help to create instant awareness, as in the case of Swacch Bharat, which included influencers appealing to various demographic segments.

NOTES:

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