Greener Urban Mobility in India

The potential for behaviour change and metro rail systems

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Executive Summary

Public transportation is an obvious and critical low carbon mobility solution for Indian cities. Over the last decade, metro rail systems have emerged as a dominant policy solution, with large budget allocations and uptake: 10 cities now operate metros and more than 15 cities are currently building them. However, despite the increasing service provision in cities, many individuals and households who can both afford and access the metro continue to opt for private vehicles for commuting. This represents a missed opportunity in terms of climate action, as metro rail systems have the potential for significant emissions reduction. It is increasingly clear that behavioural biases limit the uptake of low-carbon mobility solutions like metro rail in Indian cities.

This study on Delhi Metro found that behavioural barriers like perceptions of high effort, lack of safety, and status of the metro are deterrents to metro use for private vehicle owners. On the other hand, expensive parking, designated female compartments, and health and environmental benefits linked to the metro are enablers for metro use. This brief summarises the key structural and behavioural barriers and enablers in metro uptake, with suggested behavioural interventions and policy recommendations.

Section 01: The Project

Climate change calls for immediate and collective action: society needs to adopt new behaviours and lifestyles to address the climate crisis. However, human choice in relation to sustainable behaviour is understudied and rarely incorporated in policy decisions. In India, where cities are likely to shape the country's ability to achieve climate goals, the importance of sustainable mobility solutions cannot be overstated. Public transportation options like buses and mass rapid transit (MRT) offer a low-emissions alternative to private vehicles; given their high volumes, they have a far lower greenhouse gas emissions (GHG) footprint than a personal vehicle. Yet, despite investments in these systems, usage remains low: according to the 2011 Census, only 18% of Indians use public transportation facilities (Rukmini, 2016). With recent policy directives, including the National Urban Transport Policy (NUTP) of 2014 and union budget allocations for modern public transport facilities (PIB, 2022), there is a great opportunity to unlock the full potential of transport systems: to improve people's mobility and access to opportunities, and to address rising emissions.

The Low Carbon Lifestyles Project at CSBC seeks to initiate behaviour change towards sustainable lifestyle choices, including low carbon transportation, in Indian cities. It aims to design interventions to redirect individual and household choices towards low carbon behaviours and technologies. The primary goal is to ensure that policy incorporates an understanding of the context of consumer choices and of local barriers to the uptake of low carbon consumption, essential to devise levers for higher adoption.

In the domain of urban mobility, the project promotes the adoption of low carbon modes such as public transportation, electric vehicles, and non-motorised transportation. This brief focuses on human choice and public transportation – specifically, metro rail – examining the barriers and facilitators in its adoption in Indian cities. The project uses Delhi Metro as a case study to understand why people are choosing private vehicles over public transportation. Currently, metro systems are being prioritised in India, with increased investment in these systems and more than 15 cities building them (*Economic Times*, 2018). There is thus great potential for this research to be leveraged in many Indian cities.

Public Transport – The Indian Context

The most commonly available public transport options are buses, either deployed in dedicated bus lanes or otherwise, and MRT. Bus systems are lower cost and generally relatively easier to deploy. MRT options (heavy passenger rail and metro systems) only operate on the exclusive right of way, but they are larger-capacity transport systems and have a high potential for emissions reduction. Global studies show that a switch from personal vehicles to public transportation can reduce emissions by 32% (bus) to 74% (mass rapid transit/heavy rail) (US Department of Transportation Federal Transit Administration, 2010). On-street transitways (bus or rail) can move as many as 10,000–25,000 people per hour compared to 600–1,000 by private vehicles.

India's NUTP strongly promotes public transportation systems, providing roadmaps for urban multi-modal transportation systems and guidelines for infrastructure design with a focus on differently-abled individuals (MoUD, 2014). There are several other policy directives for improving public transportation in cities, especially the metro. The National Action Plan for Climate Change (NAPCC) acknowledges the potential of cutting GHG emissions in the transport sector through measures such as increased reliance on public transport (MoEFC, 2021). To enable state governments, urban local bodies (ULBs), and transportation authorities to implement public transportation initiatives, the Ministry of Housing and Urban Affairs (MoHUA) establishes service-level benchmarks, enhances planning and implementation capacities, and offers support and funding for these services (MoUD, n.d.). The 2017 Metro Rail Policy grants all states the responsibility for permissions, approvals, and statutory support for commercial development at metro stations and on urban land, with provisions for non-fare revenue generation (MoHUA, 2017).

However, despite the primacy accorded to public transportation in policy, implementation has principally been limited to India's largest metropolitan cities, resulting in less than 20% of the population using public transport, as noted above. Union budgets in recent years have prioritised investing in 'world-class' and modern public transport facilities (PIB, 2022), especially mass transit systems. While some of

India's largest cities have had metro systems in place for more than two decades (Kolkata since the 1980s), many are expanding their network and metro rails in several smaller cities are being built or in the pipeline this decade (*Economic Times*, 2018).

MoHUA estimates that a substantial investment of over $61 billion (Rs 4.7 lakh crores) is required for urban transportation systems across India (KPMG, 2017). Implementation will involve the engagement of diverse actors, ranging from government bodies (like the Ministry of Road Transport and Highways, MoHUA, state transportation authorities, ULBs, and metro rail corporations), to special purpose vehicles and public–private partnerships that are involved in construction, financing, operations and maintenance (such as L&T Metro Rail in Hyderabad, Mumbai Metro One Private Limited in Mumbai and PUNE IT Metro Rail Limited in Pune).

In India, the bus is often seen as outdated (ITDP, 2020), unsafe, and for poorer communities, but metros are not usually associated with similar stigmas. In spite of this, uptake of the newer metro systems has been disappointing. Ridership on the majority of newly built metro systems has been low (Table 1), resulting in poor financial performance (Standing Committee on Housing and Urban Affairs, 2021–2022). While limited last-mile connectivity and delays in the opening of new lines are listed as reasons for poor uptake, certain values and social norms that are deeply entrenched in society also impact the use of the metro.

CITY	AVERAGE DAILY RIDERSHIP (2019-2020)	DAILY RIDERSHIP NEEDED TO BREAK EVEN
Delhi	50.65 lakhs	38.24 lakhs
Bangalore	4.89 lakhs	13.19 lakhs
Hyderabad	2.76 lakhs	19 lakhs
Lucknow	0.537 lakhs	0.943 lakhs
Chennai	92,000	253,989
Kolkata	5.4–5.84 lakhs (pre-COVID)	15 lakhs

TABLE 1: COMPARATIVE FIGURES FOR METRO RIDERSHIP ACROSS INDIAN CITIES

Choice and Public Transport Usage

Globally, literature points to several key behavioural and structural barriers that influence individual decisions about using public transportation. First, misconceptions about service reliability and poor communication from

transportation authorities can cause uncertainty and deter potential riders (Hardin, 2001). Second, public transport is perceived as high-effort, due to factors like waiting times, ticket purchase, and the need to transfer between lines, stops, and modes (Agarwal & Collins, 2016). This compares unfavourably with the perceived flexibility of private vehicles (Anwar, 2012), offering on-demand travel. This is especially the case for commuters with non-linear journeys and trip chaining, more common among women and caregivers (Zhen, 2021). Third, status bias, where social status is tied to mode of travel and vehicle usage, can also make individuals hesitant to switch to public transport as they fear a perceived loss of status associated with private vehicle ownership and driving (Moody, 2019). Fourth, perceived challenges around safety while using public transportation, especially for women and persons with disabilities, can discourage metro use (ITF, 2018). Finally, supply-side barriers limit the uptake of public transport. For example, limited access to transit stops and high costs may compel people to opt for private vehicles (Agarwal & Collins, 2016).

On the other hand, studies also point to enablers for metro adoption. Government investment in transportation infrastructure is pivotal in improving ridership. This includes upgrading vehicles with safety and accessibility features, increasing frequency, improving and catering pricing to different users, and provision of real-time, accessible, multilingual information through maps and digital signboards (ITF, 2018; C40 Cities Climate Leadership Group, 2019; Pradeep, 2021). Integrated transport planning and ticketing services have also been impactful in cities globally, enhancing the appeal of public transit (C40 Cities Climate Leadership Group, 2019). Finally, certain design choices, such as limiting parking availability in office areas and imposing higher parking fees, serve as deterrents to private vehicle use and encourage public transit adoption. These facilitators collectively work to make public transportation more accessible, convenient, and attractive for commuters.

Project Methodology

There is a clear gap in behavioural research on the adoption of public transportation in Indian cities. This study, which explores the behavioural and policy barriers that limit the uptake of metro rail in Indian cities, and the facilitators that encourage ridership, is a step towards bridging that gap. The project team designed a robust methodology to understand barriers and facilitators in metro use and thus design interventions to promote adoption.

- First, a detailed literature review was conducted to identify national- and state-level policies and incentives for building and implementing metro systems in Indian cities.

- This was supplemented by a stakeholder mapping to understand the diverse actors involved in implementation.

- Next, the team designed and conducted fieldwork with 29 participants who both use and do not use Delhi Metro, but live and work within 1 km (walking distance) of the station. Delhi Metro was selected due to the extent of the Metro's network and current uptake in terms of ridership. The team ensured gender and age diversity within the sample.

- Then, we consolidated and analysed the fieldwork findings to identify behavioural and structural barriers to and facilitators for metro use.

- This was followed with ideation workshops to identify interventions to improve uptake.

Section 02: Insights from Fieldwork

Whether or not an individual consumer adopts a given sustainable behaviour depends on two sets of factors: (1) Demand side factors -- The preferences, needs, and beliefs of the individual can make her/him more likely to adopt that behaviour (such factors are demand-side facilitators of sustainable behaviour), or less likely to adopt the behaviour (demand-side barriers) and (2). Supply-side factors: The availability and accessibility of infrastructure and/or services at the systemic level make an individual more likely (supply-side facilitators) or less likely (supply-side barriers) to adopt the behaviour.

Our diagnostic fieldwork revealed 16 distinct barriers and facilitators relating to the uptake of the metro system among households in the Delhi National Capital Region (NCR).

Demand-Side Barriers

1. *Poor first- and last-mile experience:* The effort perception of first/last-mile connectivity is very high. Commuters find it easier to use their private vehicle from origin to destination than engage in first- and last-mile trips to access the metro. Even when these distances are not long, commuters have unpleasant experiences: some routes are not well-lit, resulting in women commuters feeling unsafe; or paths have been encroached upon, making walking difficult.

2. *Perceived lack of safety:* We found that the perception of safety on the metro is based mainly on the experiences of others. Three of the four respondents who perceived the metro to be unsafe had stories of people they know being robbed or pickpocketed on the metro. Commuters also believe that metro security cannot ensure justice. In one case, the respondent's friend had escalated the matter and found the criminal on the CCTV footage, yet the security could not track them down and recover stolen objects. Some people do not use the metro for fear of physical safety as they believe the construction is not solid.

3. *Status bias:* Non-metro users feel their car ownership gives them higher status; they see cars as a symbol of success and the metro as mass-oriented, catering to a different, lower-income demographic. Many non-metro users assume people use the metro only for financial reasons. 43% of respondents used the metro before they purchased their own private vehicle, indicating that the metro is a stepping stone on the path to a personal vehicle. Further, many people opt for their car over the metro to 'keep up' optics with their peers and juniors who use their personal vehicles for work commutes.

4. *Deemed high-effort, time-intensive, and inflexible:* Non-metro respondents falsely perceive the metro as a longer-duration mode of transportation despite agreeing that driving in traffic can take longer. They conflate the associated

effort of taking the metro (first- and last-mile connectivity, security queues, switching stations, waiting in the train) with time to justify using a personal vehicle. People also associate the metro with reduced flexibility: of being restricted to limited routes and rigid timings.

5. *Considered uncomfortable:* Respondents who drive a personal vehicle to commute listed comfort as a reason for their choice. They think the metro is very crowded and their vehicle is a more pleasant experience. Limited seats on the metro mean standing for long durations, especially tiring after the day's work.

Supply-Side Barriers

6. *Inaccessible stations:* The study found that metro stations are not accessible to all. While DMRC is installing more lifts (*Business Standard*, 2022) and accessibility infrastructure across stations, many stations do not have elevators, limiting access for people with disabilities and the elderly. In some stations, long walking distances, especially while changing lines, deter older people. Further, there are no official metro maps that indicate which stations have elevators, limiting people's ability to plan a comfortable journey.

7. *Poor mobile network:* People prefer using their commuting time to take calls, write emails, and do work on their smartphones, which is not possible in certain stations and lines of Delhi Metro, despite the efforts of the telecom authority and DMRC to expand network connectivity and even provide free wifi (Livemint, 2021). The fear of being unable to work is a deterrent for commuters.

8. *Not designed for multiple trips:* The research revealed that the metro does not cater to the needs of women and caregivers, who often have to trip-chain, i.e. take multiple trips to varied destinations (schools, workplaces, doctors, shops, tuitions).
   a. There are no cost-saving options for making multiple trips in one day.
   b. Multi-stop trips can take more time since the first-/last-mile distance must be covered multiple times, as needed.
   c. There may not be metro access at all destinations.
   d. Not all stations have elevators, and some have long walks, which may be tiring for children/elderly who often accompany caregivers.

Demand-Side Facilitators

1. *Expensive parking rates or lack of reliable parking at destinations:* Private vehicle users often opt for public transportation, such as the metro, when visiting areas where parking is limited or when the parking fees are high, indicating a desire to avoid the inconvenience and expense of finding and paying for parking.

2. *Sense of safety for women in the ladies' compartment:* We found that women feel safer in the designated ladies' compartments of public transportation, which allows them to travel without fear of harassment or unwanted attention.

3. *Health-related concerns about air pollution:* Of the 21 non-metro respondents, 16 believe that air pollution is a pressing issue in Delhi and that vehicular pollution is explicitly a problem. Their concern for the environment can act as a motivating factor in switching to public transportation.

4. *Significant time savings:* Several respondents believe that opting to travel via the metro rail system offers a significant advantage in terms of time efficiency compared to the alternative of driving in heavy traffic.

Supply-Side Facilitators

5. *Two-wheeler users shifting to metro during winters:* In winter, as the weather (in Delhi) is freezing and using a two-wheeler is inconvenient, many individuals opt for the metro instead.

6. *Frequent and reliable trains:* Regular metro riders opine that the train services are highly reliable and adhere to predetermined schedules, which makes Delhi Metro their preferred mode of transportation.

7. *High cost of fuel:* For some people, increased fuel cost has made the metro a more appealing choice as it works out much cheaper than the average monthly fuel spending on a car.

8. *Convenience of metro stations' proximity to different places:* People consider the metro system highly advantageous when it is located close to their places of origin and destinations. This proximity is a convenience factor for commuters travelling daily on the same route or to well-known public places.

Section 03: Recommendations and Interventions

This study has uncovered key behavioural and structural barriers that restrict metro adoption in India. Utilisation of these insights is critical for policy, enabling governments to employ a powerful set of levers to spur the uptake of the metro.

To activate the behavioural bridge to policy, this study employs the 4Es Model of the UK government's Department for Environment, Food and Rural Affairs (DEFRA), which aspires to enable, encourage, exemplify, and engage in moving individuals towards sustainable practices (Institute for Government, 2015). This model offers an approach to addressing behavioural and structural gaps in policy:

1. Enable focuses on providing the necessary infrastructure to make sustainable choices accessible and attractive.
2. Encourage delves into the realm of information dissemination and public awareness to motivate individuals.
3. Exemplify emphasises the importance of leading by example.
4. Engage encourages active participation and collaboration amongst stakeholders to influence policy.

Through a series of ideation workshops, this project identified 14 interventions that address the behavioural barriers to metro use, organised below in the 4Es framework.

Enable

Policy- and decision-makers must recognise that the environments in which people live shape mobility decisions, such as using the metro. This study revealed that the physical environments in and around metro stations have led to certain barriers; to address these contextual and structural barriers the project proposes the following interventions:

1. Reduce sensory clutter and cognitive load at metro station entrances/exits: Visual clutter around station entry and exit gates, ranging from the unorganised presence of vendors to *auto-wallas* crowding the escalators, heightens the cognitive load of metro users. This adds to the high-effort perception of using the metro and can contribute to the lack of accessibility. Design elements, such as designated vending zones or queues for autos, can help improve visibility of the metro station, making it easier and safer (thereby addressing the lack of safety barrier) to find information and approach the metro, especially for differently abled persons and girls and women.

2. Improve last-mile connectivity: As cities like Delhi develop Transit-Oriented Development policies and promote non-motorised last-mile connectivity, station operators must prioritise creating safe bicycle parking and public bicycle sharing docks, and implementing organised para-transit stands (e.g. auto lines) at metro stations to address concerns about last-mile connectivity.

Encourage

Information provision, incentives, regulations, and communication campaigns are traditional policy tools to motivate action. Bringing insights from behavioural research to metro uptake can only sharpen the efficacy of these tools. The project suggests the following behaviour change campaigns:

3. Improve signage at metro exits and entrances: Many stations have poorly designed signage for the location of an entry or exit. There is also limited information at certain exit gates about nearby destinations and how to reach them. Improving and standardising signage with entry/exit gate numbers, as well as providing maps at exit gates for users to find their   destinations easily, can alleviate the high-effort perception of taking the metro. It also builds upon a key facilitator – the convenience of the metro's proximity to different places – by providing information about distances and routes to those places.

4. Design communication campaigns directly around safety: Non-metro users' perceptions of the lack of safety in the metro can be countered with stories and positive experiences of regular metro users. For example, building on facilitators like the sense of safety in the women's compartments, narratives by real women who take the metro daily can address safety concerns.

5. Create status signalling campaigns around the metro being efficient: Behaviour change communication campaigns can address barriers around uncertainty of service, high-effort perception, and longer commutes. Campaigns that highlight how extremely productive figures, e.g. CEOs or senior bankers on Wall Street, choose to take public transport to save time can help counter biases around status as well as address concerns about time/effort perceptions.

6. Reframe long-term cost savings: Similarly, campaigns can be designed to reframe the cost savings of taking the metro. This idea builds on facilitators such as significant time savings and reliability of trains to address the fact that non-metro users perceive the metro as uncomfortable after a long day. These campaigns can be linked to multiple frames and targeted for different groups:

a. Time – e.g. even if the metro is uncomfortable, one is home 30 minutes earlier every day, which frees up one additional week every year for family time.

b. Cost – e.g. one can buy aspirational goods, such as a smartphone, with money saved while using the metro.

c. Environmental benefits – e.g. by using the metro, one's actions curb air pollution and emissions.

7. Design a campaign about the reliability of the metro: Communication campaigns around consistency of service and the reliability of the metro, compared to the unpredictability of road travel (traffic, road work, etc.) can help address barriers around perceptions of the metro being high-effort and time-intensive.

8. Design an integrated, end-to-end trip planner for non-routine metro users: While many metros, including Delhi Metro, have applications to help identify the most convenient routes, location-specific and real-time information is missing. New or non-routine metro users need context-specific information to reduce the perception of uncertainty and effort of taking the metro. The project suggests providing near real-time information about train times/waits, queues, and line change times, plus dynamic information on stations and gates to improve the last-mile experience.

9. Use targeted youth campaigns to cause a mindset shift: To address the status perceptions of the metro, campaigns to trigger a normative shift in reducing the aspirational status of cars can target youth. Campaigns can be linked to the environmental harms of personal cars and the ease of metro use.

10. Design campaigns for long-distance commuters: The average trip length in Delhi Metro is 16 km (Bhatt, 2019), signifying high metro use for long-distance commuters. To discourage those who commute long distances from using a personal vehicle the whole way, campaigns can focus on the ease and convenience of the metro. They can highlight how a commuter can address first- and last-mile issues by getting a driver to drop them off and using location sharing to have the driver pick them up easily.

Exemplify

The actions of high-profile figures in society, ranging from celebrities to entrepreneurs and government officials, send implicit messages to society about desirable behaviours. To improve the status perception of the metro, the project suggests that aspirational figures lead the way:

11. Campaign with aspirational figures using the metro: Leveraging social media, campaigns can be developed where influencers and other aspirational personalities normalise metro use. This is important in countering behavioural barriers around viewing the metro as a non-aspirational mode of travel, as it reframes the way people see the system.

Engage

Promoting metro adoption requires cooperation from diverse actors, not just the government and metro operators. The following interventions are multi-stakeholder recommendations for the private sector that can incentivise metro use:

12. Employ art and design to make metro trips more engaging: While many non-metro users highlighted that the metro seems like a time-intensive mode of travel, frequent metro users said that one of their main reasons for taking it was time savings. In order to reduce the perception of long commute times by, art and design can be brought into play for interactive experiences to engage the commuters.

13. Provide workplace incentives for metro use: Engage with offices and workplaces to design incentives for metro use. This could be enabling flexible work hours so commuters can avoid peak rush in the metro or pricing disincentives for parking.

14. Offer rewards for metro use: Metro operators could collaborate with private sector and retailers to offer freebies for completing a set of metro trips. For example, if a user completes 10 trips in a week, they get a free dessert at a participating retailer.

Towards Green Urban Mobility Through Improved Metro Use

This diagnostic brief highlights the critical need for incorporating behavioural insights in transportation policy and planning for metros. Our exploration of key behavioural barriers and facilitators in metro use, based on India's largest metro network, can be leveraged across India. While some of the barriers may be context-specific, the majority are applicable in all Indian cities. At a time when many new cities are implementing metro systems, this fresh research, with its series of recommendations and interventions on improving metro ridership and adoption, points the way forward for green urban mobility.

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