Active Transport: Key to Enabling SDG-Enabled Low-Carbon Transport in India

May 2022 | Ahmedabad University, Ahmedabad

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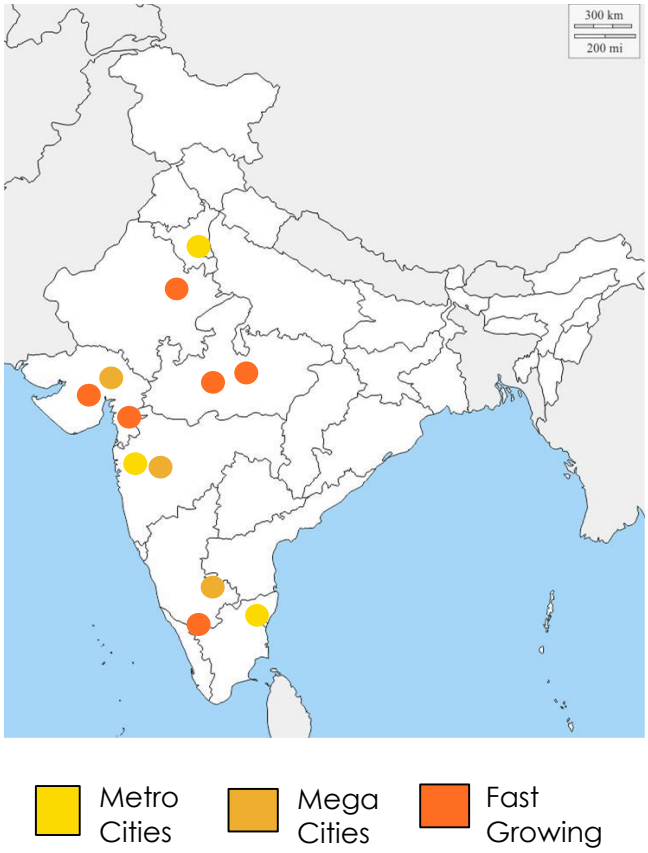
OPTIMISM Project (India)

Policy Brief 4

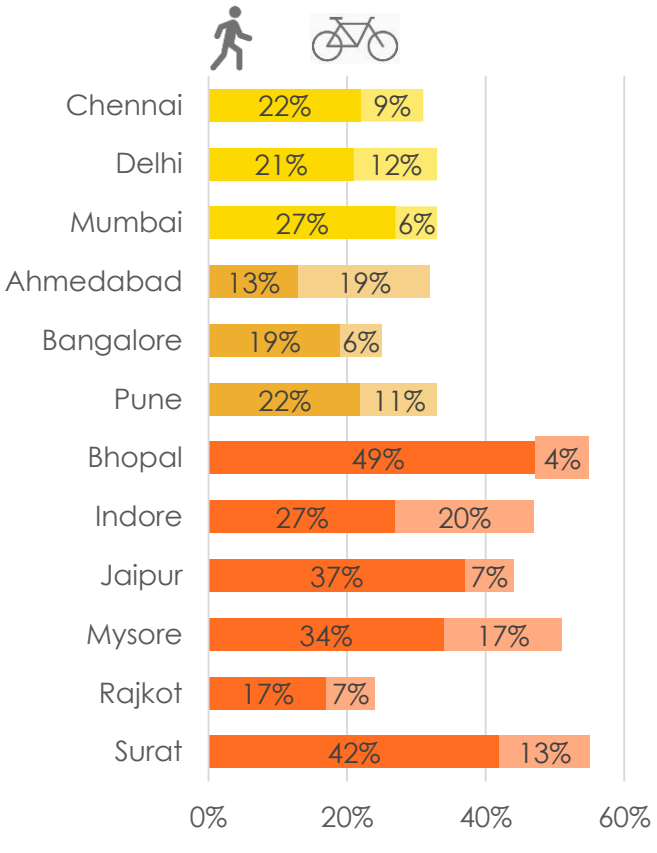
Increasing urbanization and rapid motorization lead to about 5.3 million deaths annually worldwide. With increased reliance on motorized transport, about 80% of youths experience insufficient levels of physical activity, increasing their exposure to non-communicable diseases. This urged policymakers in the Global North to prioritize non-motorized transport, resulting in the rise of the Active Transport movement. Since then, active transport is believed to play a unique role to supplement an efficient and equitable transportation system by increasing access to other modes. Active transport supports liveable communities and enhances the public realm while maintaining a neutral carbon footprint. Active transport regained popularity during the recent outbreak of the COVID-19 pandemic, as it was the only safe and reliable mode of transport amidst lockdowns. In the Global North, active transport is often perceived as a favorable first- & last-mile option, or a preferred transport choice for shorter trips. Hence, literature from these regions suggests a high synergy with sustainable mobility.

While in the Global South, active transport users are often captive users who solely rely on non-motorized transport for their work/ primary trips and walk or cycle much longer distances than their Global North counterparts. In the Global North, active transport is often perceived as a favorable first- & last-mile option, or a preferred transport choice for shorter trips. Hence, literature from these regions suggests a high synergy with sustainable mobility. While in the Global South, active transport users are often captive users who solely rely on non-motorized transport for their work/ primary trips and walk or cycle much longer distances than their Global North counterparts. They are termed captive users as they walk or cycle due to low incomes not affording them any other mobility choices and are term ‘no choice’ walkers or cyclists (Jain & Tiwari, 2013). As this study is grounded in an Indian context, it focuses on active transport as a primary mode choice for all-purpose trips as well as a first- & last-mile option for sustainable motorized modes like public transit and intermediate public transport.

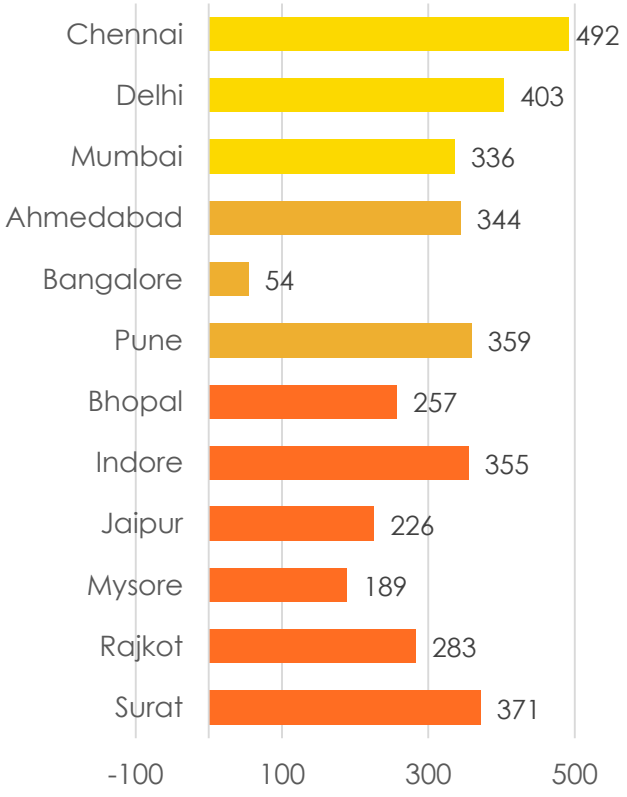
Even with inadequate infrastructure and a poor level of service, Indian cities continue with high modal shares of low-carbon transport modes like non-motorized transport and public transport (Pai, 2014). The mobility patterns discerned from the Census of India data and the growing literature on active transport in Indian cities show prevalence of non-motorized transport in urban India since the late 1960s. non-motorized transport, especially walking, continued to contribute to around half of a city's mode share across the nation (Table I). However, urban local bodies fail to invest in upgradation of pedestrian and bicycling infrastructure, resulting in a degraded quality of service that causes road safety and accessibility challenges, in turn reducing mode preference for non-motorized trips. It also leads to shift to motorized transport modes with improvement in incomes. The low-prioritization of non-motorized transport in cities, coupled with rising income levels, lead to a steep increase in vehicle ownership, and in turn, a high rate of motorization and cause local sustainability issues (Jain & Tiwari, 2013). With the rising debates around the future of mobility in Indian cities, the study aims to investigate the needs of active transport users and propose a strategy that maximizes the co-benefits of active transport, in a low-carbon mobility scenario.



Mode Share

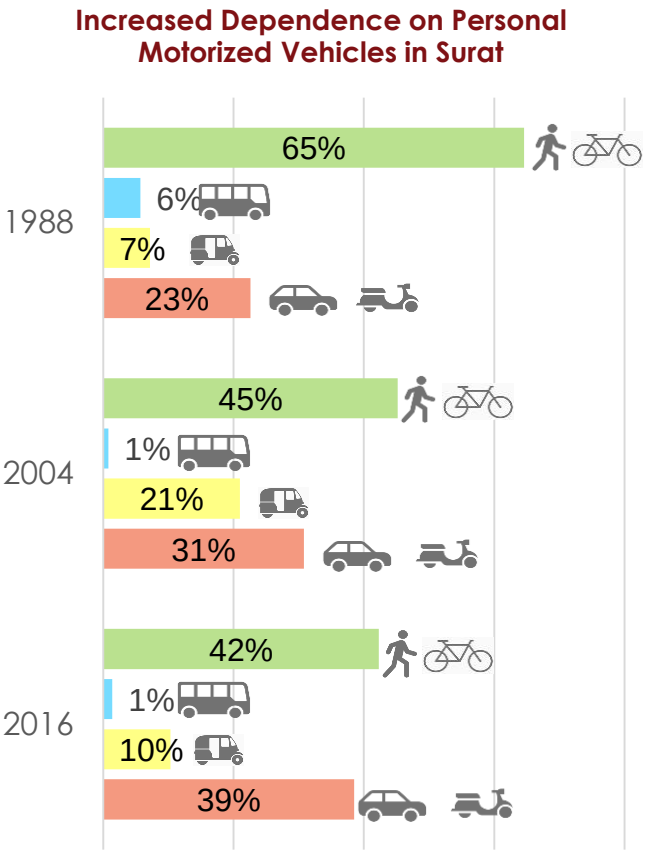


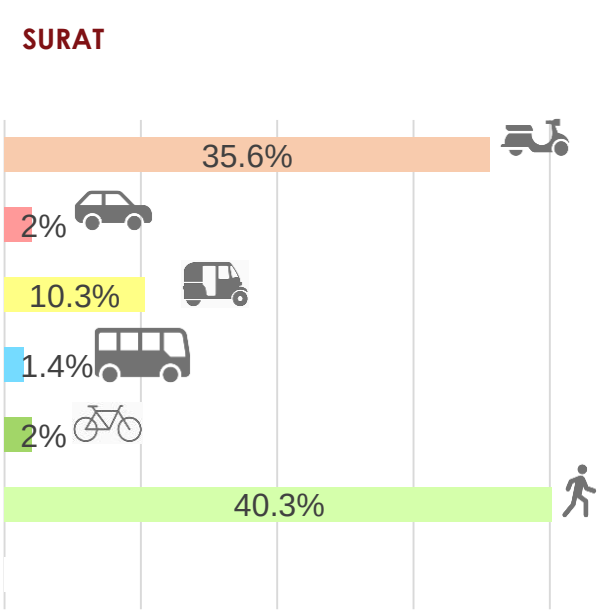
Private Vehicles per 1,000 Population



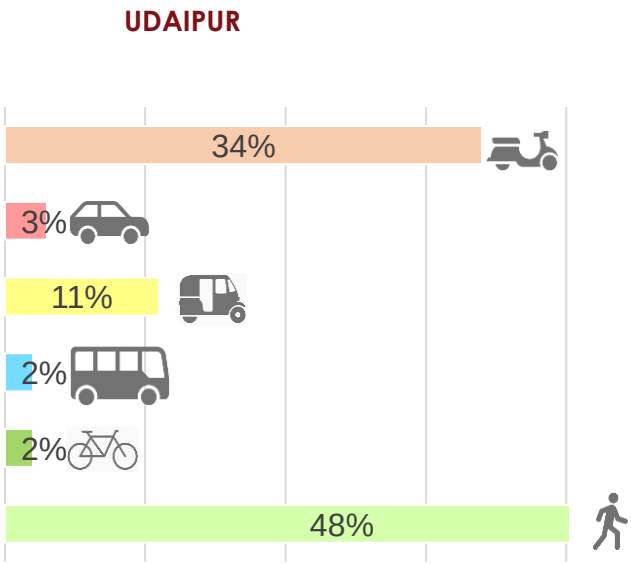
NMT user's travel experiences in Surat and Udaipur

Surat is a metropolitan city with an urban agglomeration area of about 1351 sq. km and a population of 5.9 million (2016 population). It is a polycentric city with an incomplete ring-radial road network, and a gross population density of 6,190 persons per sq. km. Textile and diamond industries form the economic base of the city. Udaipur has a population of 0.8 million (2016 population) and an urban agglomeration area of 348 sq. km. It is a small city with a preserved cultural heritage, making tourism its main industry. Udaipur traditionally a compact city with a dense, ring-radial road network, is now rapidly expanding along two highways, creating high travel demand. Both the cities serve a large floating population.50% of trips in Udaipur and 42.3% trips in Surat are by non-motorized transport (Surat CMP, 2016; Udaipur LCMP, 2013). Like other cities in India, trip choices in are gradually shifting from non-motorized modes to personal motorized modes like two-wheelers and cars, causing an inequitable distribution of road space. Since 1988, the share of NMT users in Surat decreased from 65% to 43% in 2016, out of which the share for cycling dropped by 17% (Surat CMP, 2016) (Fig. 3). Increased urbanization in both cities accompanied with higher household incomes, has led to a steep increase in motorization and 2.5 times increase in traffic levels.





High dependence on private vehicles causes the inequitable distribution of road space.



Rapid motorization causes a decline in NMT mode share

Profiling Non-motorized Transport Users in Surat and Udaipur

Non-motorized transport users in both cities travel unusually long distances, often similar to that of motorized transport users. The average trip length for walking trips is 2.9 km in Udaipur and 2.5 km in Surat, while for cycling it is 5 km in Udaipur and 4 km in Surat. The travel time for walking in both cities is close to 28 minutes (Surat CMP, 2016; Udaipur LCMP, 2013), almost 2.5 times the city and national averages, indicating non-motorized transport users experience longer travel times, subjecting them to time poverty and related health issues. Plotting NMT users by income groups highlights that the urban poor have the highest dependence on non-motorized modes for work trips. Out of the total pedestrians and cyclists, 50% in Surat and 54% in Udaipur (Fig. 4) belong to low-income groups (household income of $350/month) (Surat CMP, 2016; Udaipur LCMP, 2013). Users' mode preference showcases the captive nature of non-motorized transport users; 42% of users in Surat and 32% in Udaipur report unavailability of personal vehicles as the leading reason for choosing non-motorized transport, followed by the affordability of walk or cycle trips. Furthermore, the lack of a robust and affordable public transport network results in low bus ridership, leading to reliance on non-motorized transport, especially for vulnerable groups (Primary survey, 2020). Disaggregated data on gender and income in the city documents highlight poor women have the highest dependence on walking in both cities.

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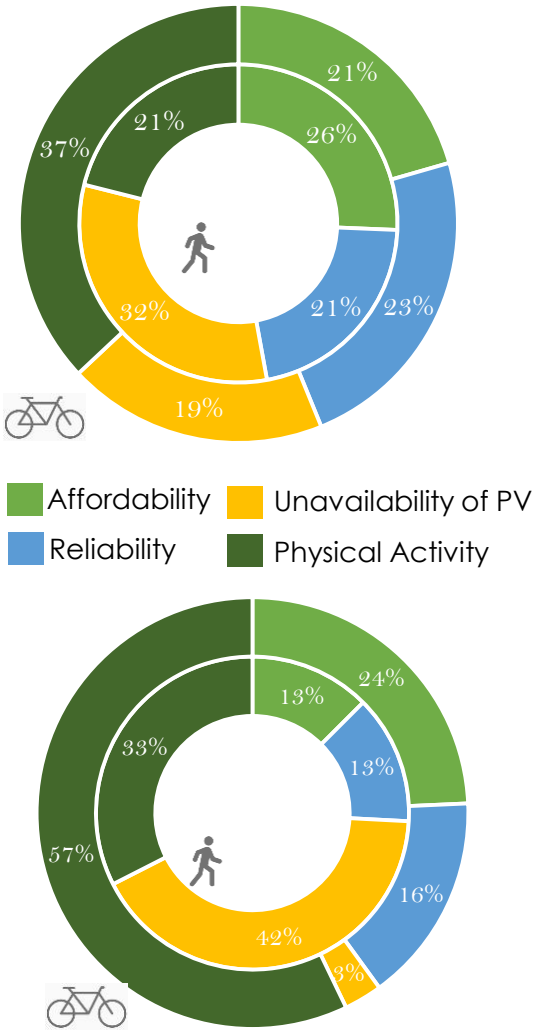
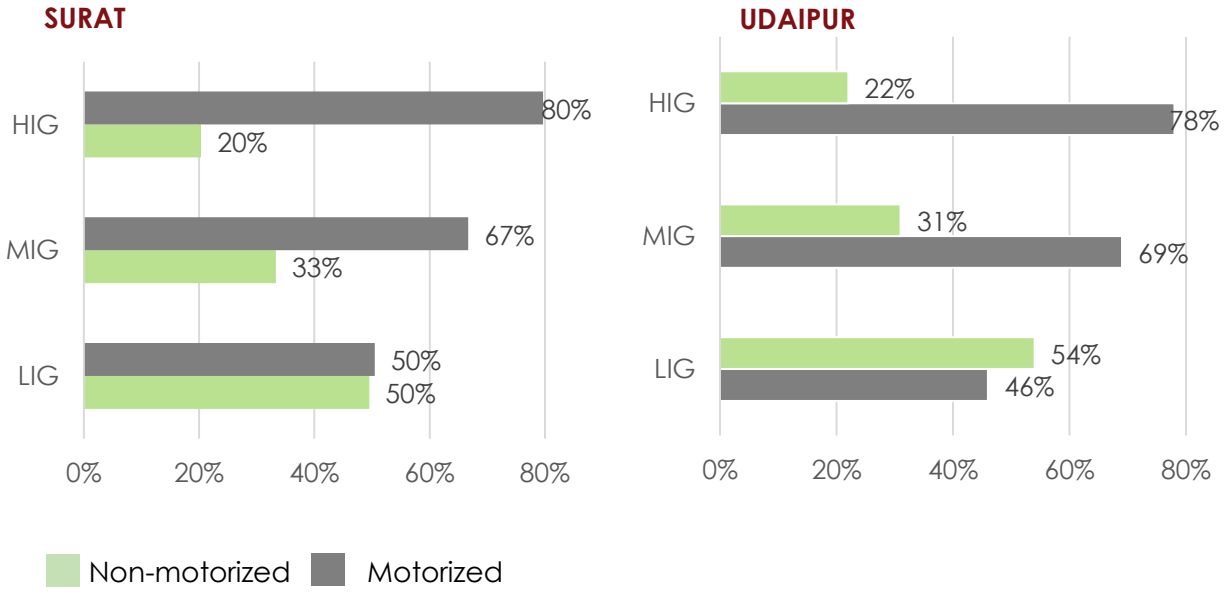
Reasons for Choosing NMT



NMT Dependence by Income Groups



Non-motorized transport infrastructure assessment

Like many Indian cities, Surat and Udaipur have poorly developed and maintained non-motorized transport infrastructure. Only 20% of Surat's roads have footpaths, and only 7.6% have cycle tracks. Out of the total 115 major junctions in Surat, only 38% have been signalised. 25% of cycle tracks are encroached by parking and only 33% of interchanges have dedicated cycle parking facilities. About 20% of the roads have no tree cover along the network. As per Ministry of Urban Development's (MoUD) Service Level Benchmarking (SLB) handbook, the overall Level of Service (LOS) for pedestrian infrastructure in Surat is 3, and for cycling infrastructure is 4 (Surat CMP, 2016). Despite pedestrian footfall in Udaipur (as high as 53,338 pedestrians/ day), non-motorized transport infrastructure including footpaths, cycle lanes/ tracks, pedestrian/ cycle crossings, street lighting is poorly designed and inadequate. Less than 1% of the roads have cycling and footpath infrastructure in the city. The LOS for non-motorized transport infrastructure in Udaipur is rated as 4.0 (Udaipur LCMP, 2013).

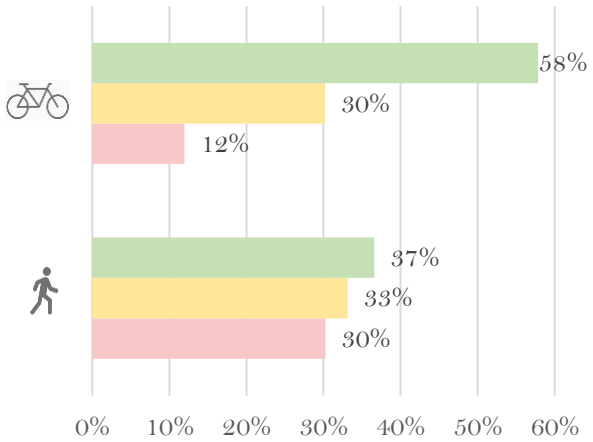
User Perception of NMT Infrastructure in Surat and Udaipur

This insufficient and ill-maintained infrastructure along with high conflict between motorized vehicles and NMT users leads to unsafe street environments (Jennings, 2016). Non-motorized transport users are often forced to walk or cycle on the carriageway sharing it with passenger and freight traffic, leading to an increased risk of fatalities and serious injuries due to road crashes. 50% of all fatalities in the city include pedestrians and cyclists (Surat CMP, 2016; Udaipur LCMP, 2013). This poorly-maintained and absent non-motorized transport infrastructure also increases women's fear of violence and curbs their mobility (Mahadevia; Lathia, 2016). Only 7.5% pedestrians and 7% cyclists in Udaipur in our survey ranked the streets as safe (Udaipur LCMP, 2013). As per the household surveys, 20% households located in 1 km of an arterial street/ highway/ freeway reported increased encountered road accidents. Further inquiry in Surat revealed that about 42% of users had been hit by a car or two-wheeler within the past three years, either on the vehicular side of the road or the footpath/ cycle lane (Primary survey, 2020).

"More than ***93% NMT*** **users** reported **feeling unsafe** while walking or cycling in the city."

Majority of pedestrians and cyclists in both cities rated the NMT infrastructure as unsatisfactory. 74% of the non-motorized transport users in Surat and 66% in Udaipur find the infrastructure discontinuous & disruptive, out of which more than 30% reported frequently broken infrastructure. Moreover, 56% users in Surat and 43% in Udaipur find footpath/ cycle track widths are insufficient and uncomfortable, needing drastic improvements. Additionally, in Udaipur 98% users mentioned that they cycle on the carriageway. 55% of the non-motorized transport users in Surat and 44% in Udaipur reported that the footpath/ cycle lanes are difficult to use during heavy monsoons and hot summer days; 41% non-motorized transport users in Surat reported heavy water logging in their areas, 18% reported compromised visibility during monsoon and 52% reported lack of shade from trees or built environments causes added discomfort during summers (Primary survey, 2020).

SURAT



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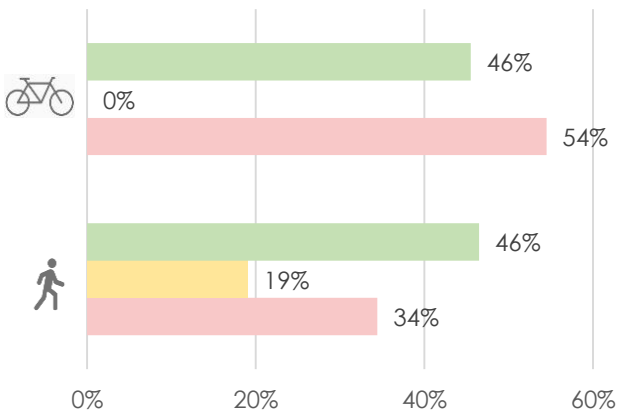

Assessing Co-benefits and Externalities of Non-Motorized Transport The existing situation poses negligible co-benefits, like higher levels of physical activity among non-motorized transport users. But studies in the Global South context show how long distances on foot and cycle, often take a toll on the non-motorized transport users health (Interface for Cycling Expertise, 2000). Increasing motorization and construction of flyovers, exposes non-motorized transport users to a disproportionate amount of negative externalities, like increased GHG emissions, air pollution, road accidents, longer travel time and other health issues.

As discussed in the mobility plans for both cities, dependency of private vehicles and reliance on fossil fuels contribute to an increase in the greenhouse gases CO2, CH4, N2O and ozone precursor gases like CO, NOx and NMVOC (UNEP, 2019). The per capita per year GHG emissions in Surat and Udaipur is 0.22 and 0.11 tonnes CO2 respectively. Around 80% of the total GHG emissions in Surat and Udaipur are attributed to personal motorized vehicles (2- & 4-wheelers). The urban passenger transport sector emits a total of 1.4 tonnes and 0.18 tonnes of PM2.5 in Surat and Udaipur respectively. Out of this, over 75% is caused by personal motorized vehicles (Surat CMP, 2016; Udaipur LCMP, 2013). Non-motorized transport users are usually the most susceptible to GHG emissions and related health concerns, causing health equity challenges in both cities.

. In Surat, 32% households reported increased exposure to air pollution and related health concerns, followed by noise pollution & longer travel times (16% households each) and higher levels of stress and anxiety (12%) (Primary survey, 2020). Indirect impacts of poor non-motorized transport manifest various economic challenges. Broken or discontinuous footpaths lead to curbed access for the poor, especially street vendors, who face difficulties reaching their place of work (ITDP, EPC, & GICEA, 2011). Also, lack of vending spaces or an indecent work environment has a negative impact on their revenues largely affecting tourism, loss of productivity and high opportunity costs.

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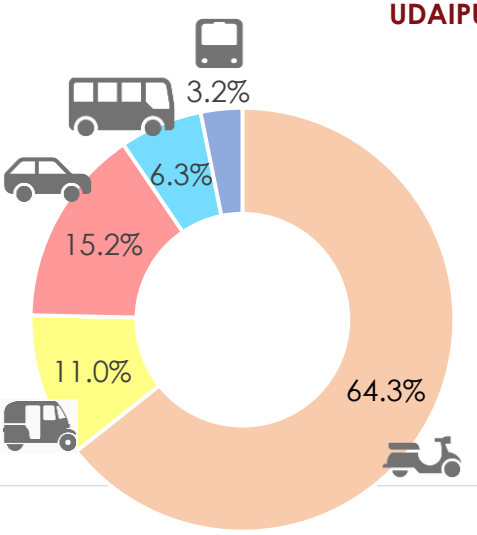

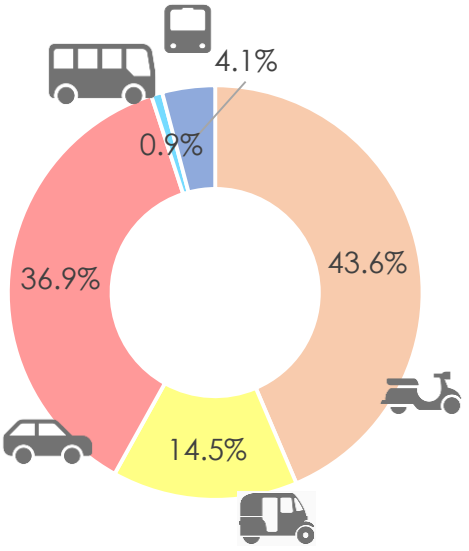

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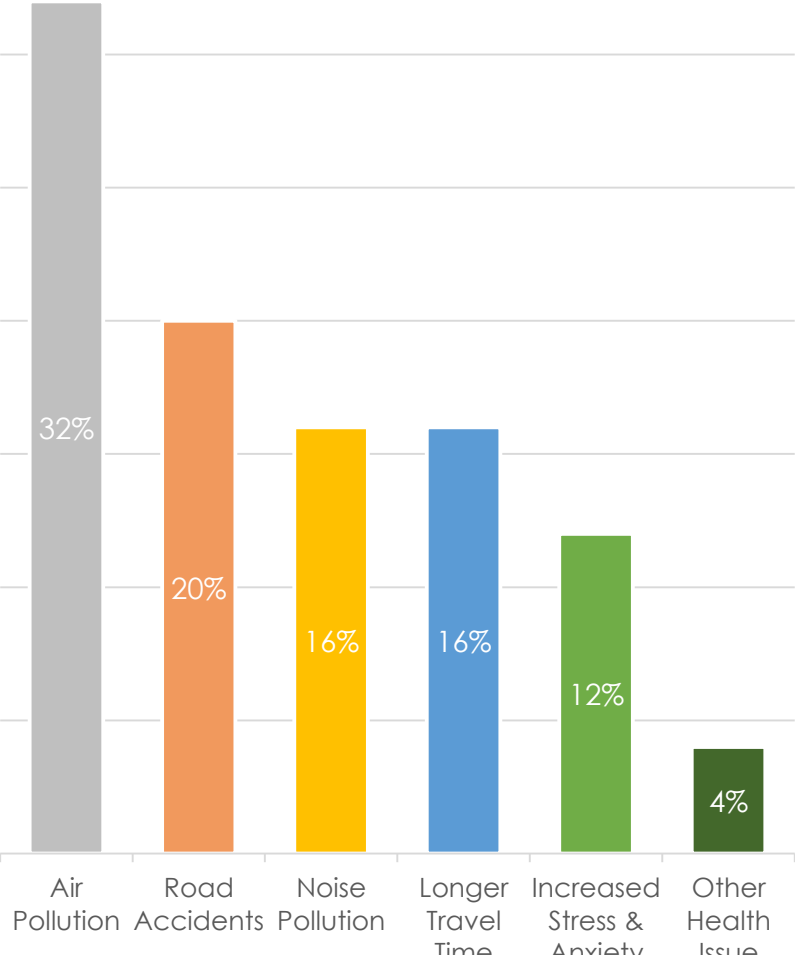
CO2 Emissions by Modes (tons/year)



Non-motorized transport proposals & relations with SDGs The Comprehensive Mobility Plan-2046 for Surat and the Low-carbon Comprehensive Mobility Plan-2041 for Udaipur propose sustainable low-carbon solutions to improve active transport and produce co-benefits with access to opportunities, safety and health in both cities. In this section these transport interventions' synergies and trade-offs with the SDGs are discussed.

LCMP Proposals (2030): In both cities, the mobility plans provide for an improved access to public transport and intermediate public transport through proposing an improved quality and coverage of non-motorized modes between high density land uses and city bus services. Along with walking and cycling being an important last mile option for long-distance trips, it aims to promote these active transport modes for shorter trips to reduce the dependence on personal motorized modes and the total vehicle kilometres travelled. Majority of the pedestrian and cycling network is planned along the transit corridors covering residential areas designed as "Complete Streets" that follow the Universal Street Design guidelines ensuring an easy, safe and inclusive access to public transit and surrounding mixed-use establishments. This safe, inclusive, and accessible infrastructure is essential along with favourable land-uses for a successful walking and cycling culture in the migrant city of Surat and the tourist city of Udaipur. In Surat, street infrastructure like street lights, zebra crossings, signalized junctions, and identification of mid-blocks (to reduce trip distance) will ensure safety of pedestrians and cyclists, especially through identifying safe movement routes that connect residential areas to work areas, schools, colleges, and transit stations.

The existing footpath network is proposed to be upgraded to a uniform width of 1.8 m. An additional 418 km of new footpaths of widths more than 1.8 m will be added, out of these 130 km of footpath is along collector and distributor roads falling within the accident-prone areas.

Similarly for bicycle infrastructure, 288 km of new bike lanes will be added (Fig. 6). The proposal aims to popularize bike-sharing schemes and includes several bike-sharing interventions with over 16,000 cycles and intelligent transport systems and additional docking points around major attractions and public transport and paratransit stands. To improve road safety and foster safe, accessible and inclusive access, especially for the transit-oriented development area, the mobility plan discusses formulation of an Accident Management Plan, Signalization Plan and establishing an Accident Monitoring Cell. The proposal also talks about integration of public transport modes with non-motorized transport modes with a 240 km long multimodal transit network with 37 planned interchange stations. Along with this, transit ready streets would have pedestrian infrastructure along bus priority lanes. This would enhance first and last mile connectivity (Surat CMP, 2016).

In Udaipur, 133 km of "obstruction-free" footpath network with a desirable width of 2m or above is proposed, along with upgrading around 10 km of existing footpaths with a minimum width of 1.5m (Fig. 7). Provision of signals for pedestrian crossings is proposed at 19 intersections to decrease crossing time and increase safety and night-time semi-mast lights installation at all junctions is proposed to improve safety. Along with this, all signalized intersections will have pedestrian crossings and all busy intersections will have handrails to ensure pedestrians can safely cross at the Zebra crossing.

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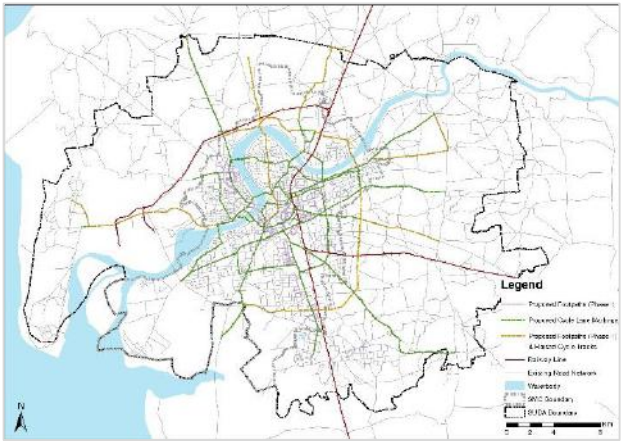

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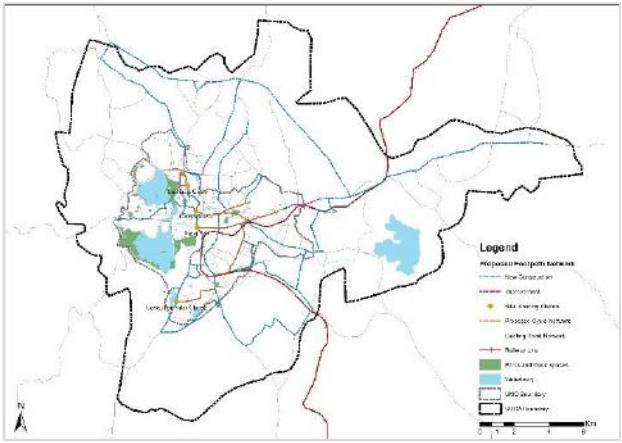

Proposed Footpath and Cycle Network in Surat and Udaipur

To promote the use of bicycles in Udaipur's slightly challenging terrain, the low-carbon mobility strategy proposes cycle tracks of around 40 km on a few major roads (Fig. 7). The proposal also aims to popularize bike-sharing schemes, especially among students and tourists by introducing bike-share docking points around major tourist attractions and other important areas. To further promote tourism through safe, accessible and inclusive non-motorized transport infrastructure, the low-carbon mobility plan proposes 3 vehicle-free heritage walk routes in and around the walled city (Udaipur LCMP, 2013).

Table II shows the comparison of existing and proposed infrastructure/ services in Surat and Udaipur. In Surat, it is observed that the NMT network coverage is improved, but not as per ideal requirements of more than 75%. The level of service is also enhanced, but not to the optimum level of 1.0. In Udaipur, both footpath and cycling infrastructure is still weak and absent at various major locations.

Assessing LCMP Proposals and SDG Interactions (2030) In both Surat and Udaipur, the proposal improves access to employment and civic opportunities for all (SDG 1, 5, 8 and 11), reduces emissions (SDG 11 and 13) and air/ noise pollution and related health hazards and increases physical activity, improving physical and mental well-being (SDG 3). Also, pedestrian and cycling infrastructure improvements particularly benefit the vulnerable groups, who are often captive users of non-motorized transport, by enabling them to safely reach other affordable, low-carbon modes like public transport (SDG 1, 5 and 11).

In Surat, comparing these non-motorized transport infrastructure improvements to a Business-as-Usual scenario, there is a 28% decrease in GHG emissions, a 37% reduction in road accidents and a 34% increase in the households that can access public transport (Surat CMP, 2016). Whereas in Udaipur, aiming to obtain more road length accessible by walking and cycling modes, the number of households residing within the 10 minutes' walk of the city bus system would increase from 16% in the Business-as-Usual scenario to 83% in the low-carbon mobility scenario. These strategies including improved lighting also propose to increase the perception of safety to use these active transport modes from 8 per cent in the Business-as-Usual scenario to 83 per cent in the low-carbon mobility scenario (Udaipur LCMP, 2013).

These proposals would improve mobility and access to opportunities for the otherwise "captive users". However, in terms of the coverage and the quality of infrastructure, both mobility plans for non-motorized transport have further scope to improve. There is a need for increased coverage of pedestrian and cycling infrastructure than the proposed levels (especially in Udaipur) ensuring an ease of access and an integrated transport system for all. The quality of infrastructure (level of service) is proposed to be 2.0. This can be improved to 1.0 (the best), highlighting a wider reach.

Existing and proposed non- motorized transport

SURAT

LOS of pedestrian:
3.0(2016)
To
2.0 (2030)

Share of congested road
14%(2016)To
14%(2030)

Signal road intersection
44(2016) to
178(2030)

Roads with street lights **50%(2016) to n/a(2030)**

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LOS of pedestrians:
3.0(2016)
To
2.0 (2030)

Share of congested road
14%(2016)To
14%(2030)

Signal road intersection
7(2016) to 26 (2030)

Roads with street lights **37%(2016) to 78.7%(2030)**

WAY FORWARD

The low-carbon mobility proposals manage to mitigate most trade-offs for both cities, as discussed in the above section. However, the fieldwork and the FGDs brought out many additional recommendations to amplify the synergies with SDG targets. 89% surveyed private vehicle users in Surat and 98% in Udaipur agreed to frequently use non-motorized transport modes if the quality of service improved (Primary survey, 2020). It is recommended that non-motorized transport infrastructure in both the cities should have a level of service of 1.0 (highest) with a network coverage of more than 75%.

To improve access to opportunities- It is recommended that there must be strict implementation to ensure no obstruction (to be continuous in front of property gates, etc.) of footpaths and cycle tracks, paving the way for better access for all. All intersections should have pedestrian crossings with lane markings, zebra crossings, pedestrian signals and raised platforms to set apart users from motorized traffic. Another key intervention highlighted in the primary survey was pedestrianizing the walled city area. A majority of pedestrians, cyclists and tourists responded positively to pedestrianizing the walled city or implementing multiple one-way streets for reduced chaos on streets. Supporting this, a majority of local shop owners and vendors believe pedestrianization would improve their businesses and boost their revenues. Hence, the old city core in both cities should be pedestrianized in a way that they are disable-friendly and age-friendly, to allow access for all, operating within a specific time window- like 8 am to 10 pm. Needless to say, there is a need for a reliable bus or paratransit service and parking spaces available outside the walled city for the pedestrianization to work effectively.

86% of Local shop owners and vendors are in favour of pedestrianization in Surat

100% of Local shop owners and vendors are in favour of pedestrianization in Udaipur

To improve safety on streets- The street design could be supplemented with tactical urbanism measures trying redesigning high-conflict intersections with refuge islands, smoother/ flattened turning curves and reduced carriageway widths, cycling lanes within mixed traffic and pedestrian and cyclist signals. This would also enable economic activities (like vending zones) along the streets improving livelihood. Adding to this, it is assessed that the proposed footpath width of 2m is insufficient for places with heavy foot traffic like tourist and commercial areas. Hence, the footpath width should be increased to 4m around commercial fronts, dense public places and tourist spots, like lake-fronts. Considering the safety aspect in both cities (especially Surat, since it has a mix of industrial and residential land use in its core city), implementing strict speed limits would reduce fatalities and other serious injuries of pedestrians and cyclists due to road crashes with private vehicles and freight movement. Raised pedestrian and cycle crossings at intersections are proposed, however the share and intensity is unclear. Hence, all intersections including motorized traffic are recommended to have a raised crossing for non-motorized transport users.

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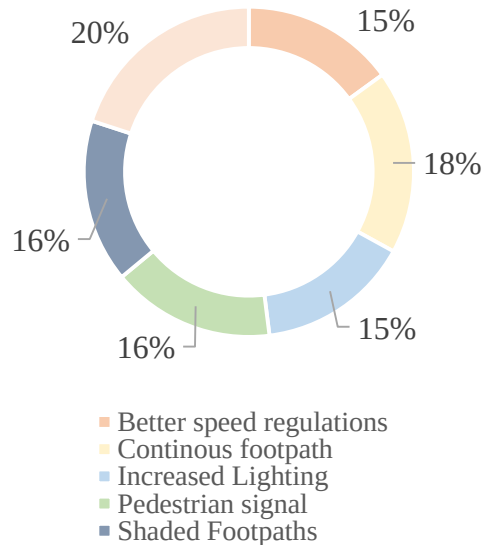

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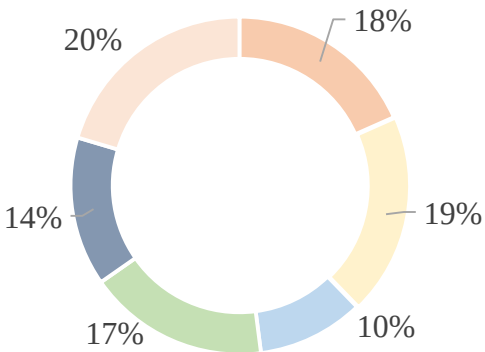

To increase health benefits- Both cities also have a potential for developing a cycle culture (considering the migrants in Surat and tourists in Udaipur), especially around E-bikes and bike-sharing infrastructure. In Udaipur, the plan fails to create a cycling network across the city. Hence, priority cycle lanes are recommended with the concept of "slow streets". It is also suggested that the government organizes awareness drives like "Cycle 4 Change", to improve accessibility of the vulnerable, specially the disabled, older adults, women and children. To reduce the urban heat island effect, strict implementation of shaded infrastructure like increased canopy cover, access during extreme weather events could be enhanced.

Considering the above assessment and recommendations, the below table shows an index assigned to each non-motorized transport-SDG interaction at the target level under each scenario (Table V). Each interaction is assessed into synergy (+1), trade-off (-1) or mixed impacts (-/+1). The table shows that the infrastructure in the existing situation show a clear trade-off with access, safety and health; the low carbon mobility scenario shows mixed impacts and the SDG enabled scenario proposed shows synergies.

Fatalities by Users

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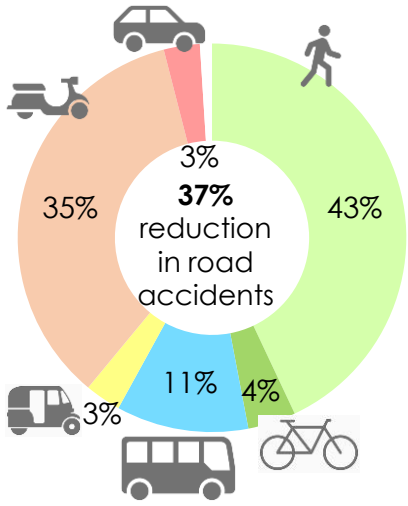

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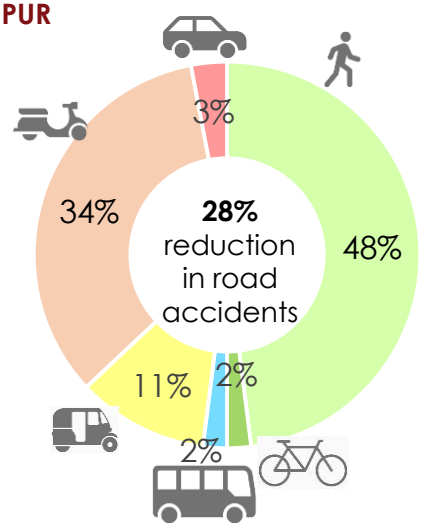

SURAT

Existing Situation				*LCMP Scenario				**SDG Enabled Scenario			
	Access	Safety	Health		Access	Safety	Health		Access	Safety	Health
NMT Network				NMT Network				NMT Network			
NMT Infrastructure				NMT Infrastructure				NMT Infrastructure			
NMT Mode Choice				NMT Mode Choice				NMT Mode Choice			

UDAIPUR

Existing Situation				*LCMP Scenario				**SDG Enabled Scenario			
	Access	Safety	Health		Access	Safety	Health		Access	Safety	Health
NMT Network				NMT Network				NMT Network			
NMT Infrastructure				NMT Infrastructure				NMT Infrastructure			
NMT Mode Choice				NMT Mode Choice				NMT Mode Choice			

Synergy Mixed Impact Trade-off

*LCMP = Low-Carbon Mobility Proposal created by Municipal Corporations

**SDG = Sustainable Development Goals

Acknowledgements:

OPTIMISM (Opportunities for Climate Mitigation and Sustainable Development) is an international multi-stakeholder partnership and research network, funded by the UK Natural Environment Research Council as part of the research council's "Towards a Sustainable Earth" program. The international team consists of four partners: (i) Imperial College London, UK, (ii) Lund University, Sweden, (iii) Waseda University, Japan, and (iv) Ahmedabad University, India.

Dr. Darshini Mahadevia (Principal Investigator- India) and Dr. Minal Pathak (Co-Principal Investigator) lead the project team placed in India, that is supported and funded by Department of Biotechnology (DBT), Government of India. They investigate low-carbon urban transport's interactions with Sustainable Development Goals (SDGs).

This document is a part of the Policy Brief series on Low-Carbon Urban Transport by the project team placed in India.

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Suggested Citation: Mahadevia, D., Lathia, S., Gounder, K. (2022). Active Transport: Key to Enabling SDG-Enabled Low-Carbon Transport in India (Policy Brief No. 4). OPTIMISM (Opportunities for Climate Mitigation and Sustainable Development) Project, Ahmedabad University.

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