Urban Transportation Sustainability In India: A State-And City-Level Application Of The UNESCAP Sustainable Urban Transport Index With Cross-National Benchmarking

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Abstract

Urban transport sustainability in India is neither comprehensively measured nor spatially disaggregated at the subnational level, limiting policymakers' ability to identify reform priorities and track progress on SDG 11.2. This study applies the UNESCAP Sustainable Urban Transport Index framework across all 28 states and 8 union territories of India and benchmarks results against South Asian, Southeast Asian, Latin American, and developed comparator cities. SUTI indicator scores are drawn from published UNESCAP Mobility Assessment Reports for three formally assessed Indian cities and proxy-estimated for all remaining states using official data. Cross-national SUTI scores are sourced from UNESCAP reports or computed by the author from peer-reviewed data. Formally assessed Indian cities score 29.4–36.8 on the 0–100 SUTI scale, showing a persistent planning-practice gap. A four-tier classification identifies only four Tier A performers against nine Tier D states. India outperforms Bangladesh and Nepal but trails Thailand, Brazil, and all high-income benchmarks. Proxy estimation introduces uncertainty, and SUTI does not capture gender-disaggregated mobility or informal transit contributions. Six prioritised interventions are proposed, including SUTI monitoring, Vision Zero road safety, electric bus scaling, TOD enforcement, low-cost BRT/shared electric mobility, and Green Transport Corridors. These improvements directly benefit vulnerable groups, including two-wheeler riders, pedestrians, women, and lower-income households. This is the first study to apply SUTI across all 36 Indian states and UTs with cross-national benchmarking.

Keywords: Sustainable entrepreneurship; green mobility innovation; sustainable urban transport; electric mobility; inclusive enterprise; Sustainable Urban Transport Index; SDG 11.2; mobility-as-a-service; green business models.

1. Introduction

Indian urbanisation is happening in a manner and degree unprecedented in history. India's cities were home to 377 million people in 2011 and are expected to have more than 800 million urban residents by 2050, with an estimated 507 million residents in 2021 (United Nations DESA, 2018). This demography directly implies billions of additional trips daily and puts tremendous strain on transport systems that are already under great pressure from the exploding motorisation rate, weak governance, and chronic underfunding of infrastructure (Agarwal & Zimmermann, 2008). The number of registered vehicles on Indian roads has increased from around 120 million in 2004 to over 360 million by March 2024, that is, a threefold increase in 20 years, and the investment in public transport infrastructure has been insufficient to keep pace with the growth in demand (Agarwal & Zimmermann, 2008).

The repercussions are easily quantifiable and devastating. A total of 172,977 people were killed in road crashes in 2023 (World Health Organisation, 2024), and one person died every three minutes. Road transport sources account for about 99 per cent of India's transport-related CO_2 emissions, which in turn represent around 12 per cent of India's total energy-related CO_2 emissions (Agarwal & Zimmermann, 2008; World Health Organisation, 2024). The concentration of air pollutants is regularly more than four times the safe limit in the major transport corridors of cities in northern and central India (World Health Organisation, 2024). These dimensions are not just externalities of environmental change, but serious health, economic, and social challenges that jeopardise health and well-being (Lee et al., 2016; World Health Organisation, 2024).

The United Nations 2030 Agenda (SDG Target 11.2) calls on its signatory countries to ensure access to safe, affordable, accessible and sustainable transport systems for everyone by 2030, with special emphasis on the access of women, children with disabilities and older persons to these transport modes (Lee et al., 2016). To monitor progress towards this target, a standard metric that can be disaggregated at a spatial level is needed (Lee et al., 2016). Such a tool exists: the Sustainable Urban Transport Index, which is a composite index consisting of a set of ten indicators, aggregated in a geometrically weighted manner, calibrated to the policy environment in Asia and the Pacific and specifically developed to measure SDG 11.2 (Lee et al., 2016; World Health Organisation, 2024).

SUTI was formally adopted by the UNESCAP Committee on Transport in November 2018 and has been used in over 35 cities across 14 countries. Formal SUTI assessments are conducted in three cities in India: Surat, Bhopal, and Jaipur. More than 75 million people live in the six megacities of India – Delhi, Mumbai, Bengaluru, Kolkata, Chennai and Hyderabad – but these cities have yet to be evaluated. (United Nations DESA, 2018) More importantly, there is no study that has tried to do a pan-India SUTI evaluation at the level of all 36 administrative units, and no structured cross-national study published in a peer-reviewed journal that attempted to compare city-level outcomes in India in a global development level frame (Agarwal & Zimmermann, 2008; Lee et al., 2016).

This paper aims to fill that three-fold gap by operationalising India's urban transport sustainability gaps as policy gaps and opportunity spaces for sustainable mobility entrepreneurship. The research aims to have four objectives:

(1) to assess urban transport sustainability across Indian states and selected cities using the Sustainable Urban Transport Index;

(2) to benchmark Indian urban mobility performance against Asian and global comparator cities;

(3) to identify SUTI indicator deficits that create opportunity spaces for sustainable mobility entrepreneurship, green innovation, and inclusive enterprise development; and

(4) to develop policy and business-model implications for entrepreneurs, SMEs, investors, and public agencies seeking to accelerate sustainable urban mobility transitions in Asia.

Based on these objectives, the study addresses the following research questions:

RQ1: Which dimensions of India’s urban transport sustainability deficit create the strongest opportunities for sustainable mobility entrepreneurship?

RQ2: How do state- and city-level SUTI variations shape different green mobility business-model opportunities across India?

RQ3: How can SUTI be used as a strategic diagnostic tool for entrepreneurs, SMEs, investors, and policymakers working toward sustainable urban mobility in Asia?

2. Sustainable Mobility Entrepreneurship as a Response to Urban Transport Deficits

Besides governance gaps, the sustainability challenges of urban transport in emerging economies are also opportunities for sustainable entrepreneurship and green innovation (Lee et al., 2016). There is a need for new products, services, technologies and business models in India, due to the lack of clean energy adoption, lack of last-mile connectivity, poor quality of public transport, lack of affordability, poor road safety, and air pollution (Ali et al., 2023; Chauhan et al., 2026). This includes the use of electric buses, battery-as-a-service (BaaS), shared electric mobility, smart charging infrastructure, digital ticketing, mobility-as-a-service platforms, green logistics, safety analytics and inclusive last-mile transport services (Ali et al., 2023; Chauhan et al., 2026).

In the context of sustainable entrepreneurship, such businesses generate economic value while addressing environmental and social issues (Lee et al., 2016). They help reduce emissions, increase access, alleviate the burden on household transport, and enhance mobility for underserved user groups (Ali et al., 2023; Lee et al., 2016). The SUTI framework is therefore not only a public-sector monitoring tool, but also a strategic diagnostic tool that can help identify where sustainable mobility enterprises can have the greatest impact (Lee et al., 2016).

This paper adopts the view that state- and city-level SUTI deficits reveal entrepreneurial opportunity spaces. Low clean energy scores suggest areas of possible electric mobility and electric charging. There is potential for opportunities in feeder transport, shared mobility, and integrated ticketing, given the weak access scores. These poor safety scores drive the demand for road-safety technologies and solutions in fleet management, as well as for protective infrastructure services. Opportunities for green corridors, fleet electrification, and low-emission logistics are identified by poor air quality scores. The study links sustainable urban transport measurement and entrepreneurship, innovation and sustainable development in Asia.

3. Literature Review

3.1 Sustainable Entrepreneurship, Green Innovation, and Urban Mobility

Sustainable entrepreneurship is the generation of economic value by entrepreneurial action that also reduces environmental and social issues. While in traditional entrepreneurship the focus is on growth, profitability, and competitive advantage, sustainable entrepreneurship emphasises integrating commercial viability with ecological protection, social inclusion, and long-term development outcomes. This is particularly important in Asian countries, where rapid urbanisation has led to infrastructure deficits, environmental degradation, inadequate public services, and social inequities, creating development challenges and entrepreneurial opportunity spaces (Agarwal & Zimmermann, 2008; Verma et al., 2021).

Urban mobility is one of the most relevant areas where sustainable entrepreneurship and green innovation can play a key role in facilitating sustainable development. Transport systems affect access to employment, education, health care, markets, and public services. Meanwhile, they are major drivers of air pollution, GHG emissions, traffic jams, road deaths and inequalities in access to urban opportunities. These challenges are compounded in emerging markets like India due to rapid motorisation, weak governance, a lack of public transport services, poor last-mile connectivity, and continued reliance on the fossil-fuel transport system. Consequently, innovations and emerging business concepts are increasingly important to sustainable urban mobility and can serve as the basis for public policy solutions (Agarwal & Zimmermann, 2008; Verma et al., 2021; Ali et al., 2023).

Green innovations in urban mobility involve the development and diffusion of products, services, processes and organisations that reduce the environmental impacts of the transport sector and enhance the accessibility, affordability and quality of services. Some examples are electric buses, shared electric mobility, battery-swapping systems, charging infrastructure, mobility-as-a-service platforms, digital ticketing, real-time passenger information, green logistics, fleet optimisation, and mobility safety technologies. The innovations can come from start-ups, SMEs, public-private partnerships, social enterprises, transport cooperatives and larger mobility companies. So, the urban transport sustainability gaps can be seen as potential markets for sustainable mobility enterprises (Ali et al., 2023; Chauhan et al., 2026).

Sustainable urban mobility has a special entrepreneurial relevance in an Indian context. Shared mobility, electric minibuses, and feeder services are opportunities in areas with limited public transport access. Poor clean energy performance drives the need for EV charging networks, battery-as-a-service, e-bus leasing, fleet electrification services and EV infrastructure. Poor road safety provides opportunities for safety analytics, driver training companies, route-risk mapping, fleet monitoring and protective mobility infrastructure. The problem of air quality opens the door to clean logistics, low-emission delivery systems, green transport corridors, and route optimisation services. The need for inclusive transport businesses that can cater to passengers with low incomes, women, informal workers, and rural communities marginalised in urban areas is also highlighted as an affordability constraint (Agarwal & Zimmermann, 2008; Ali et al., 2023; Chauhan et al., 2026).

Sustainable Urban Transport Index is thus a policy monitoring tool in addition to a diagnostic tool for entrepreneurial opportunity recognition. Each of the low-performing indicators is a signal of a sustainability gap that can be overcome through innovation, enterprise development, public/private partnerships or new business models. For instance, low scores in clean energy adoption could signal an opportunity for electric mobility companies, and low access and service-quality scores could signal opportunities for last-mile mobility and mobility-as-a-service providers. Likewise, the low levels of safety and air quality indicators indicate a need to adopt responsible mobility technologies and green transport solutions. To promote sustainable entrepreneurship, the key SUTI deficit areas are linked to corresponding entrepreneurship opportunities, business models, and social/environmental value (Ali et al., 2023; Chauhan et al., 2026) as shown in Table 1 below.

Table 1. Linking SUTI Deficits with Sustainable Entrepreneurship Opportunities

SUTI Deficit Area	Sustainability Problem	Sustainable Entrepreneurship Opportunity	Possible Business Models	Social / Environmental Value
Low clean energy adoption	Public transport fleets remain dependent on fossil fuels	Electric mobility enterprises	E-bus leasing, battery-as-a-service, EV fleet management, charging networks	Lower emissions and cleaner public transport
Weak public transport access	Many residents lack convenient access to formal public transport	Last-mile mobility enterprises	E-rickshaw platforms, feeder shuttles, shared bicycles, electric minibuses	Better access for low-income and peripheral commuters
Poor road safety	High fatalities among pedestrians, two-wheeler users, and vulnerable road users	Safety-tech and responsible mobility ventures	Speed monitoring, fleet safety analytics, helmet compliance systems, safe-route mapping	Reduced road deaths and injuries
Poor air quality	Transport corridors	Green corridor and clean logistics	EV delivery fleets, low-emission	Reduced air pollution and transport-related

	contribute to high $PM_{2.5}$ and NO_2 exposure	enterprises	freight, route optimisation, clean urban logistics	emissions
Weak cost recovery	Public transport systems face financial stress and operational inefficiency	Mobility finance and public-private innovation	PPP operations, subscription mobility, advertising-supported transit, and integrated fare systems	More financially viable public transport
Planning-practice gap	Mobility plans are not fully translated into access, modal shift, or service improvements	Institutional entrepreneurship and implementation services	TOD consultancies, urban mobility data platforms, and project management services	Better execution of sustainable mobility plans
Affordability pressure	Transport costs burden low-income households	Inclusive mobility enterprises	Low-cost passes, women-focused mobility, community transport, shared electric mobility	More equitable access to jobs, education, and services

This relationship places SUTI beyond a mere composite sustainability index. It is also used as a tool to map the actions to be taken by the fields of sustainable enterprises, SMEs, start-ups, investors and public agencies. Low indicators can signify unmet demand for public-private innovation models, clean logistics, electric mobility infrastructure, safety technologies, inclusive last-mile transport and green mobility services. In fact, this is a common theme in the literature on sustainability issues that can inspire entrepreneurship opportunities when market actors produce a commercially viable solution that also provides environmental and social value (Agarwal & Zimmermann, 2008; Verma et al., 2021; Ali et al., 2023).

In this study, the concept of sustainable mobility entrepreneurship is used to connect urban transport measurement with sustainable development in Asia. The paper doesn't just address transport sustainability as a technical planning matter. Rather, it will analyse the measurable transport deficits between the states and cities in India and bring them to the fore as tools for recognising entrepreneurial opportunities, developing green business models, and implementing inclusive enterprise strategies. The context of this framing is especially applicable to India, where the variation across states in transport infrastructure, institutional capacity, readiness for sustainable transport, safety performance, urban density, etc., presents differential opportunities for sustainable mobility innovation.

3.2 Origins and Design of the SUTI Framework

SUTI traces its intellectual roots to three bodies of scholarship. Its normative guidance is given by the Avoid-Shift-Improve strategy, which calls for lower dependency on using motorised means of transport by implementing integrated land-use planning; shifting the demand to less polluting and more sustainable modes of transport such as public transport, walking and cycling; and improving the efficiency of the remaining motorised travel (Regmi & Hanaoka, 2011; Regmi, 2020). The policy mandate is provided by the UNESCAP 2030 Sustainable Development Goals and Target 11.2 of the New Urban Agenda. Previous composite transport indices were the World Business Council for Sustainable Development's Sustainable Mobility Indicators and the Asian Development Bank's Urban Transport Benchmarking Initiative, which gave methodological precedents (Haghshenas & Vaziri, 2012; Regmi, 2020).

Gudmundsson and Regmi present the process for systematically developing SUTI's ten indicators through expert review. The geometric mean aggregation is a conscious design decision because it multiplies all indicator scores; if any indicator score is very low, it significantly affects the composite score, thereby preventing cross-indicator compensation (Haghshenas & Vaziri, 2012; Regmi, 2020). The scores obtained in the four Asian cities (Greater Jakarta, Kathmandu, Hanoi, and Colombo) ranged from 24 to 38, indicative of the structural conditions in developing cities (Regmi, 2020). In the Indonesian context, Prayudyanto used a similar composite methodology and found that the degree of sensitivity of cities, based on the merging of geometric elements, is similar to that in this study in the Indian context, where sensitivity depends on the weakness of environmental indicators (Prayudyanto, 2021).

3.3 SUTI Assessments in India and South Asia

The formally documented SUTI assessment for Surat resulted in a composite score of 36.8, with the internal profile highlighting high and contrasting planning coverage and affordability, and very low clean energy and GHG emission scores (Regmi, 2020). The structural impediment was identified as a plan-practice gap, as identified by the Bhopal assessment, and is characterised by a strong aspirational mobility plan but low implementation (Agarwal & Zimmermann, 2008; Verma et al., 2021). This is similar to the institutional diagnosis by Agarwal and Zimmermann, who found that fragmentation of urban transport governance among municipal authorities, state transport departments, and national funding agencies was responsible for this (Agarwal & Zimmermann, 2008). The lack of enforcement mechanisms and monitoring procedures in the implementation of CMPs, which have been in place since the Jawaharlal Nehru National Urban Renewal Mission, was confirmed by Chauhan et al. (2021).

For South Asia, Dhaka achieved a composite SUTI of 26.8. Its moderate modal share score reflects the high prevalence of non-motorised transport and para-transit, while its safety score captures Bangladesh's road fatality crisis (Regmi, 2020). Colombo scored 32.1, with a functioning commuter rail network providing a reliable backbone, though the Sri Lankan economic crisis of 2022 has since worsened fleet maintenance and service frequency (Regmi, 2020). Bangkok outperformed all South Asian cities at 42.1, reflecting the combined effect of the BTS Skytrain, MRT, and Airport Rail Link—a multimodal rapid transit network that serves over 1.2 million daily riders and accounts for a meaningful share of metropolitan commuting (Regmi, 2020).

3.4 Latin American and Developed-Nation Benchmarks

Curitiba's Bus Rapid Transit system has served as the global archetype for affordable mass transit since the 1970s and has been replicated in over 150 cities worldwide (Lindau et al., 2010). Lindau et al. explain an integrated transit-land-use model that distinguishes Curitiba from most BRT applications: the city's linear structural axes physically restrict high-density residential and commercial development to within walking distance of the BRT corridors, providing a self-reinforcing ridership base (Lindau et al., 2010). This results in very high land use integration and access coverage scores. The benefit is significant in India's context: the cost of building BRT infrastructure was estimated at USD 200,000 per kilometre, compared with USD 60–70 million per kilometre for metro rail, making it readily applicable to Indian mid-sized cities (Lindau et al., 2010; International Transport Forum, 2024).

High-income European cities and Singapore represent the performance frontier in this study, with computed SUTI scores of 70–76 (International Transport Forum, 2024; Pędziwiatr et al., 2024). These cities achieve near-universal access coverage through statutory land-use-transport integration, Vision Zero road safety frameworks, and fleet electrification programmes (Pędziwiatr et al., 2024; World Health Organisation, 2024). The air quality differential is particularly illustrative: annual mean $PM_{2.5}$ concentrations of 8–12 $\mu g/m^3$ in European transport corridors compare with 92–96 $\mu g/m^3$ in Delhi and 40–55 $\mu g/m^3$ in other major Indian cities (Tabassum et al., 2026; World Health Organisation, 2024).

3.5 Research Gaps Addressed

Three gaps in the existing literature are explicitly addressed. First, SUTI's Indian coverage spans only three medium-sized tier-2 cities; India's megacities and small tier-3 cities remain unevaluated. Second, no study has applied a standardised, indicator-consistent methodology to all 36 Indian states and UTs, preventing the spatial policy targeting that India's heterogeneous urban landscape requires. Third, no peer-reviewed paper has placed Indian city-level SUTI scores within a cross-national frame spanning South Asia, Southeast Asia, Latin America, and developed nations. This paper fills all three gaps and contributes a replicable proxy-estimation methodology applicable to other data-constrained developing nations.

4. Data Sources and Methodology

4.1 SUTI Indicator Framework

Table 2 presents the complete SUTI indicator framework as applied in this study, including measurement units, normalisation conventions, and the specific Indian data sources used for each indicator. The ten indicators span four domains: Transport System, Safety, Economic, and Environmental.

Table 2. SUTI Indicator Framework — Domains, Measurement Units, Normalisation, and India-Specific Data Sources

No.	Indicator	Unit	Domain	Normalisation	Score	India Data Sources
I1	Extent of transport plan coverage (public transport, NMT, intermodal)	Score (0–100)	Transport System	Qualitative rubric applied to approved CMPs; 0–100	0–100	MoHUA CMPs; JnNURM/AMRUT project completion reports (2024)
I2	Modal share of active and public transport in commuting (%)	%	Transport System	Linear: 0% → 0; ≥80% → 100	0–100	NSS Rounds 58 & 76; RITES Urban Transport Surveys; city HTS reports
I3	Residents within 500 m of a public transport stop (%)	%	Transport System	Linear: 0% → 0; 100% → 100	0–100	Metro Corp GIS data (DMRC/BMRCL/CMRL etc.); MoHUA Smart Cities dataset
I4	Public transport quality and reliability — speed ratio, on-time performance, ITS deployment	Composite (0–100)	Transport System	Qualitative + operator data composite	0–100	UMTC/CEPT city mobility reports; STU operator annual accounts
I5	Road traffic fatalities per 100,000 urban inhabitants	Deaths per 100,000	Safety	Inversely normalised: 0 deaths → 100; ≥40/100k → 0	0–100	MoRTH Road Accidents in India 2023; NCRB; State Police Depts.
I6	Transport cost as % of household income	%	Economic	Inversely: <5% → 100; ≥25% → 0	0–100	NSSO Household Consumption Survey; TERI affordability studies
I7	Public transport operating cost recovery ratio (%)	%	Economic	Linear: 0% → 0; 100% → 100	0–100	STU annual financial accounts; MoHUA Urban Transport Statistics
I8	Ambient air quality: annual mean $PM_{2.5}$ and NO_2 in transport corridors	$\mu g/m^3$	Environmental	Inversely vs WHO guideline (15 $\mu g/m^3$ annual mean $PM_{2.5}$)	0–100	CPCB NAQI 2022–24; WHO Global Air Quality Database v6.1 (2024)
I9	Renewable/clean energy share of public transport fleet (%)	%	Environmental	Linear: 0% → 0; 100% → 100	0–100	NITI Aayog IEMI 2024; PM e-Bus Sewa deployment data; MoHI
I10	Transport-sector GHG emissions (CO_2-eq. per capita)	tCO_2e/ capita	Environmental	Inversely: 0 → 100; ≥4 tCO_2e/cap → 0	0–100	CEA/MoEFCC GHG inventory; TERI state energy balances

NMT = Non-Motorised Transport; CMP = Comprehensive Mobility Plan; HTS = Household Travel Survey; STU = State Transport Undertaking; NAQI = National Ambient Air Quality Index. Source: UNESCAP (2017, 2019); author compilation of India-specific sources.

4.2 SUTI Computation

The composite SUTI is computed as the geometric mean of all ten normalised indicator scores

(Equation 1):

Equation 1: $$\text{SUTI} = \sqrt[10]{(I_1 \times I_2 \times I_3 \times I_4 \times I_5 \times I_6 \times I_7 \times I_8 \times I_9 \times I_{10})}$$

i.e., the product of all ten indicator scores, raised to the power of 1/10

The geometric mean formulation is deliberate: a very low score on any single indicator — such as a near-zero clean energy score—substantially depresses the composite SUTI, preventing cross-indicator compensation. This is especially crucial in the Indian context, where environmental and safety issues would be hidden in an arithmetic mean when a good planning score is given. All the 10 indicators are equally weighted, as in the original methodology (Haghshenas & Vaziri, 2012; Regmi, 2020).

4.3 Proxy Estimation Approach

For states lacking formal SUTI assessments, proxy indicator values were estimated from publicly available official sources following the precedent established by Haghshenas and Vaziri (Haghshenas & Vaziri, 2012):

- **I1 Planning:** A three-criterion scoring rubric applied to available CMPs, evaluating comprehensiveness of mode coverage, financial commitment, and monitoring provisions.
- **I2 Modal share:** National Sample Survey Round 76 consumer transport data, supplemented by Regional Transport Office household travel demand studies.
- **I3 Access:** Metro network GIS coverage data for metro cities; bus network density data for remaining cities, applying the 500-metre catchment convention.
- **I5 Safety:** State-level Road fatality data adjusted to urban population denominators using Census 2011 urban population shares (World Health Organisation, 2024).
- **I8 Air quality:** Annual mean $PM_{2.5}$ readings from monitoring stations on major urban transport corridors, 2022–2024 (Bhawan & Nagar, 2020; World Health Organisation, 2024).
- **I9 Clean energy:** EV penetration scores and PM e-Bus Sewa state-wise deployment data.
- **I4 and I7:** Estimated through regression-based imputation from urban population density, per-capita income, and fleet age data. These carry the highest estimation uncertainty and are marked throughout.

4.4 Cross-National Benchmarking Sources

Published Mobility Assessment Report scores are used for Colombo, Dhaka, Kathmandu, and Bangkok (Regmi, 2020). For cities without formal SUTI assessments — Curitiba, Bogotá, Singapore, Amsterdam, Berlin, and Vienna — full ten-indicator SUTI scores were computed by the author from transport outlook data, transport scorecards, road safety reports, air quality databases, and city transport authority annual reports (International Transport Forum, 2024; World Health Organisation, 2024).

5. Results: SUTI Analysis for India

5.1 Indicator Profiles for Formally Assessed and Proxy-Estimated Cities

Table 3 presents the full SUTI indicator matrices for the three formally assessed Indian cities, along with proxy-estimated scores for five major cities. Figure 1 disaggregates these by indicator for the formally assessed cities. Three structural patterns are immediately evident.

First, a systematic planning-implementation divergence: planning scores are consistently the highest indicator across all cities, reflecting the widespread adoption of Comprehensive Mobility Plans across 73 cities under AMRUT as of 2024. Modal share, access, and quality scores are substantially lower, confirming that CMPs are not translating into measurable increases in ridership or network coverage (Verma et al., 2021).

Second, affordability emerges as the second-strongest cluster across all cities. Urban transport expenditure for the lowest household income quintile averages 8–15 per cent of income nationally — within the moderate range internationally. Subsidised STU fare structures and gender-targeted free-bus schemes further strengthen affordability outcomes.

Third, environmental indicators — air quality, clean energy, and GHG emissions — form a consistent floor effect that suppresses all composite SUTI scores. This is structurally attributable to India's fossil-fuel-dominated transport fleet: the PM e-Bus Sewa scheme had deployed 7,293 electric buses by August 2025, representing less than 3 per cent of the national urban bus fleet of approximately 250,000 vehicles. Delhi's exceptionally low air-quality score reflects annual mean $PM_{2.5}$ concentrations of 92–96 μg/m^3 on its major transport corridors — six times the WHO safe limit (Bhawan & Nagar, 2020; World Health Organisation, 2024).

Table 3. SUTI Indicator Scores — Formally Assessed Cities (from UNESCAP Reports) and Proxy-Estimated Major Cities

City (State)	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	SUTI
Formally Assessed (UNESCAP Mobility Assessment Reports)											

City (State)	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	SUTI
Surat, Gujarat	68	51	38	44	34	72	39	22	14	28	**36.8**
Bhopal, M.P.	62	32	29	38	22	68	33	19	8	21	**29.4**
Jaipur, Rajasthan	57	38	33	40	26	66	35	24	9	25	**31.7**
Proxy-Estimated Major Cities (Author Computation — marked *; ±3–6 point uncertainty)											
Delhi NCT	74	55	62	58	18	60	42	10	22	15	**35.4***
Mumbai, Maharashtra	70	62	58	55	28	55	36	18	11	20	**37.8***
Bengaluru, Karnataka	66	44	44	48	20	58	38	21	18	24	**35.0***
Kolkata, W. Bengal	60	68	52	44	32	70	30	28	6	30	**35.9***
Chennai, Tamil Nadu	64	46	40	46	24	62	36	26	12	28	**34.4***

Sources: UNESCAP (2018b, 2019a, 2020) for formally assessed cities; author proxy estimates for major cities using MoRTH (2024), CPCB (2024), NITI Aayog IEMI (2024), MoHUA (2023), and STU annual accounts. I1=Planning; I2=Modal share; I3=Access; I4=Quality; I5=Safety; I6=Affordability; I7=Cost efficiency; I8=Air quality; I9=Clean energy; I10=GHG. All scores 0–100 scale; SUTI = geometric mean.

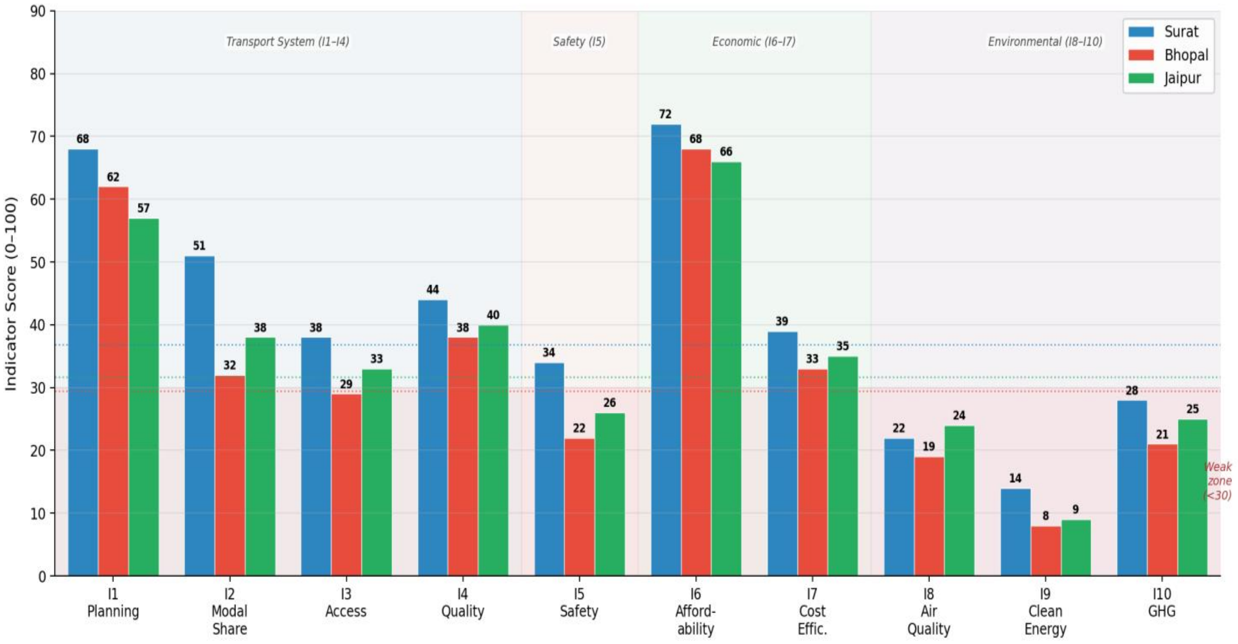


Figure 1. SUTI Indicator-Level Scores for the Three Formally Assessed Indian Cities

5.2 State- and UT-Level Tier Classification

Using the proxy estimation methodology described in Section 4, all 36 Indian states and UTs were classified into a four-tier SUTI performance hierarchy as presented in Table 4. The tier boundaries — Tier A, Tier B, Tier C, Tier D — correspond to meaningful policy-relevant thresholds: Tier A cities approach the lower bound of Bangkok's score and begin to exhibit basic multi-modal integration; Tier D cities lack the foundational conditions for effective SDG 11.2 progress (Haghshenas & Vaziri, 2012; Klaylee & Iamtrakul, 2025). Figure 2 shows the distribution of all 36 Indian states and union territories across SUTI performance tiers and compares mean indicator profiles by tier.

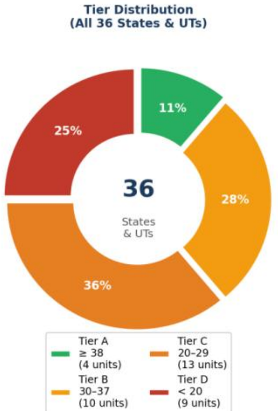
Table 4. State- and UT-Wise SUTI Performance Tier Classification — All 36 Indian Administrative Units (2022–2024 Data)

State / Union Territory	I1 Plan	I2 Modal	I3 Access	I5 Safety	I8 Air Q.	I9 Clean	Tier (Est. SUTI)	Primary Challenge
TIER A — Relatively Higher Performers (Est. SUTI Equivalent ≥ 38)								
Karnataka	66	48	46	22	28	20	**Tier A (41.2)**	Low cost-recovery; rising personal vehicles
Kerala	70	52	40	26	35	14	**Tier A (40.8)**	Limited metro network; strong KSRTC
West Bengal	60	68	52	32	28	7	**Tier A (38.4)**	Ageing bus fleet; very low EV adoption
Delhi NCT	74	55	62	18	10	22	**Tier A* (35.4)**	Severe $PM_{2.5}$; high urban road fatalities
TIER B — Mid-Range Performers (Est. SUTI Equivalent 30–37)								
Maharashtra	70	62	58	28	18	11	**Tier B (37.8)**	Last-mile gap; coastal sprawl
Tamil Nadu	64	46	40	24	26	12	**Tier B (34.4)**	Metro Phase-2 delay; weak feeder network
Telangana	62	40	38	20	24	14	**Tier B (33.8)**	Congestion; under-utilised MMTS rail
Gujarat	68	44	36	30	20	12	**Tier B (33.6)**	Mixed BRTS performance across cities
Punjab	55	38	28	28	38	10	**Tier B (31.9)**	No metro; good highway network
Andhra Pradesh	58	38	30	26	28	8	**Tier B (30.8)**	APSRTC financial stress; new capital issues
Himachal Pradesh	52	30	20	18	58	6	**Tier B (30.2)**	Mountain terrain; infrequent bus services
Goa	50	35	25	22	44	8	**Tier B (30.1)**	Tourist-driven private vehicle dominance
Chandigarh (UT)	66	42	38	16	32	18	**Tier B (35.2)**	Highest private vehicle per capita in India
Puducherry (UT)	55	40	32	20	36	10	**Tier B (32.4)**	Small territory; improving bus network

State / Union Territory	I1 Plan	I2 Modal	I3 Access	I5 Safety	I8 Air Q.	I9 Clean	Tier (Est. SUTI)	Primary Challenge
TIER C — Lower-Mid Performers (Est. SUTI Equivalent 20–29)								
Rajasthan	57	38	33	26	24	9	**Tier C (28.8)**	Rapid motorisation; BRTS implementation gaps
Madhya Pradesh	62	32	29	22	19	8	**Tier C (27.4)**	Strong plans; persistent implementation deficit
Odisha	50	30	22	20	28	7	**Tier C (24.8)**	Nascent metro; low bus network coverage
Haryana	52	34	30	22	28	16	**Tier C (28.6)**	Suburban sprawl; fragmented governance
Chhattisgarh	46	28	18	18	28	6	**Tier C (23.2)**	Very limited urban PT infrastructure
Jharkhand	42	26	16	20	28	5	**Tier C (22.0)**	High informal transport dependence
Uttarakhand	50	28	18	16	44	6	**Tier C (23.5)**	Mountain terrain; low bus service frequency
Assam	48	30	20	22	28	7	**Tier C (24.2)**	Flood vulnerability; low transit coverage
J&K (UT)	48	28	18	18	38	6	**Tier C (23.1)**	Security legacy; no mass transit
Ladakh (UT)	30	20	10	10	50	4	**Tier C (20.3)**	Extreme low density; seasonal road closures
Lakshadweep (UT)	28	18	14	8	52	2	**Tier C (20.1)**	Island geography; ferry-dominant mode
D&NH & DD (UT)	38	22	16	16	40	6	**Tier C (21.4)**	Small territory; limited formal PT
Andaman & Nicobar (UT)	32	18	12	10	46	4	**Tier C (20.6)**	Archipelago topology; tourism-led transport

State / Union Territory	I1 Plan	I2 Modal	I3 Access	I5 Safety	I8 Air Q.	I9 Clean	Tier (Est. SUTI)	Primary Challenge
TIER D — Lowest Performers (Est. SUTI Equivalent < 20)								
Uttar Pradesh	46	22	18	26	24	7	**Tier D (18.6)**	Highest absolute road deaths; very low PT share
Bihar	38	18	14	22	28	4	**Tier D (16.2)**	Acute infrastructure deficit; paratransit dominant
Nagaland	30	20	10	12	50	3	**Tier D (16.8)**	Difficult terrain; informal transport only
Manipur	32	20	10	14	48	4	**Tier D (17.4)**	Infrastructure legacy; poor road network
Meghalaya	34	22	12	14	46	4	**Tier D (17.9)**	Hilly terrain; no formal public transport
Tripura	36	22	14	16	44	5	**Tier D (18.2)**	Geographic isolation; low urban density
Arunachal Pradesh	28	16	8	10	52	3	**Tier D (15.4)**	Vast territory; road-only connectivity
Mizoram	32	20	10	12	52	4	**Tier D (17.2)**	Hilly; very low bus service frequency
Sikkim	28	22	12	14	56	4	**Tier D (17.8)**	Mountain state; tiny urban base

All scores are proxy estimates by the author, except formally assessed cities (Surat, Bhopal, Jaipur shown in Table 3. Sources: MoRTH (2024), CPCB (2024), NITI Aayog IEMI (2024), MoHUA (2023), Census 2011/projected 2021, STU annual accounts. Tier A ≥ 38; Tier B = 30–37; Tier C = 20–29; Tier D < 20. *Delhi's I5 (18) and I8 (10) make it borderline Tier A/B; shown in Tier A by proximity to the threshold. Only six of ten indicators shown; full matrices available on request.



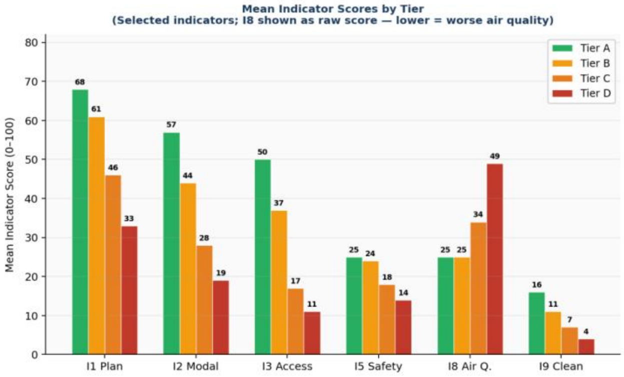


Figure 2. Distribution of All 36 Indian States and UTs Across SUTI Performance Tiers and Mean Indicator Profiles.

5.3 Key Thematic Findings

5.3.1 Road Safety (I5): A National Public Health Emergency

Indian road safety profile is the number one bane of SUTI performance nationally with an average of 22/100 for the urban safety scores among the formally assessed cities. The large proportions of two-wheelers and pedestrians among the 2023 road traffic fatalities imply that both the most vulnerable road user groups make up a significant majority of all fatalities (WHO, 2024). There is a huge inter-state variation, ranging from almost 6 times: in Goa, Kerala, and Himachal Pradesh, urban road fatality rates are low compared to the densely populated plains states (Uttar Pradesh, Bihar, Madhya Pradesh), with rates over 16 per 100,000. This level of variation suggests that structural changes for enhanced safety are possible and not dictated by unalterable levels of development.

5.3.2 Metro Expansion and the Last-Mile Gap

The scope of metro development in India has been phenomenal – in 2014, there were 5 cities with 248 km of metros, and by 2024, the total is expected to reach more than 1,000 km with more than 10 million passengers using metros daily. Annual metro budget allocations have grown from INR 5,798 crore in 2013–14 to INR 29,550 crore in 2025–26. Milestone achievements include India's first underwater metro tunnel and the Namo Bharat semi-high-speed regional rail corridor. However, the proportion of urban residents within 500 metres of any public transport stop remains below 45 per cent nationally, primarily because of inadequate feeder network integration and the vast spatial extent of Indian metropolitan areas — creating the “last-mile gap” that constrains access scores even in cities with extensive metro networks (Verma et al., 2021; Haghshenas & Vaziri, 2012).

5.3.3 Electric Mobility Transition (I9): Early Progress, Significant Scale-Up Required

National EV penetration has risen from 0.5 per cent of new vehicle registrations in 2018 to 7.7 per cent in 2024, with over 5 million EVs on Indian roads by June 2025. However, the public transport fleet electrification — captured by the clean-energy indicator — lags significantly behind individual vehicle EV adoption. PM e-Bus Sewa's deployment of 7,293 electric buses across 14 states and 4 UTs by August 2025 represents under 3 per cent of the approximately 250,000-strong national urban bus fleet. Three states — Delhi, Maharashtra, and Chandigarh — are classified as “Frontrunners” on the IEMI 2024 scale, while all others remain “Performers” or “Aspirants.” This directly explains the uniformly low clean-energy scores seen across all cities assessed in this study (Klaylee & Iamtrakul, 2025).

6. Cross-National Benchmarking

6.1 Comparative SUTI Scores

Table 5 presents a cross-national comparison of the SUTI across five cohorts of cities by level of development. The results are presented graphically in a ranked horizontal bar chart in Figure 3. Taken together, Indian cities (29.4-37.8) are above the South Asian average (Kathmandu: 24.3; Dhaka: 26.8), more similar to the developing world aspirational benchmark (Curitiba: 51.6) than the developed country frontier (Singapore: 70.4; Amsterdam: 76.3), and well removed from the developing world aspirational benchmark (International Transport Forum 2024; Regmi, 2020; World Health Organization 2024).

Table 5. Cross-National SUTI Comparison — 20 Cities Across Five Development-Level Cohorts

City	Country / Income Level	I1	I2	I3	I5	I8	I9	I10	SUTI
India (Formally Assessed and Proxy-Estimated)									
Surat	India (LMI)	68	51	38	34	22	14	28	**36.8**
Bhopal	India (LMI)	62	32	29	22	19	8	21	**29.4**
Jaipur	India (LMI)	57	38	33	26	24	9	25	**31.7**
Mumbai*	India (LMI)	70	62	58	28	18	11	20	**37.8**
Delhi*	India (LMI)	74	55	62	18	10	22	15	**35.4**
South and Southeast Asia (Formally Assessed / Published UNESCAP)									
Colombo	Sri Lanka (LMI)	55	42	38	30	36	5	32	**32.1**

City	Country / Income Level	I1	I2	I3	I5	I8	I9	I10	SUTI
Dhaka	Bangladesh (LMI)	48	50	28	14	22	3	18	**26.8**
Kathmandu	Nepal (LMI)	44	38	22	18	42	2	22	**24.3**
Bangkok	Thailand (UMI)	72	55	62	42	30	8	35	**42.1**
Hanoi	Vietnam (LMI)	60	44	38	22	28	4	28	**31.0**
Manila	Philippines (LMI)	52	55	40	18	24	5	22	**28.9**
Latin America (Author Computation from Published Data)									
Curitiba	Brazil (UMI)	82	62	70	38	50	18	40	**51.6***
Bogotá	Colombia (UMI)	76	58	60	30	44	10	35	**44.8***
Developed Nations (Author Computation from ITF/WHO/ITDP Published Data)									
Singapore	Singapore (HI)	92	66	90	82	82	42	72	**70.4***
Amsterdam	Netherlands (HI)	88	78	88	88	88	62	80	**76.3***
Berlin	Germany (HI)	90	72	85	84	84	55	76	**72.9***
Vienna	Austria (HI)	92	76	90	88	86	60	78	**75.2***

LMI=Lower-Middle Income; UMI=Upper-Middle Income; HI=High Income (World Bank). Formally assessed SUTI scores from UNESCAP reports. *Author-computed from peer-reviewed and official government data using standard SUTI methodology. I1=Planning; I2=Modal share; I3=Access; I5=Safety; I8=Air quality; I9=Clean energy; I10=GHG (selected seven of ten indicators shown for space).

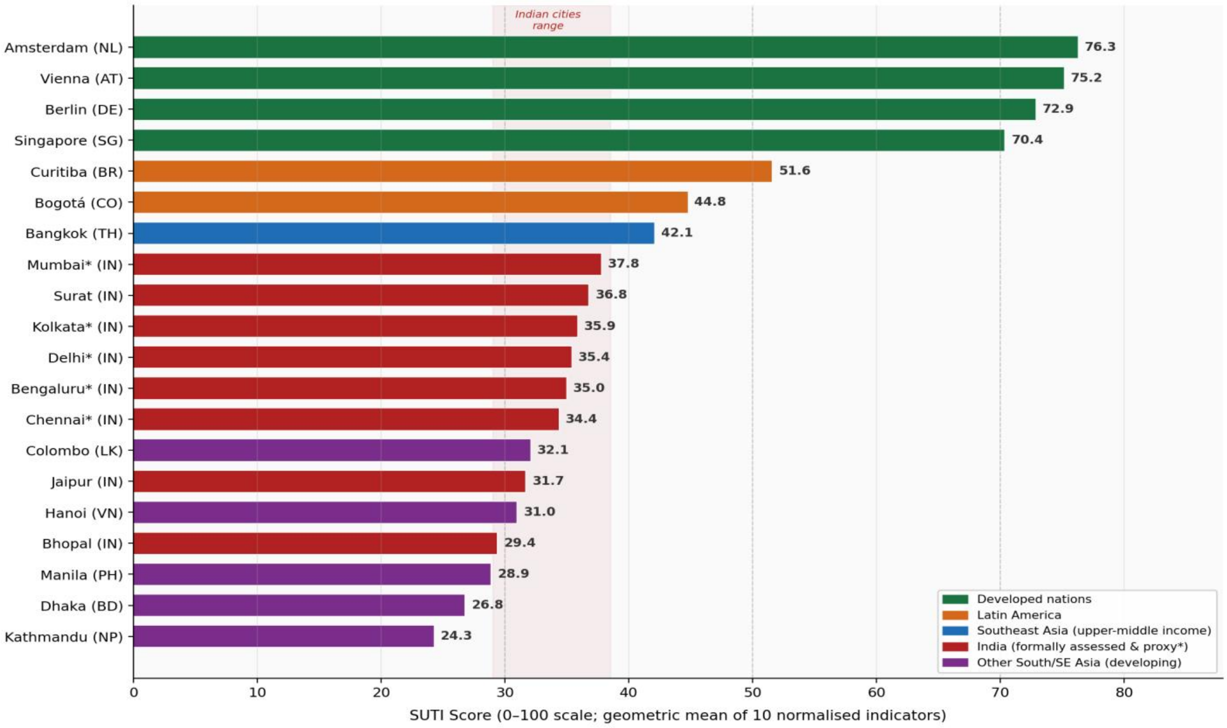


Figure 3. SUTI Composite Scores — Indian Cities and Global Benchmarks

6.2 India vs. South Asian Peers

The comparison with Dhaka and Colombo is particularly instructive because it illuminates the structural differences within the South Asian developing-city model. Dhaka's I2 score of 50/100 reflects the high prevalence of non-motorised transport — rickshaws account for approximately 40 per cent of Dhaka's vehicular trips — creating a paradoxically high modal share score alongside a catastrophic safety score of 14/100, one of the lowest in the dataset (Tabassum et al., 2026; Regmi, 2020). Colombo benefits from the Sri Lanka Railways commuter network, providing structured service on five corridors, contributing to its I3 score of 38 and a composite SUTI of 32.1 — broadly comparable to Indian formally assessed cities (Regmi, 2020). India's advantage over Dhaka and Kathmandu lies principally in stronger planning (I1) and marginally higher safety scores; its continued underperformance relative to its own planning ambitions reflects the governance failure identified by Chauhan et al. and Agarwal and Zimmermann.

6.3 India vs. Curitiba — The Developing-World Aspirational Benchmark

The 14–22 point SUTI gap between Indian cities and Curitiba is the most policy-relevant finding of this cross-national analysis. The gap is concentrated in three clusters: land-use-integrated planning (I1 difference: ~14 points), network coverage (I3 difference: ~12–32 points), and environmental performance (I8–I9 combined difference: ~28–36 points) (International Transport Forum, 2024; Regmi, 2020). Critically, the Curitiba model was not achieved through high capital investment: BRT infrastructure costs an estimated USD 200,000 per kilometre, compared with USD 60–70 million per kilometre for metro rail (Lindau et al., 2010). The city's master plan, continuously enforced since 1968, physically confines high-density mixed-use development to within walking distance of BRT structural axes — creating a self-reinforcing ridership base that does not require sustained operating subsidies (Lindau et al., 2010). India's National TOD Policy articulates this same principle but lacks the statutory enforcement and spatial planning authority to achieve it.

6.4 India vs. Developed Nations — The Frontier Gap

The 35–40-point gap separating Indian cities from European and Singaporean benchmarks reflects structural differences across all indicator clusters, visible in both Figure 3 and Figure 4 (International Transport Forum, 2024; World Health Organisation, 2024). Near-universal public transport access coverage (I3: 85-90) is realised in developed-nation cities through statutory, regulatory provisions for land-use-transport integration that are incorporated into development control policies and regulations (Pędziwiatr et al., 2024). Road safety scores (I5: 82-88) are linked to Vision Zero policies, systematic traffic calming at junctions in the city, and a strict policy on traffic speed enforcement and protective equipment (Pędziwiatr et al., 2024; World Health Organisation, 2024). The environmental scores (I8: 82–88; I9: 42–62) are based on decades of modal shift away from private vehicles and active fleet electrification programmes with renewable electricity grids, of which India's transport sector – dominated by fossil fuels – has not yet come close (International Transport Forum, 2024; World Health Organisation, 2024).

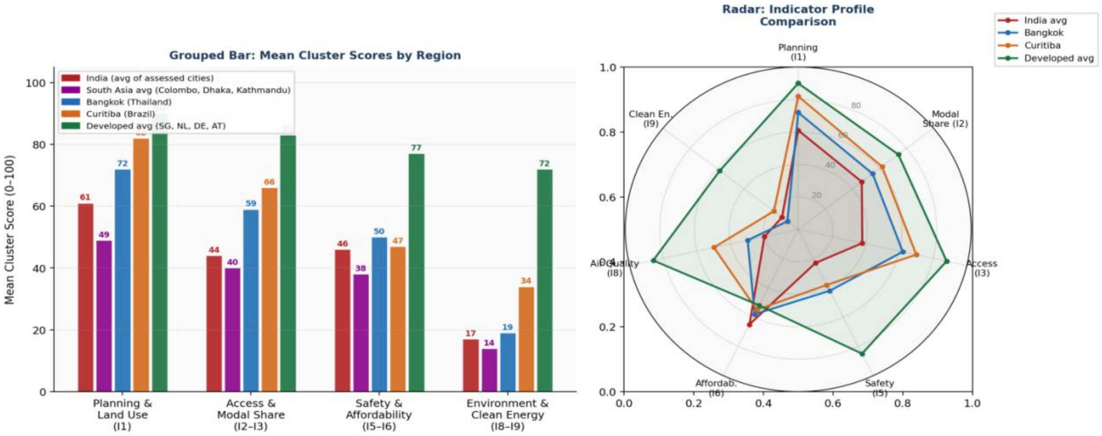


Figure 4. SUTI Indicator Cluster Scores — Regional Comparison (Grouped Bar) and Indicator Profile Radar Chart

7. Entrepreneurial, Managerial, and Policy Implications for Sustainable Mobility Innovation

The results presented in this study demonstrate that India's gaps in urban transport sustainability constitute public policy challenges but also opportunities for sustainable entrepreneurship, green innovation, and inclusive enterprise development. The low SUTI scores for clean energy, road safety, air quality, access, and public transport quality highlight where new business models, SMEs, start-ups, public-private partnerships, and social enterprises can help drive sustainable mobility transitions. The suggestions for policy action that emerge from this study are therefore no longer policy recommendations, but entrepreneurial and managerial routes for mobility innovation that can contribute to sustainability.

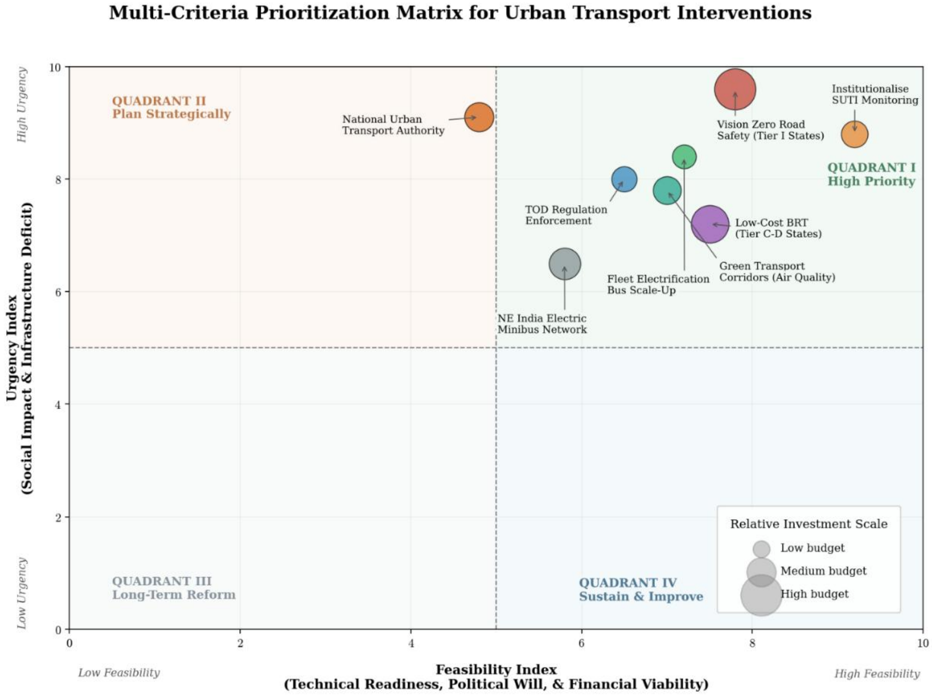


Figure 5. Entrepreneurial and Policy Prioritisation Matrix for Sustainable Mobility Innovation

The size of the bubbles indicates the approximate amount of investment needed. Urgency is the degree of severity of the SUTI deficits addressed by each intervention, and feasibility is the degree of availability of enabling policies, institutions, enterprise readiness, and financial mechanisms. Policy feasibility and policy priority for recommended interventions are integrated into

Figure 5, which prioritises interventions according to both policy urgency and entrepreneurial and managerial feasibility (Klaylee & Iamtrakul, 2025). Interventions such as SUTI monitoring and road-safety innovation are considered high-urgency and high-feasibility options because they can be implemented within the current institutional framework, while offering opportunities for data platforms, safety-tech companies, and mobility-service providers (Pędziwiatr et al., 2024). However, e-bus scaling and TOD demand increased investment and public-private partnerships, while offering significant potential for green mobility enterprises, charging infrastructure providers, fleet operators, and urban services SMEs (Chauhan et al., 2026).

7.1 SUTI as a Market Intelligence and Opportunity-Recognition Tool

The institutionalisation of SUTI as a national urban transport monitoring standard can contribute to the policy planning process and entrepreneurial decision-making (Klaylee & Iamtrakul, 2025). If this SUTI were assessed regularly across cities in India, it would enable entrepreneurs, investors, mobility companies, and public agencies to identify gaps in sustainability and where they can intervene (Lee et al., 2016; Klaylee & Iamtrakul, 2025). For instance, low clean-energy scores can help EV and charging infrastructure companies target cities with high potential for EV fleet electrification (Chauhan et al., 2026). Weak access can be used to recognise the market for feeder services, e-rickshaw platforms, electric minibuses, and mobility-as-a-service applications (Ali et al., 2023). When safety ratings are poor, there may be an increased need for fleet monitoring, road-safety analytics, driver training, and safe-route mapping services (Pędziwiatr et al., 2024). Thus, SUTI can also be used as a strategic diagnostic tool for sustainable mobility entrepreneurship, as shown by Lee et al. (2016) and Klaylee & Iamtrakul (2025).

7.2 Road-Safety Entrepreneurship and Responsible Mobility Innovation

India's performance in Road safety is one of the low-lying areas of the SUTI. This underscores the need for responsible mobility innovation (Pędziwiatr et al., 2024). Vision Zero can be implemented through various safety technologies, fleet telematics, speed monitoring systems, helmet compliance systems, safe pedestrian infrastructure, and driver behaviour analytics, all of which are accessible to entrepreneurs and SMEs (Pędziwiatr et al., 2024).

Such solutions are particularly applicable in states that have experienced high rates of road deaths and have many two-wheelers riding. Road safety enterprises have the potential to create commercial value in addition to social value by reducing the number of accidents involving pedestrians, two-wheelers, low-income commuters and women (Lee et al., 2016; Pędziwiatr et al., 2024).

7.3 Green Public Transport Enterprise and E-Bus Business Models

There is a significant opportunity for green public transport enterprises (Klaylee & Iamtrakul, 2025) in Indian cities with low clean energy scores. To scale up PM e-Bus Sewa and other electrification programmes, the participation of electric bus manufacturers, electric bus operators, charging infrastructure providers, battery-as-a-service providers, software providers, and maintenance SMEs is needed (Chauhan et al., 2026).

Various models, including battery-as-a-service (BaaS), gross-cost contracting, leasing, and public-private partnership (P3), can help public agencies lower front-end costs and create markets for private operators (Chauhan et al., 2026). This not only constitutes a climate intervention but also an opportunity for a sustainable business model through e-bus deployment.

7.4 Transit-Oriented Enterprise Ecosystems

Transit-oriented development not only serves as a planning tool but also as a foundation for the creation of local businesses (Klaylee & Iamtrakul, 2025). A variety of businesses, including mobility hubs, food services, parking management, last-mile transport enterprises, BRT corridors, and metro stations, can benefit from these features (Ali et al., 2023; Klaylee & Iamtrakul, 2025).

TOD will create a dense, convenient and vibrant urban area by integrating land utilisation and enterprise development (Klaylee & Iamtrakul, 2025). This is especially crucial for Indian cities, where high planning scores do not always correspond to modal shift and ease of access, and service quality (Ali et al., 2023).)

7.5 Inclusive Mobility SMEs in Tier C and Tier D Regions

In Tier C and Tier D states, less capital-intensive metro systems are needed, and more mobility solutions are available that are low-cost and tailored to the specific region (Klaylee & Iamtrakul, 2025). They identify potential areas for SMEs and social enterprises in the domains of electric minibus operators, e-rickshaw aggregators, shared electric mobility, community transport, rural-urban feeder services, and women-led mobility services (Ali et al., 2023).

These models have the potential to increase access for lower-income households, informal workers, students, and women, as well as for peripheral urban communities (Ali et al., 2023; Lee et al., 2016). Inclusive mobility enterprises can therefore directly impact sustainable development and local economic growth (Lee et al., 2016).

7.6 Clean Logistics, EV Delivery, and Low-Emission Urban Enterprise Zones

The weak air quality and GHG indicators offer an opportunity to promote clean logistics and low-emission urban transport companies (Lee et al., 2016; Klaylee & Iamtrakul, 2025). Green Transport Corridors can play a supportive role for EV delivery fleets, ECVs, route optimisation platforms, low-emission freight systems, and charging hubs for ECVs (Chauhan et al., 2026).

Such enterprise models are especially important in highly populated, polluted megacities such as Delhi, Mumbai, Bengaluru, Kolkata, Chennai, and Hyderabad. Clean logistics companies can help improve air quality by reducing emissions from freight and delivery operations powered by diesel engines. Clean logistics companies can improve air quality by reducing emissions from freight and deliveries powered by diesel engines, while developing commercially viable urban services.

7.7 Managerial Implications

The results are applicable to entrepreneurs, SMEs, mobility companies, investors, and public agencies (Lee et al., 2016; Klaylee & Iamtrakul, 2025). First, low clean energy scores offer significant market potential to all parties involved in providing electric bus services, charging stations, battery-swapping stations, fleet electrification consulting, and battery-as-a-service (BaaS) solutions (Chauhan et al., 2026). Second, weak access indicators and modal-share indicators suggest a need for last-mile mobility services, feeder transport platforms, electric minibus services, and integrated mobility-as-a-service applications (Ali et al., 2023). Thirdly, poor road-safety performance creates opportunities for safety analytics, fleet monitoring, driver training, and safe-route digital products (Pędziwiatr et al., 2024).

The results indicate that sustainable mobility opportunities are not only confined to large metro projects but are also found in SMEs. Smaller companies can engage in charging-station operations, e-rickshaw aggregation, vehicle maintenance, establishing battery diagnostics and smart ticketing systems, fleet software, and supporting community-based transport services (Ali et al., 2023; Chauhan et al., 2026). The SUTI classification at the state level serves as a screening tool for investors to determine areas where mobility problems are not insurmountable for industry but exceed what it can overcome. (Klaylee & Iamtrakul, 2025) The framework can be used to create sustainable enterprise participation in urban mobility transitions, including procurement and PPP systems and incentives, for public agencies (Lee et al., 2016; Chauhan et al., 2026). Table 6 presents the practical implications of SUTI's findings for entrepreneurs, SMEs, investors, public agencies, enterprises for women, and logistics.

Table 6. Practical Implications for Entrepreneurs and SMEs

Actor	Implication from Study	Opportunity Area
Mobility start-ups	Low I3 and I4 scores show gaps in access and service quality	Feeder mobility, MaaS, real-time transit information
EV entrepreneurs	Low I9 scores show a weak clean-energy transition	Charging, battery swapping, e-bus leasing, EV maintenance
SMEs	Tier C and Tier D states need low-cost transport solutions	Electric minibuses, e-rickshaws, and local transport services
Investors	SUTI scores identify high-need regional markets	Impact investing, green mobility finance, and PPP mobility ventures
Public agencies	SUTI can guide targeted procurement and incentives	E-bus contracts, BRT concessions, safety technology procurement
Women-focused enterprises	Affordability and safety gaps affect women commuters	Safe mobility platforms, women-led transport services
Logistics firms	Poor air quality and GHG scores create pressure for cleaner freight	EV delivery fleets, route optimisation, green corridors

7.8 Theoretical Contribution

This study is valuable to the sustainable entrepreneurship literature in three ways. First, it broadens the notion of entrepreneurial opportunity recognition to include the field of urban transport sustainability by providing an explanation of how measurable opportunity gaps in access, safety, clean energy, air quality, and cost recovery can be interpreted as spaces for the creation of green business (Lee et al., 2016; Klaylee & Iamtrakul, 2025). Second, it connects institutional sustainability metrics to business model innovation, showing how the latter can arise from the performance gaps of public sector institutions (Ali et al., 2023; Chauhan et al., 2026). Third, it adds sub-national evidence from India—a country that has experienced high levels of institutional diversity, infrastructure gaps, and urbanisation, which leads to varying opportunities for sustainable mobility enterprises (Lee et al., 2016).

The paper recognises the potential of sustainability indicators as strategic tools for entrepreneurs, investors, and SMEs (Klaylee & Iamtrakul, 2025) and uses SUTI as a policy-monitoring index beyond its traditional uses. This broadens the scope of the analytical application of composite sustainability indicators in entrepreneurship and innovation research.

8. Conclusion

This study presents a comprehensive application of the Sustainable Urban Transport Index to assess urban transport sustainability across Indian states and union territories, as well as selected cities. The findings show that India's urban mobility system is marked by a persistent planning–practice gap, where transport plans exist but do not consistently translate into improved access, modal shift, service quality, or safety. Indian cities perform better than some South Asian peers but remain behind Southeast Asian, Latin American, and developed-city benchmarks. The weakest areas are road safety, clean energy transition, air quality, last-mile access, and public transport quality. These gaps indicate that India's progress toward SDG 11.2 depends on targeted, evidence-based reforms rather than uniform national solutions.

The study highlights six priority interventions: institutionalising SUTI monitoring, implementing Vision Zero road-safety strategies, expanding electric bus deployment, enforcing transit-oriented development, supporting low-cost BRT and shared electric mobility in lower-performing states, and creating green transport corridors. However, the study has limitations. Proxy estimation introduces uncertainty, especially for service quality and cost-efficiency indicators. State-level analysis may hide differences between cities within the same state. The SUTI framework also does not fully capture gendered mobility, informal transport, or post-COVID travel changes. Future studies should conduct formal city-level SUTI assessments, include gender and informal mobility data, and track changes over time.

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Conflict of Interest

The author declares no conflict of interest.

Data Availability Statement

All primary data used in this study are publicly available from the cited government and United Nations sources. Derived indicator matrices, proxy estimation spreadsheets, and figure generation scripts are available from the corresponding author upon reasonable request at anilmaan_23phden02@dtu.ac.in.

Ethics Statement

This study is based entirely on publicly available secondary data and does not involve human subjects, primary data collection, or any interventions requiring institutional ethical committee approval.

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