

Electric Revolution: The Role of E-Scooters in Bangalore's Smart City Vision

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Abstract: This study examines the role of electric scooters (e-scooters) in Bengaluru's Smart City vision. It explores the rising number of people having e-scooters in Bengaluru and how this Silicon Valley city of Karnataka maintains its legacy as a garden city by focusing on its role in enhancing sustainable urban mobility. The research aligns with the United Nations Sustainable Development Goal (SDGs) 11 Target 11.2, which promotes inclusive, safe, resilient, and sustainable cities.

Amid growing concerns over traffic congestion, rising fuel costs, and environmental degradation, e-scooters seem to offer a viable option for short-distance urban transportation. This research also delves into how Bengaluru's residents embrace e-scooters, evaluates their feasibility, and assesses their environmental impact.

The study employs a quantitative research design, and it surveyed 81 residents of Bengaluru primarily youth aged 18-24 years old and young adults aged 25-35. Both groups are regarded as essential for the future of sustainable mobility due to their significant impact on the adoption of technology and environmental awareness (United Nations, 2020; WHO, 2020).

This research investigates whether e-scooters represent a shift towards electric mobility in urban areas. As a smart city, Bengaluru is characterized by innovation, technology, and a significant emphasis on sustainability. Furthermore, the research analyses current market dynamics to pinpoint areas for growth and assess the potential of e-scooters in aiding long-term sustainability objectives by evaluating their availability, affordability, and connectivity.

In conclusion, the study stresses the significance of data-informed urban planning to facilitate electric mobility as a feasible and eco-friendly transportation alternative in Indian cities.

Keyword: E-scooter, sustainable transport, smart city, urban mobility, environmental awareness, SDG 11, Bengaluru.

Urban mobility is undergoing a significant transformation worldwide, driven by the urgent need for cleaner, more efficient, and sustainable transport systems. While electric vehicles (EVs) are often seen as a modern innovation, their origins can be traced back to the late 19th century. However, it is only in the last two decades that the global shift toward environmental sustainability and renewable energy has renewed serious interest in electric mobility (Zeller, 2001; Kirsch, 2001). Today, governments, industries, and individuals around the world are increasingly adopting EVs as a solution to reduce greenhouse gas emissions, minimize fossil fuel dependence, and promote ecological balance.

India, as one of the world's fastest-growing economies, has recognized the importance of electric mobility in addressing rising urban pollution and energy security. The country's journey began in 1996 when Tube Investments of India Ltd. introduced BSA e-scooters, marking an early attempt to enter the electric two-wheeler market (IEEMA, 2022). These initial efforts were constrained by limited technology, short battery life, and weak infrastructure. A more notable shift occurred in 2007 with Hero Electric's entry, which made affordable electric scooters accessible to urban consumers (ETAUTO, 2023). In response to global climate goals and increasing urban challenges, the Indian government launched the National Electric Mobility Mission Plan (NEMMP) in 2013, followed by the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme in 2015. These policy frameworks have provided subsidies, tax benefits, and infrastructure development to accelerate EV adoption (NITI Aayog, 2021). Electric scooters have become a central focus within India's EV landscape. With two-wheelers accounting for over 80% of all vehicles on Indian roads, electrifying this segment presents a strategic opportunity to reduce emissions and fuel consumption (IEA, 2023). E-scooters are lightweight, cost-effective, and highly suitable for

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short-distance travel making them ideal for densely populated cities.

Among India's urban centers, Bengaluru stands out as a pioneering city in adopting electric mobility solutions. Recognized under the Smart Cities Mission, Bengaluru is actively pursuing its Smart City Vision, which emphasizes clean mobility, digital innovation, and environmental sustainability. This vision aligns with the United Nations' Sustainable Development Goal 11: Sustainable Cities and Communities (Smart Cities Mission, 2023). The city's tech-savvy population, environmental consciousness, and supportive state policies have made it a favorable ecosystem for electric vehicle adoption, especially electric two-wheelers. According to the Ministry of Road Transport and Highways, Karnataka consistently ranks among the top states in EV adoption, with Bengaluru accounting for a major share of electric two-wheeler registrations (MoRTH, 2023). State initiatives, such as the Karnataka Electric Vehicle and Energy Storage Policy, have further supported this transition by promoting charging infrastructure and EV manufacturing hubs.

This study examines the role of electric scooters in shaping sustainable urban mobility in Bengaluru. It focuses on user adoption patterns, demographic trends, behavioral preferences, and infrastructure-related challenges. Through this analysis, the research aims to highlight the potential of electric scooters to contribute meaningfully to Bengaluru's Smart City Vision and to provide actionable insights for policymakers, urban planners, and mobility innovators seeking to drive inclusive and eco-friendly transport solutions.

Research Question:

1. What is the e-scooter usage patterns, frequency, and purposes of young adults in Bengaluru?
2. What do consumers think about e-scooters in terms of brand preference, price, and environmental benefits?
3. What difficulties do users encounter when utilizing e-scooters, and what changes would they recommend increasing their uptake in the city?

Research Objectives:

1. To investigate the frequency of e-scooter uptake and usage trends among Bengaluru's young adults.
2. To examine consumer opinions about e-scooters' eco-friendliness, brand preference, and price.

3. To determine the main obstacles e-scooter users encounter and investigate user-recommended enhancements to boost uptake.

LITERATURE REVIEW

This research paper focuses on the role of electric scooters in Bangalore, a city known for its rapid urbanization. Bangalore is increasingly being examined as a critical aspect of India's smart city vision. This literature review explores existing research on the adoption and effects of electric scooters, environmental sustainability, and the broader smart metropolis framework. Young purchasers' perspectives on electric-powered two-wheelers are rapidly evolving due to technological advancements, allowing manufacturers to adapt to changing consumer preferences. Young clients are increasingly aware of the environmental impact of traditional combustion engine vehicles. Studies suggest that Generation Z and millennials view E2Ws to contribute to environmental sustainability [Reddy & Thomas, 2023].

Sustainable elements influencing the adoption of electric vehicles are increasingly seen as a crucial step toward reducing greenhouse gas emissions, improving air quality, and promoting sustainable transportation. This review explores the sustainable factors that influence the adoption of EVs, including environmental concerns, government incentives, and technological and financial elements [Kumar & Nagaraju, 2024]. The rapid urbanization and increasing environmental concerns have triggered the need for sustainable solutions in urban mobility. City sustainability is now a global challenge. Micro-mobility vehicles (MMVs), including bicycles, e-bikes, and hoverboards, offer a compact solution. Yulu, a dockless bike-sharing startup, addresses traffic and pollution problems by offering affordable, sustainable transport. Starting in Bangalore, it has expanded to cities like Pune, Gurugram, and Bhubaneswar, promoting green commuting for urban residents [Upadhyay, Purswani & Jain, 2020].

This section explores the awareness and perception of electric vehicles among car users in Bangalore, focusing on their likelihood of adopting these vehicles for environmental sustainability. With the Indian automobile sector witnessing significant growth, metropolitan cities remain major

contributors to pollution. EVs offer a potential solution; however, their impact depends on public awareness [Ansar & Monika, 2019].

Urbanization, coupled with economic growth, has led to challenges like inequality, environmental degradation, and traffic congestion, making urban sustainability a key concern. Traditional transportation systems struggle to meet growing demand, especially for short-distance travel. MMVs (lightweight vehicles like bicycles, e-bikes, skateboards, and hoverboards) offer a solution for first- and last-mile connectivity [Diviya, Sandhiya & Kumar, 2022].

Theoretical Framework

This study uses the Diffusion of Innovations Theory to understand how people in Bengaluru are adopting e-scooters. The theory sheds light on user behavior based on factors like noticed benefits, how well the innovation fits into their lifestyle, the influence of media and social circles. It helps explain how awareness, infrastructure availability, and peer usage play a role in encouraging people to use e-scooters, especially in the context of a developing smart city.

Research Gaps

While electric scooters are becoming increasingly common in Indian cities, there's still a lack of focused research on their adoption within smart city environments like Bengaluru. Most studies tend to look at electric vehicles, without exploring e-scooters as a separate mode of transport. There's also limited understanding of how media exposure, brand messaging, affordability, and infrastructure limitations affect people's opinions and usage habits. Young adults who are among the most frequent users haven't been studied extensively. This research aims to fill those gaps by exploring how people behave, what they know, and how they view sustainability in relation to e-scooters, offering deeper insights into their role in the future of urban transportation.

RESEARCH METHODOLOGY

This study based on a quantitative research look at how electric scooters are shaping Bengaluru's journey toward becoming a Smart city. It explores how people are using these e-scooters, what problems they are running into with things like charging and parking, and what drives or discourages their adoption.

Research Design: A descriptive survey research approach was used to gather direct insights from Bengaluru residents, focusing specifically on those between 18 and 35 years of age. This age group was chosen because they are more inclined to interact with digital technology and sustainable transportation options. The purpose of the survey was to understand the perceptions, behaviors, and experiences associated with e-scooter usage.

Survey Instrument and Focus Areas: The questionnaire included a mix of multiple-choice and Linkert scale questions, focusing on several key areas. It was all about getting their thoughts on these main topics:

- How familiar people are with e-scooters and how often they use them.
- If they think they are easy on the wallet and good for the planet
- What are the challenges they faced.
- It touched on which brands people prefer and whether they would recommend e-scooters to others.

Sampling Method and Data Collection

- **Sample Size:** 80 respondents
- **Sampling Method:** To get good insights about e-scooters, we are using purposive non-probability sampling to focus on young adults in Bengaluru who probably know a thing or two about e-scooters, maybe even use them.
- **Data Collection Tool:** Google Forms

The sampling strategy focused on including people who actively travel around the city and are open to greener ways of getting around or be influenced by sustainable transportation choices.

Data Analysis: Responses were analyzed using basic stats to spot important trends, common usage habits and what people think about e-scooters. To make things easier to understand, we used Microsoft Excel to create pie charts and bar graphs that visually showed the results. This approach helped us to get a good and clear idea of how E-Scooters fit into Bengaluru's smart city vision.

Limitations of the Study:

Limited Sample Size and Demographic Scope: The study surveyed around 80 respondents; primarily young adults aged 18-35 in Bengaluru. As a result, the findings may not accurately represent the

opinions of other age groups or the entire urban population.

Geographical Restrictions: The findings are specific to Bengaluru. Therefore, the results might not apply to other Indian cities that differ in terms of infrastructure, traffic conditions or availability of e-scooter.

Absence of Qualitative Data: The study solely uses a quantitative survey approach which limits the ability to fully comprehend consumer's motives, personal experiences and complex challenges faced by users.

DATA ANALYSIS AND FINDINGS

Q1. What is your age group?

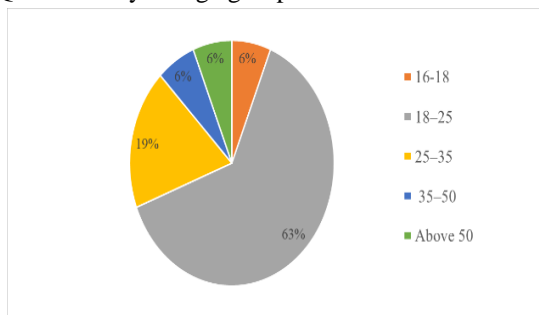


Fig 1: Distribution of respondents based on age group

63% were in the 18–25 age group, followed by 19% in the 25–35 age group. The remaining 18% included people aged 35–50 and those above 50. This shows that younger people, especially those between 18 and 25, are the main users or those most interested in e-scooters.

Q2. What is your primary mode of transportation in Bangalore?

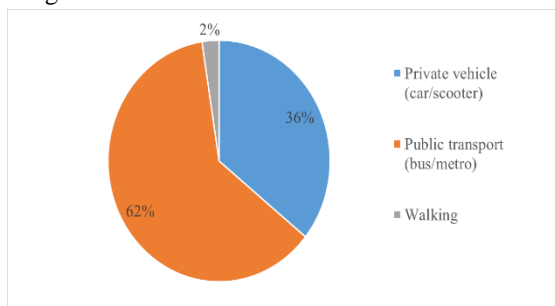


Fig 2: Primary mode of transportation used by respondents in Bangalore.

When asked about their primary mode of transport, 62% of respondents reported using public vehicles (buses or metro), while 36% preferred private transport such as (cars or scooters). Walking was chosen by 2%. This data emphasizes the dominance

of public transportation in Bangalore and the emerging but limited role of e-scooters

Q3. How likely are you to recommend e-scooters as a sustainable transportation option to others?

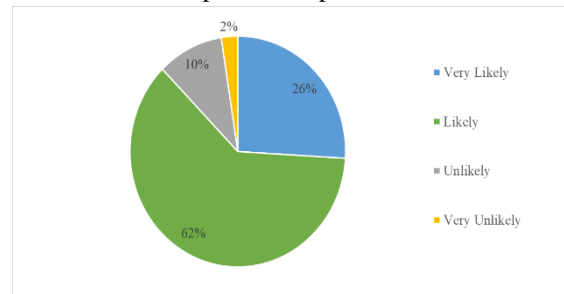


Fig 3: Likelihood of the respondents to recommend e-scooters as a sustainable option.

Most respondents showed a strong willingness to recommend e-scooters as a sustainable mode of transport, with 62% stating they are "likely" and 26% "very likely" to do so. A smaller portion of respondents were less supportive, with 10% being "unlikely" and 2% "very unlikely" to recommend them. Overall, the results suggest a generally positive perception of e-scooters among the public.

Q4. What improvements do you think can enhance e-scooter adoption in Bengaluru?

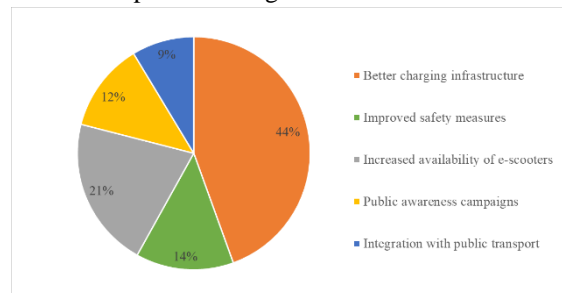


Fig 4: Suggested improvements to encourage greater adoption of e-scooters in Bangalore.

Respondents recommended better charging infrastructure 44% as the top priority for improving e-scooter adoption. Other suggestions included increased vehicle availability 21%, enhanced safety measures 14%, public awareness campaigns 12%, and integration with public transport systems 9%. This suggests that improving charging infrastructure is seen as the most crucial step to boost e-scooter adoption, followed by better availability, safety, awareness, and integration with public transport

Q5. Have you ever used an e-scooter in Bangalore?

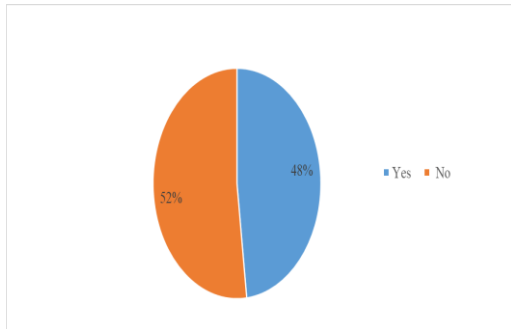


Fig 5: Respondent's experience with using e-scooters in Bangalore.

Among the 81 respondents, 48% (39 individuals) reported having used e-scooters, whereas 52% (42 individuals) indicated they have not.

Q6. If yes, how often do you use e-scooters?

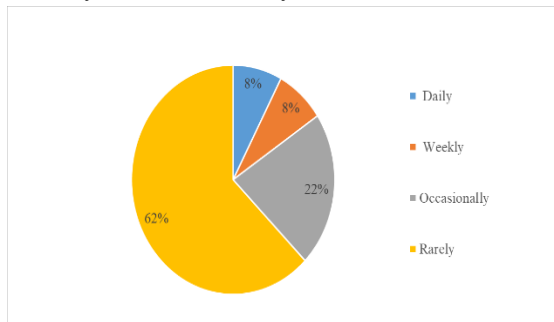


Fig 6: Frequency of e-scooter usage among users.

The data reveals that 62% of users reported using e-scooters rarely, indicating that consistent adoption is still limited. However, 22% mentioned occasional use, suggesting that many users engage with e-scooters when needed or convenient. Additionally, 8% of respondents use e-scooters weekly, and another 8% reported daily use. While the majority still use e-scooters infrequently, the presence of regular and occasional users highlights a growing acceptance and the potential for e-scooters to become a more integrated part of daily urban transport over time.

Q7. What is your main purpose for using e-scooters?

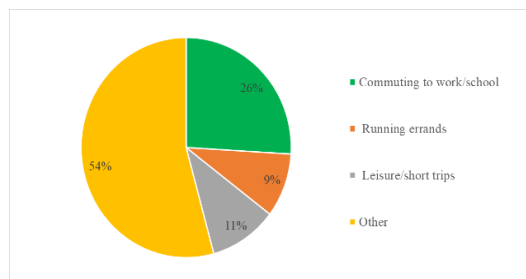


Fig 7: Main purpose for which e-scooters are used.

E-scooters are primarily used by delivery personnel and for shared travel with others, as reported by 54% of respondents under "others" category. This is followed by leisure or short recreational trips 11% and running errands 9%, indicating a developing market segment.

Q8. Which e-scooter brand or service do you prefer in Bangalore?

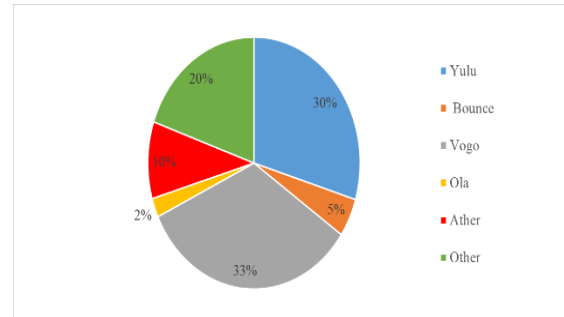


Fig 8: Preferred e-scooter brand or service among users in Bangalore.

Vogo and Yulu were the most preferred e-scooter brands, selected by 33% and 30% of respondents, respectively. Bounce, Ather, and Ola were chosen by 10%, 5%, and 2% respectively. However, 20% of respondents were unaware of available brands, indicating limited brand awareness.

Q9. Your reason for opting e-scooters

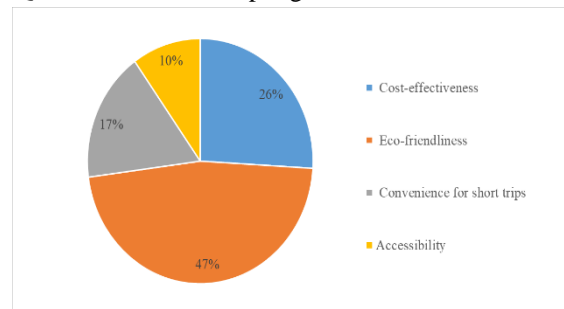


Fig 9: Primary reason for choosing e-scooter for a reason.

Eco-friendliness was the most cited reason for preferring e-scooters, selected by 47% of respondents. Other reasons included cost-effectiveness 26%, convenience for short trips 17%, and accessibility 10%. These findings suggest that Bangalore residents adopt to e-scooters strongly influenced by environmental awareness.

Q10. How would you rate the affordability of e-scooters compared to other modes of transport?

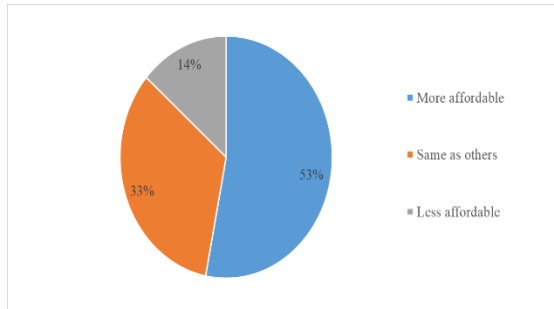


Fig 10: Perception of e-scooter affordability compared to other modes of transportation.

A majority of respondents (53%) found e-scooters to be more affordable compared to other modes of transport, while 33% believed the cost was about the same, and 14% considered them less affordable.

Q11. What challenges do you face when using e-scooters?

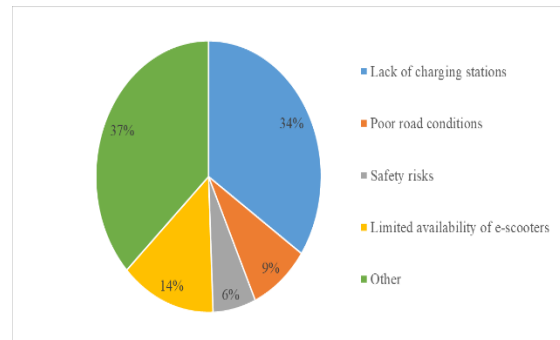


Fig 11: Key challenges faced by users while using e-scooters.

Most responses fell under the "Others" category, with 37% of respondents specifically citing low battery life and high initial cost as major concerns. In addition, inadequate charging infrastructure was reported by 34%, limited availability of e-scooters by 14%, poor road conditions by 9%, and safety risks such as accident hazards by 6%. This highlights the importance of understanding specific user concerns for targeted improvements.

CONCLUSION

This study reveals that most e-scooter users in Bengaluru are young adults, with 63% of respondents falling within the 18–25 age group. The eco-friendliness and convenience of e-scooters for short commutes contribute to their growing popularity among this demographic. Although many respondents use e-scooters occasionally 22% or for commuting 26%, there remains a significant portion of users 62% who use them rarely. This suggests that

while young adults are interested in e-scooters, regular usage is still limited, indicating that this mode of transport is not yet a routine part of their daily commute. These findings suggest that e-scooters have appeal among young adults, but their usage patterns indicate that barriers such as infrastructure and convenience still need to be addressed to encourage more frequent adoption.

In terms of consumer opinions, the environmental benefits of e-scooters were the most cited reason for their adoption, with 47% of respondents highlighting this factor. This aligns with Bengaluru's vision of promoting sustainable urban mobility and integrating e-scooters into the city's transportation network. The study also revealed a strong preference for certain e-scooter brands, with Vogo and Yulu being the most favored, selected by 33% and 30% of respondents, respectively. However, 20% of respondents were unsure about the available brands, indicating a lack of awareness in the market. Regarding affordability, 53% of respondents considered e-scooters to be more affordable than other modes of transport, while 33% felt the cost was about the same. These insights reveal that e-scooters are perceived as a cost-effective and environmentally friendly alternative, but the importance of increasing brand awareness and making them more accessible to a broader audience is clear.

The study identified several challenges that users face when using e-scooters, which hinder more widespread adoption. The most significant issue cited by 34% of respondents was the lack of adequate charging infrastructure, followed by concerns about low battery life, poor road conditions, and safety risks. Users also reported that they would recommend improvements in charging infrastructure 44%, vehicle availability 21%, and safety measures 14% to increase e-scooter uptake. These insights suggest that addressing infrastructure gaps, such as increasing charging stations and ensuring better road conditions, could substantially improve the overall e-scooter experience and encourage more regular usage. Furthermore, integrating e-scooters with the public transport system, as suggested by 9% of participants, could enhance their convenience and accessibility for urban commuters.

In conclusion, this study sheds light on the significant potential of e-scooters as part of Bengaluru's Smart City Vision, particularly in promoting eco-friendly

and efficient urban mobility. While e-scooters are already popular among young adults, the adoption rate is still limited due to various infrastructural challenges. The positive perception of e-scooters, particularly in terms of eco-friendliness and affordability, highlights the opportunity for Bengaluru to leverage them as a sustainable transport solution. To achieve broader adoption, the city must address the key challenges identified in this research, such as improving charging infrastructure, increasing vehicle availability, and integrating e-scooters with public transport. By tackling these issues, Bengaluru can enhance its Smart City Vision and foster a more sustainable and integrated urban mobility system for the future.

RECOMMENDATIONS

Expand Charging Infrastructure: To reduce range concerns and promote frequent use, the government and private players should focus on expanding the availability of fast and conveniently located charging stations throughout the city.

Increase Public Awareness Initiatives: Awareness campaigns through media and local initiatives should be enhanced to inform the public- especially non-users- about the advantages of e-scooters, the services offered and safety practices.

Connect E-scooters with Public Transport Systems: In order to facilitate last-mile travel and promote multiple transportation modes the use of various modes of transportation, e-scooter operations should be connected with already-existing public transit hubs, such as bus stops and metro stations.

Offer Incentives and Flexible Pricing Options: Policymakers and service providers could introduce benefits like subsidies, loyalty rewards or time-based rental plans to make e-scooters more affordable and attractive for long-term usage.

Upgrade Safety Measures and Urban Infrastructure: Establishing dedicated lanes, improving road conditions, and enforcing safety regulations will help reduce risks and make e-scooter travel more appealing to a broader audience.

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