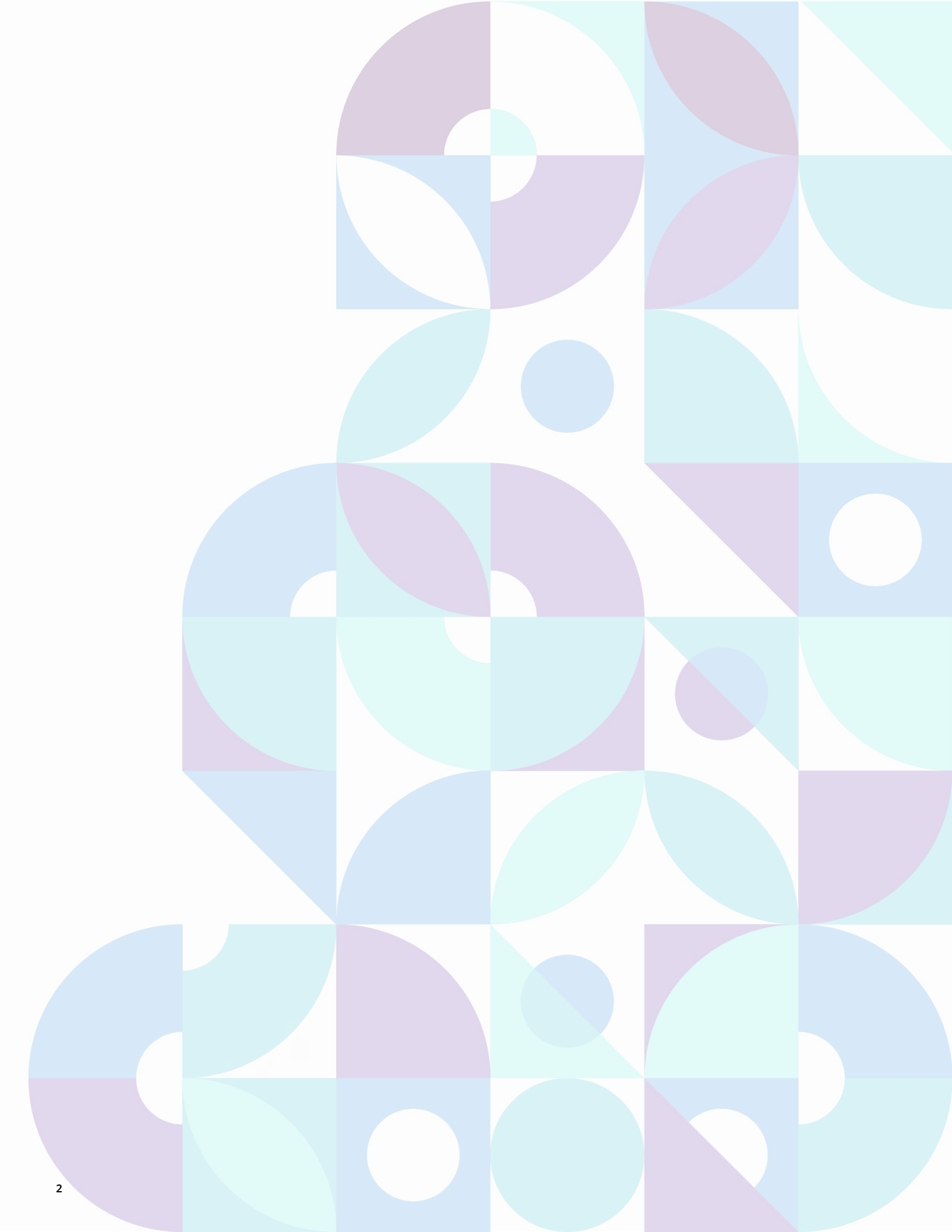


EV-READY TAMIL NADU

Accelerating Electrification of Commercial Two-Wheelers



July 2024



About Guidance Tamil Nadu

Established in 1992, 'Guidance' is the Government of Tamil Nadu's nodal agency for investment promotion and single window facilitation. The aim is to promote Tamil Nadu as the most preferred investment destination by reaching out, helping, and improving the ease & cost of doing business. The team facilitates and coordinates with multiple stakeholders involved to help investors operationalise their projects swiftly.

The team of sector, policy, and country experts provides round-the-clock support to the investor during the entire investment cycle from inception to aftercare. We also bring together industry, community partners, and various government departments under one roof for business facilitation.

About OMI Foundation

OMI Foundation, a registered Trust, is a policy research and social innovation think tank operating at the intersection of mobility innovation, governance, and public good. Mobility is a cornerstone of inclusive growth providing the necessary medium and opportunities for every citizen to unlock their true potential. OMI Foundation endeavours to play a small but impactful role in ushering meaningful change as cities move towards sustainable, resilient, and equitable mobility systems which meet the needs of not just today or tomorrow, but the day after.

OMI Foundation conducts evidence-based policy research housed under three interdisciplinary centres of excellence. These are:

Centre for Future Mobility

OMI Foundation's Centre for Future Mobility envisions a future which meets the aspirations of all in a diverse world, anchored in the paradigms of active, shared, connected, clean, and AI-powered mobility.

Centre for Clean Mobility

OMI Foundation's Centre for Clean Mobility explores the diversity of near- and long-term pathways to clean mobility. It focuses on the use of electric, future fuels, and renewable energy alike within the mobility ecosystem.

Centre for Inclusive Mobility

OMI Foundation's Centre for Inclusive Mobility ensures the existing and emerging mobility paradigms are Safe, Accessible, Reliable, and Affordable for every user of mobility infra and services, including persons with disabilities, women, LGBTQIA+, children, and the elderly. It further paves the road for the future of work and platform economy to fulfil the modern promise of labour.

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Foreword

Secretary – Department of Industries, Investment Promotion, and Commerce, Government of Tamil Nadu

As one of the key initiatives by the Government of Tamil Nadu towards developing the State's highly acclaimed electric mobility ecosystem, I am proud to introduce this significant report on "EV-Ready Tamil Nadu: Accelerating Electrification of Commercial Two-wheelers," a collaborative endeavour between Guidance and the OMI Foundation.

Our State has always been at the forefront of embracing change and progress, which is amply reflected in our determination to make Tamil Nadu a Global EV manufacturing hub, building upon our current position as the EV capital of India. This aspiration is backed by our robust industrial infrastructure, favourable policies, and a skilled workforce capable of bringing this vision to life.

The Government of Tamil Nadu has been diligent in its efforts to make electric mobility a norm rather than an exception. This report attests to our commitment to reducing our carbon footprint and contributing to global climate change mitigation efforts.

The comprehensive recommendations outlined in this report will be instrumental in driving sustainable development and growth in the State and beyond. The insights outlined in this report will shape the State's EV policies, accelerate investment in EV infrastructure, and promote widespread adoption of electric mobility.

As we gear up for a future defined by electric mobility, we are not just investing in a cleaner environment but also creating avenues for economic development, job creation, and technological innovation. The Government of Tamil Nadu stands committed to making this transformative journey a reality.

This report is a clarion call to all stakeholders to join hands in this transformative journey towards a cleaner, greener, and brighter future for Tamil Nadu, setting a precedent for the rest of the world to follow.



Mr. Arun Roy IAS

Secretary
Department of Industries, Investment
Promotion, and Commerce
Government of Tamil Nadu

Foreword

MD & CEO – Guidance

As the nodal agency of the Government of Tamil Nadu for investment promotion and single-window facilitation, Guidance has been a torchbearer in the realm of industry and commerce in the State, consistently endeavouring to foster a business and industrial ecosystem that is beneficial to investors, the Government, and the State's people alike. In light of our initiatives towards advancing the electric vehicle ecosystem in Tamil Nadu, I am honoured to present this collaborative study conducted with the OMI Foundation titled "EV-Ready Tamil Nadu: Accelerating Electrification of Commercial Two-wheelers".

The partnership between Guidance and the OMI Foundation is built upon shared visions and mutually beneficial collaboration. Our collaboration on this report exhibits our united commitment to fostering a cleaner, more sustainable future. The OMI Foundation, with its expertise in policy research and social innovation in mobility, has been instrumental in forming a comprehensive understanding of the potential in the transport sector's electrification.

Guidance has always striven to promote Tamil Nadu as a prime investment destination by developing a robust industrial ecosystem in the State and attracting investments across an entire range of industrial sectors, both legacy and emerging. The insights garnered from this study will serve future policy-making and investment strategies, especially in the electric vehicle (EV) infrastructure space. Our role in fostering an enabling environment for sustainable industries like EV manufacturing and electric mobility services is a testament to our commitment to creating a future-ready Tamil Nadu.

This report will serve as a blueprint for Tamil Nadu's journey towards a sustainable future. As we progress, Guidance will continue to lead the way in attracting investments, leading policy initiatives, and creating an advanced and inclusive electric mobility ecosystem in Tamil Nadu that will eventually see the State become a leading global EV hub soon.



Mr. Vishnu Venugopalan IAS
MD & CEO
Guidance

Foreword

Foreword – OMI Foundation

The Indian story of two-wheeler electrification is becoming important for a variety of reasons. As part of the efforts to decarbonise the Indian transport sector, electrification of this segment is critical alongside increased penetration of renewable energy into the grid. In states like Tamil Nadu, where renewable energy injection is high, two wheeler electrification is a low hanging fruit, and must be effectively utilised.

The state of Tamil Nadu has been a torch bearer of India's EV story so far. The latest update of the state's Electric Vehicle (EV) Policy has become a model to emulate for states and countries around the world. Thanks to its focus on building the entire ecosystem, clear policy direction on charging infrastructure, vehicle adoption incentives, and leveraging of existing manufacturing capabilities feature in the state government's strategy. This all-round strategy is appreciable and the state government deserves plaudits for its commitment to comprehensively address the challenge of (Internal Combustion Engine) ICE-to-EV transition.

Among the various segments embracing the adoption of two-wheelers, commercial services have played a pivotal role. Food delivery, last-mile logistics or hyperlocal delivery, passenger transport services are leading to a manifold expansion of the two-wheeler market and associated service industry. Coupled with the gig and platform economy's rise, two wheelers today are a critical part of income earning avenue for lakhs of people. This segment has its own opportunities and challenges, and needs detailed attention when pursuing electrification. Given the long distances they traverse, conventional engine-based two-wheelers contribute significantly to emissions, both greenhouse gases and other air pollutants. Electrification within the State, powered by renewable energy for charging, creates a win-win situation for the state, accelerating its journey towards carbon neutrality.

It is, therefore, heartening to see Guidance Tamil Nadu joining forces with OMI Foundation to understand this space and identify interventions that can catalyse the transition of commercial vehicles towards an electric future. OMI Foundation and Guidance Tamil Nadu have made a commendable effort in understanding the current state of EV adoption in Tamil Nadu, and delineating steps to foster the usage of electric two-wheelers for commercial purposes.

We are confident that the recommendations brought forth after a rigorous research and consultation process are timely and relevant. The interventions proposed by the report will further solidify Tamil Nadu's position as a progressive state encouraging electric mobility, and once again position Tamil Nadu as a model state for the rest of the nation, and the rest of the world to follow.



Ambassador (Retd.) Gautam Bambawale
Managing Trustee, OMI Foundation



Harish Abhichandani
First Trustee, OMI Foundation

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Executive Summary

Climate change has emerged as a major global issue in recent years, fuelled by rising greenhouse gas (GHGs) emissions. The transport sector accounts for nearly one-quarter of global energy-related CO₂ emissions. However, transport demand per capita continues to rise and is expected to grow at an accelerated pace due to increasing incomes and infrastructure development. Therefore, decarbonisation of the transport sector is critical to curtailing the emissions.

In Tamil Nadu, vehicle registrations have been increasing at a rapid pace. There are more than 3 crore vehicles currently registered in the State - a number that's estimated to increase to 9.8 crore by 2030 (Government of Tamil Nadu, 2019). This projected growth of more than 300% emphasises the need to focus on decarbonising the sector at an equally steady rate.

In FY 2023-24, there were a total of 18.8 lakh vehicles registered in Tamil Nadu and more than 76% of these were two-wheelers (2Ws). Similarly, of the 1,01,205 electric vehicles (EVs) registered in the state in FY 2023-24, electric two-wheelers (E2Ws) accounted for 86% of the total number. This shows that 2Ws have emerged as a viable, cost effective way for a large number of services for passenger and goods transport; especially in the first-mile and last-mile segment, while creating an opportunity for sustainable livelihoods for citizens engaged with platform businesses and online marketplaces.

The proportion of E2Ws in Tamil Nadu has increased from 5.1% of total 2Ws in FY 2022-23 to 6.4% in FY 2023-24 in both personal and commercial categories combined. Electrification of commercial vehicles is economically viable and provides more benefits than private vehicles due to higher utilisation rates. Given the growing use of 2Ws for commercial purposes, it is important for the state to create an enabling policy environment that accelerates their electrification. In its latest EV policy, the state government has underscored that it shall undertake measures to electrify shared transport vehicles in a gradual manner beginning from the 6 priority cities of Chennai, Coimbatore, Madurai, Tiruchirappalli, Salem and Tirunelveli.

Against this backdrop, Guidance Tamil Nadu and OMI Foundation conducted a study between October 2022 and March 2024 to accelerate electrification of 2Ws used for commercial purposes in Tamil Nadu. This report documents the findings and recommendations of the research.

Key Findings

Current Degree of Electrification

Through stakeholder interviews, this study finds that there are more than 2 lakh 2Ws used for commercial applications in Tamil Nadu. Bike taxis and food delivery services constitute a majority of these. However, only 5% of such vehicles are electric. This presents Tamil Nadu with an opportunity to significantly increase the adoption of electric vehicles in the State, led by 2Ws. i.e. around 5%, have transitioned to EVs, signalling the early stages of Tamil Nadu's journey towards broader electrification in this domain. This emerging trend underscores a remarkable opportunity for Tamil Nadu to further foster the adoption of E2Ws.

Potential Impact of Electrifying 2Ws Used for Commercial Purposes

There are environmental and economic benefits to electrifying 2Ws used for commercial purposes in Tamil Nadu. These benefits, as listed below, strengthen the case for accelerating the transition of commercial vehicles towards electric mobility.

1. There are more than 2 lakh two-wheelers used for commercial applications in Tamil Nadu. Even if half of all these two-wheelers were to go electric, an avoidance of at least 85,410 tonnes of CO₂ can be achieved annually within the state. This would offer a huge impetus towards Tamil Nadu achieving its ambition of carbon neutrality.
2. Comparing the total cost of ownership of an electric bike model for commercial operations with that of a petrol bike, we find that the user of electric two-wheeler can save more than INR 1,15,000 - 1,35,000 over the course of three years. This money can be spent for a better lifestyle, enhancing the quality of life, and improving savings for the future as well. Thereby, augmenting the lives of people while also generating economic benefits via greater spending for the state.

While the promise of electric mobility is immense, there are barriers slowing down this transition that need to be urgently addressed.

Accelerating Electrification of Commercial 2Ws: Key Opportunities

The current adoption rate of E2Ws in Tamil Nadu's commercial sector highlights areas for strategic growth. Insights from stakeholder surveys, consultations, and literature review suggest the following.

1. Broadening access to affordable finance options can ease the transition to electric for commercial users
2. Simplifying regulations for E2Ws in passenger and goods transport can accelerate adoption
3. Expanding the network of affordable, and reliable public chargers is vital for supporting E2Ws
4. Enhancing after sale services ecosystem
5. Increasing awareness among owners and drivers about EV advantages can shift perceptions positively.

Key Recommendations

While comprehensive recommendations are detailed in Chapter 8 of this report, this section presents key recommendations.

1. Innovative Financing and Risk-Sharing Facilities

In most commercial two-wheeler applications, vehicles are not owned by the companies but by driver/delivery partners themselves. However, several barriers hinder the provision of attractive financing options, including the limited availability of credit history of the emerging class of asset owners, nascent second resale market for electric vehicles and a lack of risk-sharing mechanisms. This necessitates the introduction of innovative financing solutions such as cash flow-based lending, and collaboration by state-owned financial institutions with multilateral banks to create risk-sharing facilities.

2. Scaling Charging Infrastructure and Introducing Single-Part Tariff

The availability of affordable, reliable, and accessible charging infrastructure plays a vital role in accelerating the electrification of commercial vehicles. It significantly reduces the down time of the vehicle, maximising the remunerative opportunities of the vehicle. Currently, Tamil Nadu experiences a shortfall in the number of public charging stations. Providing land at concessional rates, adequate parking provisions in public places and conducting demand assessments for future EV support can help create scale so that charging infrastructure availability increases.

Further, to make public charging affordable for the masses, the State Electricity Regulatory Commission may replace the existing two-part tariff with a single-part tariff system, effectively removing fixed charges¹ from the tariff. This will lower the cost of charging, make public charging more financially viable for service providers and help rapidly expand public charging infrastructure in Tamil Nadu.

3. Guidelines for Commercial Applications

Clear guidelines may be brought out with respect to the usage of electric two-wheelers for transport purposes. Currently, the G.O. does not, by itself, clarify whether it applies to electric two-wheelers as well.

Even as such a clarification is issued, it is necessary to ensure guidelines, which allow 2Ws - internal combustion engine-based or EVs - to be used for commercial applications, continue to nurture an ecosystem with limited entry barriers and the potential to unlock millions of livelihood opportunities, while promoting sustainable mobility.

4. Awareness

There is also a need for aggregators and fleet operators to enhance awareness among their driver and delivery partners regarding the advantages of transitioning to electric vehicles, as well as the available support systems. Here there is a significant role for civil society, wherein the government and industry alike can partner with campaigning organisations, financiers and others to create the necessary awareness and demand among workers.

Overall, sustained and concerted efforts are required to create a favourable ecosystem in Tamil Nadu for the electrification of 2Ws used in bike taxis, hyperlocal deliveries and other such commercial applications. This endeavour will not just contribute to the reduction of greenhouse gas emissions but also generate numerous green jobs in the State.

¹ Fixed charges compel the charge point/ charging station service provider to incur recurring monthly costs regardless of the utilisation of their service, thereby making public charging an expensive business. Removing fixed charges will help create a conducive environment for service providers, as they will not be billed in the absence of sale of energy for electric vehicles.

1. Introduction

1.1. Context: Burgeoning mobility ecosystem

India's transport sector has grown exponentially over the past few decades, in tandem with the country's economic growth. According to the Vahan data portal, there are over 33 crore registered vehicles in India. Notably, two-wheelers constitute more than 70% of the registered vehicles, due to their relatively low total cost of ownership (figure 1) (SIAM, 2023). The dominance of two-wheelers in new vehicle sales is expected to persist, with The Energy and Resources Institute (TERI) estimating that two-wheelers will continue to represent two-thirds of total automobile demand in the country until financial year 2030-31 (TERI, 2019).

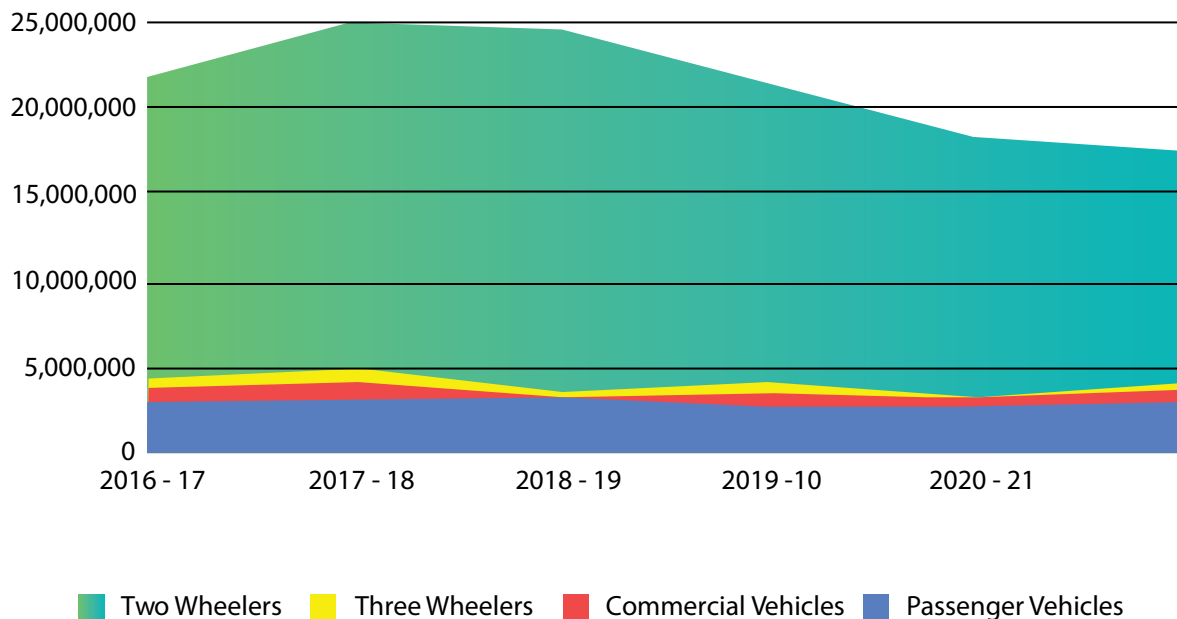


Figure 1: Two-wheeler sales continue to dominate the Indian automotive market; Source: SIAM, 2022

10% of all vehicles registered in the country come from Tamil Nadu, making it the third largest state in the country, in terms of vehicle penetration, following Uttar Pradesh and Maharashtra, as indicated by data released by the Ministry of Road Transport and Highways, Government of India, dated 2018-19 (MORTH, 2021). With a staggering number of over 3 crore registered vehicles (as of 2021), the state surpasses the combined vehicle count of Australia (approximately 2 crore) and New Zealand (nearly 40 lakh) combined (Lau, 2021). The Tamil Nadu Government further expects vehicle population to reach 9.8 crores by 2030, three times the current vehicle population in the State (Government of Tamil Nadu, 2019).

The total number of registered motor vehicles in Tamil Nadu increased 100 times between 1981 and 2021 (TNSTA, 2022). To put this into perspective, the yearly addition of vehicles in Tamil Nadu is equivalent to the entire vehicle fleet of New Zealand being introduced onto its roads. Of this, over 2.06 crore, or 68.2% of the registered vehicles belong to the motorcycle/scooter category. It is worth noting that this count excludes certain types of two-wheelers like mopeds, as they fall below the speed threshold of 25 kmph, and don't require registration. The actual number of two-wheelers added would be much higher if mopeds and motorised cycles were also considered.

EV two-wheeler adoption has gained momentum in Tamil Nadu, accounting for 86.18% of total EV sales in the state during the financial year FY 2022 (JMK Research, 2023). Motorcycles and scooters are recognized as the primary mode of choice for navigating short distances and the fastest mode of transport especially in congested cities. Two-wheelers have also emerged as a viable, cost effective way of delivering freight, services and connectivity, especially in the first- and last-mile segment. This creates opportunities for sustainable livelihoods for individuals engaged with platform businesses and online marketplaces.

1.1.1. Logistic Services – A Growth Segment for Two-wheelers

The expansion of the automotive market in recent times has been accompanied by the growth of logistical and shared mobility services in India. These innovative business models have also contributed to higher sales for the automotive industry in India. For instance, Tata Motors and Ashok Leyland recorded that the e-commerce sector has contributed to 7-10% and 25% growth in sales (Economic Diplomacy Division, 2021). Also, the shared mobility space, comprising e-commerce industry (especially last mile logistics) and intermediate public transportation have been identified as significant contributors to the demand of two-wheelers in India (Business Wire, 2022). India handles a significant volume of deliveries, with approximately 2.6 billion parcels being transported annually. Notably, Chennai alone contributes to 0.2 billion annual parcels, resulting in approximately 5.4 lakh parcels delivered within the city each day. This is expected to further increase as online sales are projected to constitute nearly a quarter of total global retail sales by 2025 (Clean Mobility Collective and Stand.earth, 2022).

Hyperlocal delivery services depend on two-wheelers to cover the last mile (Ken Research, 2021). Simultaneously, the increasing use of two-wheelers in shared mobility is helping to complement public transport with first and last-mile connectivity options (Jha, 2022). Notably, a significant portion of last mile deliveries are carried out using two-wheelers. Given the growth of these services, it is evident that the commercial sector plays a significant role in driving the sales of two-wheelers in India.

1.1.2. Shared Mobility and Platform Economy: New Economic Revolutions in the New Frontier

The gig economy has already created over 77 lakh (7.7 million) livelihood opportunities in the country, and this number is expected to grow exponentially, reaching 2.35 crore (23.5 million) jobs by 2029-30 (NITI Aayog, 2022). A sizable share of these livelihood opportunities is already present, with expectations of further expansion in Tamil Nadu, given the state's substantial contribution to National GDP.

A significant number of individuals engaged in gig and platform work use two-wheelers as their preferred mode, making the vehicle pivotal to empowering them to find gainful jobs. However, vehicle ownership may vary. In some instances the two-wheeler is provided by the vendor. Local fast food chains and restaurants maintain fleets of two-wheelers used by delivery executives - oftentimes engaged as contract workers or employees - to serve the end consumer. There is an equally significant number of platform and aggregator businesses where the delivery agent/service provider uses their personal vehicles to perform tasks. The vehicle in the latter instance becomes a necessary tool for the gig/platform worker to effectively carry out the services tendered. The total cost of ownership (including showroom price, levies and fuel cost), therefore, becomes relevant.

Most characteristics applicable to the gig and platform workers apply to the riders as well – they tend to be comparatively young, enjoy flexibility to choose the hours spent each day on gig work; and often do not have gig work as their primary source of income (Ramachandran and Raman, 2021), (Srinivasa, 2021). This variety and complexity makes it difficult to determine the extent to which this group as a whole depends on deliveries as a business. An exact number of gig and platform workers using two-wheelers in Tamil Nadu and the country, is hard to quantify given the heterogeneous nature of services provided by such a workforce. This prompted us to engage in discussions with various industry stakeholders to ascertain a number which is specified in section 4.2 of the report.

Moreover, multiple state governments have formulated rules on allowing the use of two-wheelers for bike taxis, bike pool, bike rentals and other commercial activities, as has been allowed by the Union government in 2004 (Ministry of Road Transport and Highways (MoRTH), 2004) and the Parliament in 2019 (Raman, 2020). Despite the policy support of the Union government, bike taxis are not a common service readily available across India, on account of two broad issues (Raman, 2020):

- A lack of precedence stemming from technical and legal uncertainty over the classification of bikes as a transport vehicle; and
- A lack of clear evidence demonstrating the positive impact of bike-taxis in Indian cities.

The regulatory landscape on the subject of bike taxis is a good case study to indicate how state governments have engaged with this space.

States and UTs with Bike Taxi and Bike Pooling Policies

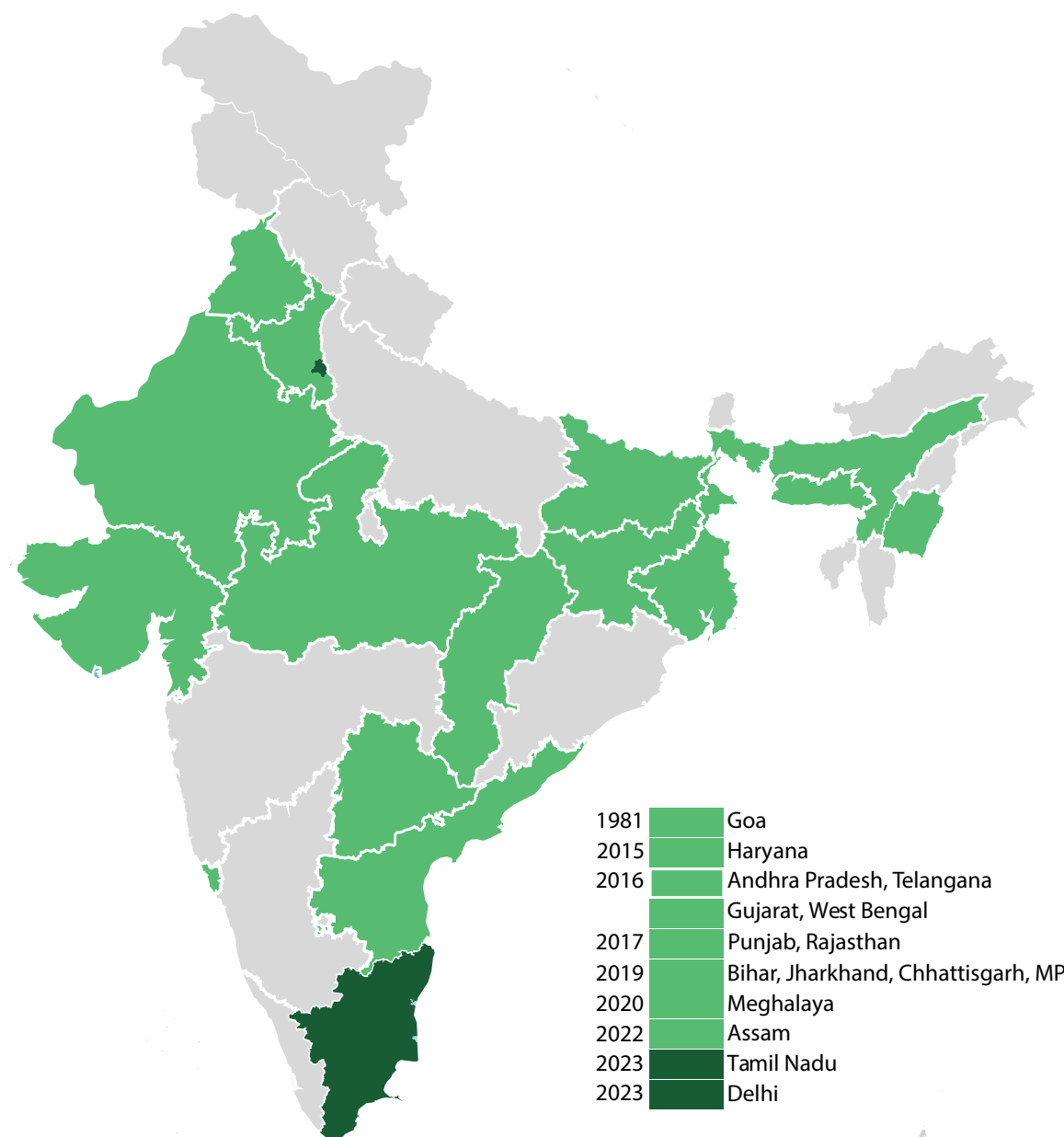


Figure 2: Map showing the rocky road to bike taxis getting legalised in India. Notably, bike taxis are not recognised in all Indian states; Source: Raman (2020) and authors' analysis. Delhi and Tamil Nadu have given recognition only for electric two-wheelers for transport purposes.

As depicted in Figure 2, Indian states began recognising bike taxi markets in 2015, even though the concept of bike taxis is rather old. Goa was the first state in India to permit bike taxi way back in 1981 (Jha, 2022). As of April 2024, the tally of states allowing sharing of bikes has gone up to 16.

The business emerges as a peculiar challenge for automotive manufacturers as well. The nature of service that a two-wheeler has to deliver is a significant departure from the regular usage of the vehicle. This arises from the longer hours of operating the vehicle every day. Mileage matters as earnings are sensitive to fuel price. However, the entry price of the vehicle, even though low, also can be a barrier, especially for commercial usage, where the vehicle is an essential tool to create a work opportunity, and not a luxury. This is among the key reasons why the second-hand two-wheeler market is significant in India and is now getting organised (Express Drives, 2022). It can be reasonably conjectured that this market has an audience among the riders who use two-wheelers for commercial purposes.

1.2. Requirement of the Study

Transport sector is the third largest contributor of greenhouse gas (GHG) emissions and accounted for approximately 13.5% of energy related emissions (New Climate Institute and Climate Analytics, 2020). Road transport contributes 90% of the transport related carbon dioxide emissions (Kumar, Shao, Braun and Bandivadekar, 2022). The contribution of ICE two-wheelers to overall road transport emission is significant, given that around 85% of the registered vehicles in the state are two-wheelers.

Air pollution is another factor of concern within the transport sector. The National Clean Air Action Plan (NCAP) identified the transport sector as one of the major contributors to air pollution in Indian cities. Over 130 cities across India have been identified as non-attainment cities, where the annual average air quality exceeds the National Ambient Air Quality Standards (NAAQS). It may be noted that these standards are also higher than the World Health Organisation (WHO) standards. Unhindered growth in the sale of internal combustion engine (ICE) vehicles will further add to emissions and increase dependency on imported fossil fuels. Electrification of the fleet has been identified under the NCAP as an important mitigation strategy (MoEF&CC, 2019).

Electric vehicles (EV) have emerged as a viable clean mobility alternative to ICE vehicles, with zero tailpipe emissions and fast emerging price parity with ICE counterparts (Barisione, 2021). The difference has significantly narrowed in the two-wheeler space, where the total cost of ownership is, in fact, lower than ICE vehicles (Avendus, 2020). The same is reflected in rising EV sales, as has been reflected in the VAHAN database. EVs constitute at least 4.7% of total automobile sales for the calendar year (CY) 2022 (Philip, 2022).

Certain platform-based delivery aggregator and delivery operator entities have also announced their commitment on transitioning towards 100% electrification and have started pilots with electric vehicles in their delivery fleet. The announcements are driven by a variety of factors at various levels:

1. Tapping into potential benefits of reduced operational costs.
2. Compliance with regulatory norms aimed at reducing carbon footprint and air pollution.
3. Companies' commitment to reducing environmental footprint, and seeking the necessary policy and regulatory support to enable full transition to clean mobility.
4. Investors who prioritise environmentally conscious and use ESG frameworks to assess the impacts of their investments.

While these trends set the pace for fleet electrification across form factors, a more sustained effort is needed to ensure that the transition is sustainable and can subsequently be expedited to meet climate goals. It, therefore, becomes necessary to develop a baseline scenario and understand the prospects, opportunities, and challenges of electrifying two-wheelers used primarily for commercial applications. The envisioned outcomes will offer policymakers an opportunity to create a favourable environment for such transition among delivery and fleet aggregators and operators.



1.3. Objectives and Scope of the Study

This study focuses on commercial application of two-wheelers and aims to understand the current market scenario, challenges, opportunities and enablers. Its objective is to draw policy recommendations to boost EV adoption in the two-wheeler segment for commercial applications within the State. In this regard, the study seeks to examine the following:

1. Current ecosystem of the transport sector in Tamil Nadu, with a focus on two-wheeler adoption
2. Current landscape of commercial applications of two-wheelers, including the types of stakeholders and their interactions
3. Current EV adoption scenario in the state, with a focus on electric two-wheelers
4. Adoption of EVs for commercial purposes, the supporting ecosystem and the current drivers within it
5. Current opportunities, enablers and barriers within the state for increasing the share of EVs in commercial applications
6. The social, economic, and environmental impacts generated by the adoption of EVs in the State
7. Recommendations for increasing the adoption of EV two-wheelers for commercial applications within the State.

1.4. Flow of the Report

The report is divided into the following sections.

1. Approach and Methodology
2. Current state of mobility ecosystem in Tamil Nadu
3. Current state of adoption of EVs in Tamil Nadu
4. Opportunities, enablers, and barriers
5. Impact of increased adoption
6. Recommendations and the way forward



2. Methodology

Given the complexity of the subject and the presence of various stakeholders with their respective, and often competing priorities, conducting a stakeholder consultation, in addition to research, helps paint a detailed picture of the current scenario of two-wheeler usage for commercial purposes in Tamil Nadu.

2.1. Literature Review

Review of the existing literature proved valuable in identifying areas of prior scholarship highlighting research gaps and identifying conflicts in previous studies. This was useful in narrowing down the questions that need to be addressed, building the case for additional research and addressing the challenges suitably (UpState Library, 2022).

Given this context, an extensive review of the existing literature on the subject was conducted focusing on the following points.

1. Landscape of vehicle usage in Tamil Nadu; penetration of two-wheelers for commercial purposes and challenges faced
2. Current status of electrification of vehicles and adoption rate of electric two-wheeler fleet
3. Status of the support ecosystem, particularly charging infrastructure, within Tamil Nadu
4. The policy ecosystem to encourage EV adoption in Tamil Nadu, including the regulatory policies surrounding tariff ecosystems
5. Global benchmarks on EV adoption and the supporting charging infrastructure
6. Enablers arising from the gig and platform economy and the status of the sector

Additionally, to understand the drivers and the enablers for adoption of EVs in this space, we undertook a study based on the following data sets.

1. The contribution of transport sector to climate change and air pollution
2. The climate change commitments within the State and the potential role of the transport sector for the same.
3. The current air pollution/pollution challenges across the State

During this process, the following information sources were identified:

1. Global, national, and state policies and regulations on electric mobility
2. Technical Reports on EV and charging infrastructure
3. Databases to understand vehicle penetration in the State, such as:
 - VAHAN Database
 - Road Transport YearBook of Ministry of Road Transport and Highways
 - Tamil Nadu government's state road transport data and projections
4. Database on charging infrastructure prepared by BEE (EV Yatra)
5. Central Pollution Control Board (CPCB) data on the current status of the air pollution and critically polluted areas within Tamil Nadu.
6. Public announcements pertaining to the development of the charging ecosystem and/or battery swapping ecosystem, wherever applicable.

The literature survey helped to narrow down the stakeholder list and then design our survey exercise. This was necessary, as we realised that information related to two important factors were absent:

1. The availability of clear data on the number of two-wheelers in operation for commercial purposes within the state proved to be elusive.
2. Information gaps surfaced in relation to specific elements of the EV ecosystem, such as battery swapping stations, charging station utilisation, and the density of charging stations within the State.

2.2. Stakeholder Consultations

For this process, the questions varied for different sets of stakeholders, considering their unique entry point into the problem at hand. Thus, the questionnaires were prepared to ensure relevance, and coverage. They aimed at capturing the most pertinent data to aid decision-making. The questionnaires were subsequently submitted for review by the team at Guidance Tamil Nadu, before being administered on a representative sample of stakeholders in the ecosystem. The questions sought to achieve three objectives:

1. Accurately assess the deployment of two-wheelers (EV and non-EV) for commercial purposes in Tamil Nadu
2. Fill gaps on information specific to the state of Tamil Nadu that were observed in the literature survey
3. Capture and propose meaningful policy recommendations relevant to the state of Tamil Nadu that may be rolled out to encourage adoption of EVs for commercial purposes.

Following this, a mix of interactive methods were employed to engage with the stakeholders. Detailed interactions were conducted with government agencies and private sector organisations of Tamil Nadu with the support of Guidance Tamil Nadu (Table 1 of annexure). These interactions helped bring together diverse stakeholders onto a common platform to create awareness and foster understanding of the issue at hand. Written responses and individual stakeholder consultations were also sought from organisations in response to the questionnaire, to document their experiences with electrification of fleets and their role therein. Additionally, consultations were undertaken with subject matter experts from reputed think tanks and civil society organisations to gain insights about the perspectives, barriers, and opportunities within this domain in the State. This was followed by a closed-door round table with the industry to validate our findings and seek further recommendations on the way forward.

Data collection is to be followed by a ground level assessment of driver partners at a later stage. To that end, a calibrated approach has been proposed, keeping in mind the following factors.

- According to the Census 2011 (Government of Tamil Nadu, 2021), the state of Tamil Nadu has thirty-two urban centres, with a population of 100,000 and above, with a cumulative population of 17.8 million people (1.78 crore). However, a closer examination reveals that more than half (51%) of this population is concentrated in three cities – Chennai, Coimbatore, and Madurai. These centres are the state's leading economic centres as well, and serve as the potential market for a large number of stakeholders being considered in the survey.
- Any decisions taken around electrification of commercial fleets will likely be led by the rollout in these cities. Therefore, it is essential to understand the availability of supporting infrastructure within these cities, with respect to the electric vehicle ecosystem.

Additionally, the Tamil Nadu EV Policy 2023 has identified three other cities - Tiruchirapalli, Salem, and Tirunelveli - in addition to the aforementioned ones for development as model EV cities. Therefore, it was essential to consider the state of infrastructure and the presence of two-wheeler usage for commercial purposes in all of these six cities.



3. Current Mobility Ecosystem in Tamil Nadu

Transport vehicles in India are broadly categorised into two, based on the type of service they provide. This includes passenger carriers and goods carriers. Passenger carriers are further classified into private and public vehicles as listed in the following chart (figure 3). It is important to note that the classification is not impacted by the source of energy or fuel used.

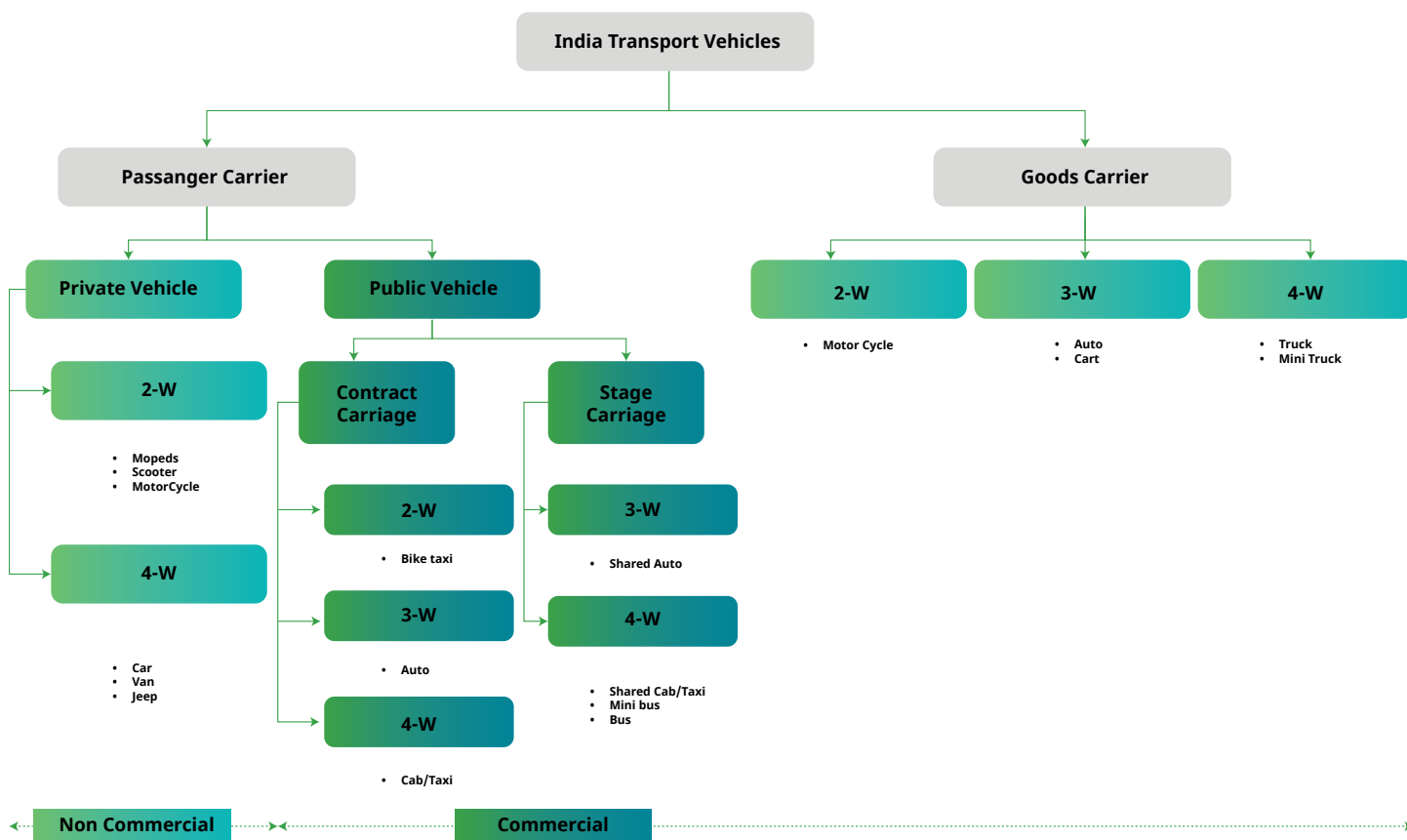


Figure 3: Vehicle categories and associated services in the Indian market; Source: NITI Aayog (2021) and authors' analysis

3.1. Growth of the Transport Sector

Mobility plays a pivotal role in providing access to jobs, education, healthcare and trade. It has been the growth engine for development. Rapid urbanisation has been the major driving factor of growth for the transport sector. India's rate of urbanisation increased from 31.2% (Chandramouli 2011) to 34.9% (UNCTAD, 2021) from FY2011 to FY2020. 60% of India is expected to live in cities by 2050 as per the Government of India, which will significantly escalate the demand for mobility will rise manifold in the future (Livemint, 2016).

Moreover, the mobility landscape is also rapidly evolving. New forms of mobility like shared, electric and connected mobility are gaining prominence. App-based mobility services, particularly for first- and last-mile connectivity, are gaining popularity especially in cities like Chennai, where they serve as feeder services to metro stations.



²Passenger carriers or contract carriage means a motor vehicle which carries a passenger or passengers for hire or reward and is engaged under a contract, whether expressed or implied, for the use of such a vehicle as a whole for the carriage of passengers. Goods carriage means any motor vehicle constructed or adapted for use solely for the carriage of goods, or any motor vehicle not so constructed or adapted when used for the carriage of goods as per Motor Vehicles Act 1988.

Transport Vehicles State Wise (2019)

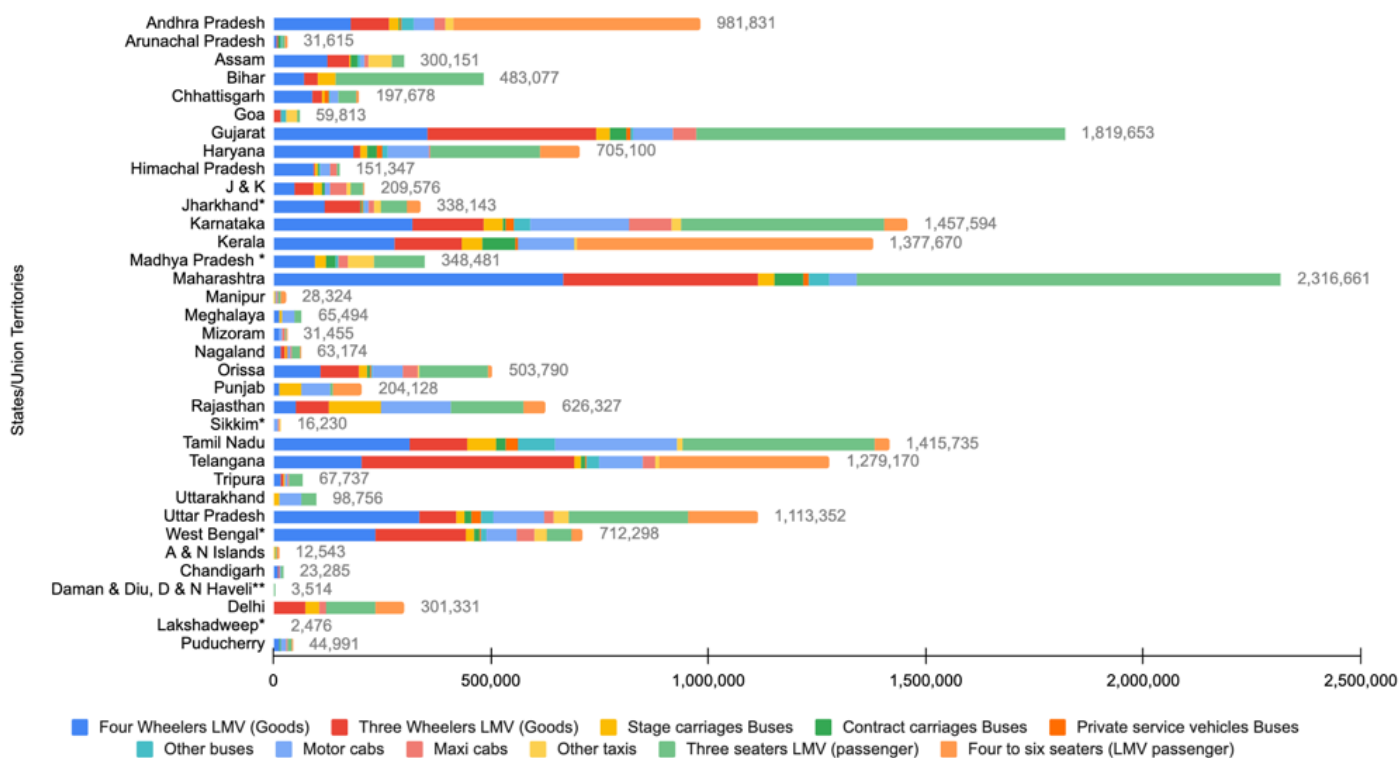


Figure 4: State/UT wise distribution of Registered Motor Vehicle (in 000) as on 31st March, 2019; Source: MoRTH (2021)

*: Data relates to 2016-17 as data for the year 2017-18 was not furnished by the State Govt.

** : Data included in D&N Haveli

Non Transport Vehicles State Wise (2019)

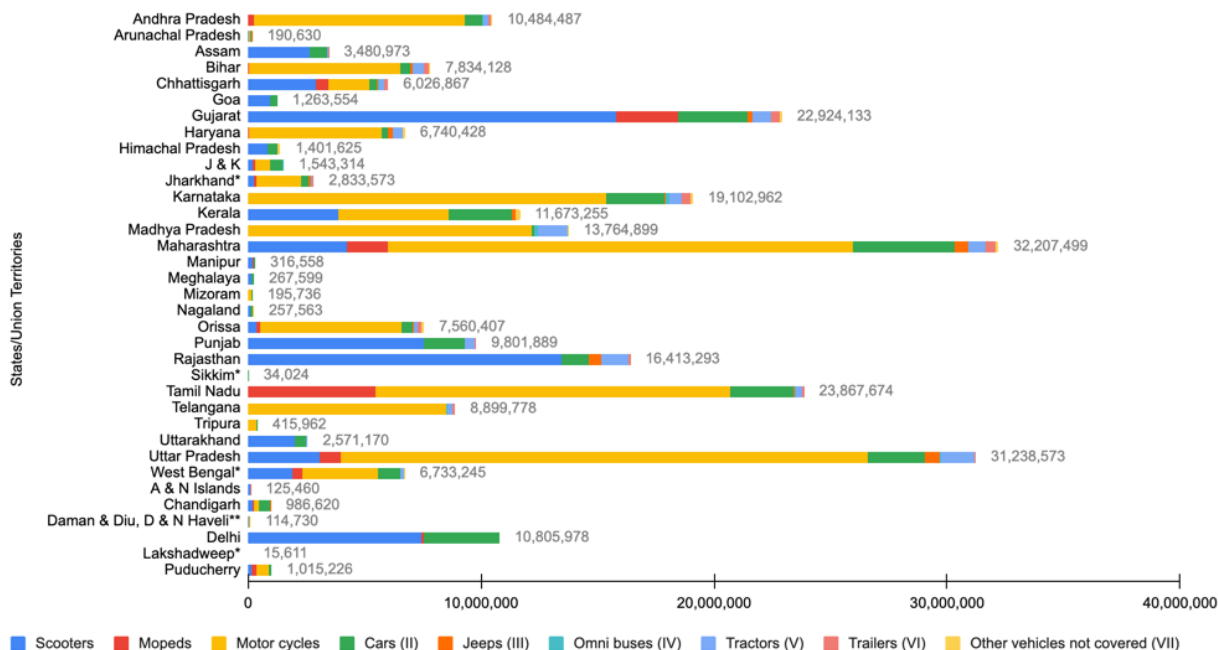


Figure 5: State/UT wise distribution of Registered Motor Vehicle (in 000) as on 31st March, 2019; Source: MoRTH (2021)

*: Data relates to 2016-17 as data for the year 2017-18 was not furnished by the State Govt.

** : Data included in D&N Haveli

Tamil Nadu ranks third nationally when it comes to vehicle registrations. In the year 2018-19, the number of vehicle registrations in the State stood over 3 crore (figure 4 and figure 5), placing it behind Maharashtra and Uttar Pradesh, accounting for 10.2% of the total vehicles registered in the country (MoRTH, 2021). The State registered a CAGR of 8.8% over a 10-year period from 2009-2019. The total vehicle population for Tamil Nadu is projected to reach 9.8 crore by 2030 (Government of Tamil Nadu, 2019), which is three times the State's vehicle population in the year 2018-19.

3.2. Two-Wheeler Dominance in the State

In Tamil Nadu, two-wheelers dominate the market, accounting for over 76% of total vehicles registered in FY 2023-24, exceeding the national average (71.2%) and other states with higher vehicle registrations, like Uttar Pradesh (72.4%) and Maharashtra (69.6%) . The number of two-wheeler registrations in Tamil Nadu has surpassed 2.5 crore in Tamil Nadu, with an annual average registration of 13.6 lakh over the past five years. (Table 1). It is noteworthy that moped registrations in the State have crossed 27 lakh (VAHAN, 2024), indicating a significant demand for low speed two-wheelers. This is important because certain entry-level electric two-wheelers get classified as low speed two-wheelers, despite not adhering to stated norms, including speed restrictions of 25 km/hour. However, the Government of India has recently issued a note of caution on these low speed scooters, noting that high battery, low-speed vehicles contravene the Central Motor Vehicles Rules (CMVR Act), 1989, and that under specific provisions mandated by the CMVR Act, appropriate action must be taken against dealers found guilty (Autocar India, 2022).

Year	Total Registered Two-Wheelers
2019	16,19,670
2020	12,39,498
2021	12,10,574
2022	13,36,512
2023	14,03,648

Table 1: Registration of two-wheelers in Tamil Nadu over the last 5 years; Source: VAHAN

Chennai, Coimbatore, and Thiruvallur are the top three districts in the State with the highest number of two-wheelers as enumerated in Table 3 (TNSTA, 2021).

District Name	Number of Two-Wheelers
Chennai	4,903,370
Coimbatore	2,502,486
Thiruvallur	1,390,321
Salem	1,281,925
Madurai	1,095,614
Erode	966,586
Tiruchirappalli	942,618
Tiruppur	859,763
Namakkal	796,157
Thanjavur	727,505
Thanjavur	727,505

Table 2: Top 10 districts in two-wheeler registrations in Tamil Nadu as of April 2021; Source: Tamil Nadu State Transport Authority

Two-wheelers used as commercial vehicles operate on private registration due to the regulatory framework in Tamil Nadu. In Tamil Nadu two-wheeler vehicles are categorised as non-transport vehicles. However, despite the registration challenges, it is evident that two-wheelers are extensively used for commercial purposes in most urban centres of Tamil Nadu. A large

number of services like home delivery, postal and courier services, parcel delivery, grocery and e-commerce retail presence tend to depend on two-wheeler services for last mile delivery. This is prevalent in many states with significant market size, especially in the case of electric two-wheelers, where OEMs have reported a surge in sales driven by the electrification of the e-commerce logistics fleet. (Philip and Balakrishnan, 2022). Business-to-Business (B2B) segment constituted 23% of Hero Electric's sales in 2022, up from 14% in 2021. Greaves Electric Mobility (which sells EVs under the Ampere brand) reported a similar trend, with the B2B segment representing 10% sales, doubling from 5% in 2021 (Philip and Balakrishnan, 2022).

The emergence of the platform economy has led to the creation of numerous jobs across India, with Tamil Nadu being a contributor to this trend. **Based on insights from stakeholder consultations, we estimate that around 2 lakh (200,000) two-wheelers are utilised for commercial purposes in the State, with a predominant focus on food delivery and bike taxi applications.**



3.3. Three-wheelers and Cars in Tamil Nadu

Tamil Nadu has over 6.5 lakh registered three-wheelers in the transport category and over 17,000 vehicles in the non-transport category (VAHAN, 2024). There was a dip in the sales during the years 2020 and 2021 due to the Covid-19 pandemic. The sales have since improved in the year 2022 (Table 3).

Year	Transport	Non-Transport
2019	42,527	243
2020	18,759	151
2021	14,892	164
2022	22,047	221
2023	44,521	286

Table 3: Registrations of three-wheeler vehicles in Tamil Nadu in last 5 years; Source: VAHAN

The number of registered personal cars (officially categorised as 'light motor vehicles') in the state is over 4.2 million (42 lakh) and over 0.44 million commercial cars (4.4 lakh) (registered under the category 'light passenger vehicle') in the state. New personal car registrations have grown at a CAGR of 6.31% in the last five years (Table 4).

Year	Light Motor Vehicle	Light Passenger Vehicle
2019	2,07,169	18573
2020	1,72,882	7667
2021	2,25,220	4624
2022	2,58,444	7422
2023	2,81,330	14942

Table 4: Registrations of Cars in Tamil Nadu in last 5 years; Source: VAHAN

In Tamil Nadu, EV penetration in three-wheelers, however, remains low compared to two-wheelers. Across India, the electric three-wheeler market is driven by e-rickshaws which mostly run on lead acid batteries. Such lead acid battery-powered electric rickshaws are not a common sight in Tamil Nadu unlike many cities (Tiers 1, 2, and 3 alike) in North India and East India, a fact that e-rickshaw developers also acknowledge (Business Standard, 2021). EV penetration in the auto rickshaw segment is also dictated by the licensing regime and the high entry cost of the vehicle (Sundaram, 2021), wherein new permits are issued at intervals and only in specific lot sizes. This trend of low vehicle numbers is true for electric four-wheelers as well. Electric four-wheelers continue to be more expensive than ICE equivalents, which affects their sales in a price sensitive market.



4. Current Electric Two-wheeler Ecosystem in Tamil Nadu

4.1. Number of Registered Electric Two-wheelers

The electric two-wheeler ecosystem in Tamil Nadu has experienced significant growth over the past three years, reaching a milestone of 1,00,000 registrations in December 2022. Currently, the number stands at 2.1 lakh (as on 10 April 2024). Over 80% of all the two-wheeler electric vehicle registrations in the State happened in the year 2022 and 2023 (Table 5). This surge in registrations indicates a high degree of acceptance (ET Now, 2022) and perceived cost effectiveness (Thakkar and Shyam, 2022).

Year	Number of registered electric two-wheelers
2013	171
2014	51
2015	14
2016	10
2017	31
2018	1,264
2019	3,389
2020	5,413
2021	23,937
2022	61,621
2023	78,421

Table 5: Registrations of electric two-wheelers in Tamil Nadu for CY 2013-2023*; Source: Vahan



The EV ecosystem in Tamil Nadu is currently led by two-wheelers, driven by factors like affordability, price parity with ICE vehicles, and consumer preferences favouring two-wheelers over cars. In FY 2023-24 electric two-wheelers constituted a remarkable 86% of all the electric vehicles sold in Tamil Nadu.

According to the VAHAN portal for FY 2023-24, there are 70 Original Equipment Manufacturers (OEMs) selling electric two-wheelers in Tamil Nadu. The leading manufacturers among them are Ola Electric, TVS, and Ather, which together have sold over 61% of all the registered electric two-wheelers in the year (Table 6). It is worth noting that all three manufacturers are located in Tamil Nadu, highlighting the state's prowess in electric two-wheeler manufacturing.

Year	Number of registered electric two-wheelers
Ola Electric Technologies Pvt Ltd	19,011
TVS Motor Company Ltd	18,019
Ather Energy Pvt Ltd	16,723
Greaves Electric Mobility Pvt Ltd	7,957
Ampere Vehicles Private Limited	4,495
Bajaj Auto Ltd	3,676
Bgauss Auto Private Limited	3,043
Hero Electric Vehicles Pvt. Ltd	2,223
Okinawa Autotech Pvt Ltd	1,921
Hero Motocorp Ltd	1,744

Table 6: Top 10 Electric Two-Wheeler Manufacturers based on vehicles registered during FY 2023-24; Source: VAHAN Database Accessed on April 10, 2024

4.2. Current Penetration of Electric Two-wheelers in the Commercial Segment

Till June 2023, the registration of EVs was limited to private vehicles in Tamil Nadu. Thus, private-registered internal combustion engine-powered two-wheelers have been used for commercial purposes. At the same, the Tamil Nadu EV Policy 2023 (Government of Tamil Nadu, 2023) stipulates that the State's Transport Department shall issue guidelines and undertake capacity building of Regional Transport Offices (RTOs) to enable registration of two-wheelers for commercial use. Subsequently, the Tamil Nadu government's G.O. (Ms.) No. 319 dated June 28, 2023 brought in the following order:

"3. Hence, for proper regulation and also to avoid unnecessary confusion among the operators, all battery transport vehicles and also vehicles driven on ethanol and methanol fuel meant to be used as transport vehicles except goods vehicles whose GVW is below 3,000 kg shall be issued with permit without payment of any permit fee."

Notably, as per S.O. 1248, dated November 5, 2004 the Ministry of Road Transport and Highways, Government of India, classified motorcycles used for hire to carry one passenger on pillion as transport vehicles.

To enhance understanding, further explanation regarding the recent Government Order (G.O. Ms.) No. 319 issued by the Tamil Nadu government would be beneficial, particularly in relation to its relevance for two-wheelers. This would help in ensuring that the registration process of two-wheelers as transport vehicles at Regional Transport Offices (RTOs) proceeds without any issues.

The regulatory unambiguity notwithstanding, Tamil Nadu is home to several electric two-wheelers used for commercial purposes. **Through stakeholder consultations, we find that the adoption of electric two-wheelers, however, at 200,000 (2 lakh) is less than 5% of the total two-wheelers used for commercial applications in the State.** It is worth noting that the adoption is relatively higher in quick commerce applications compared to bike sharing applications. One of the reasons for the difference is lower range anxiety associated with shorter trips made in hyperlocal deliveries. Boston Consulting Group, in a recent study, estimated the national average for electric vehicle adoption for commercial two-wheelers in organised last-mile deliveries to be between 1.5% to 2%, and projected to reach 20% to 30% by 2025 (Janakiraman et al, 2023).



5. Factors Influencing Adoption of Electric Two-wheelers in Commercial Segment

Based on the discussions and secondary literature review, it has been found that two-wheeled vehicles have been a popular choice for commercial applications for last mile delivery. One significant factor driving this preference is lower cost associated with hiring a two-wheeler compared to hiring a truck. (Porter, 2022). Another major benefit of utilising two-wheeler vehicles for last-mile delivery is that the majority of the drivers own their vehicles. In contrast, four-wheeler load vehicles or big trucks are more suitable for bulk transportation in its category and long-distance transportation of products. Moreover, narrow streets and never-ending traffic jams make these two-wheeler-based transportation highly advantageous for e-commerce and food delivery companies, as it enables deliveries to the customers in various locations, including interior pockets of the towns and metropolises (Gupta, 2021).

Research shows that the following factors have been key in generating interest in the adoption of electric two-wheelers in the commercial segment (Appan et al, 2022):

1. Steep rise in petrol prices, falling battery prices, increase in the number of electric two-wheeler models and the lower operating cost associated with electric two-wheelers have emerged as major, if not the primary, factors influencing the decision to transition to EVs. Companies like Flipkart have acknowledged that, considering the total cost of ownership (TCO), light EVs (two-wheelers and three-wheelers) have already become economically viable, particularly when the daily utilisation of the vehicles is high. This high utilisation scenario is typically observed in many commercial applications of two-wheelers.
2. The growth of the convenience economy or hyperlocal economy characterised by the mushrooming of e-commerce, hyper local delivery and first- and last-mile connectivity businesses - has created a favourable environment for electric two-wheelers. Typical characteristics of commercial applications like fixed pick-up points, consistency of kilometres travelled daily, and predictability of routes and energy demands make electric two-wheelers a suitable choice for businesses in the sector.
3. Government nudges in the form of incentives and mandates have also emerged as a driver for adoption of electric two-wheelers in the commercial segment. Electrification of shared mobility including public transport, intermediate public transport, vehicles used for hyperlocal deliveries and long-haul, has gained immense public policy currency at the central and state levels alike. This has been complimented by efforts of the central and state governments to create robust charging networks.
4. Environmental unsustainability of the commercial segment has driven large players to adopt alternative methods, making way for electric vehicles. For instance, it is well known that the existing urban logistics system is often unsustainable, and the growing shipments of e-commerce goods to consumers' doorsteps have a negative impact on cities, including by increasing the quantum of carbon emissions, local vehicular and noise pollution, and traffic congestion.

5.1. Availability of Charging Infrastructure for Two-Wheelers

Charging infrastructure is the backbone of EV adoption. It is crucial that such infrastructure is affordable, accessible, and reliable. In accelerating electrification of commercial vehicles, charging infrastructure will play a critical role in minimising the down time of the vehicle, thereby maximising the remunerative opportunities of the vehicle.

According to the Tamil Nadu EV Policy 2023, the State has planned to install charging stations at every 25 kms along National Highways and State Highways. These stations will also be set up in Government offices, public places in six "EV cities" i.e Chennai, Coimbatore, Madurai, Tiruchirappalli, Salem and Tirunelveli (Government of Tamil Nadu, 2023). Under the Policy, the government has also proposed to encourage existing apartments with 50+ families and residential townships with 500+ families to set up charging points and charging stations respectively. The Policy also states that commercial building operators like hotels/malls/multiplexes/apartments shall be encouraged to set up EV Charging stations.

Aggregators in commercial applications face distinct requirements compared to public charging stations when it comes to reducing vehicle down time. For instance, quick commerce players can use their dark stores as locations for setting up charging infrastructure, effectively minimising vehicle down time. The state government aims to address this challenge, by now providing a capital subsidy of 25% on the cost of equipment and machinery for the first 50 such private charging stations set up in the State, as outlined in the new Policy (Government of Tamil Nadu, 2023).

According to the Bureau of Energy Efficiency's EV Yatra Portal as on 10 April 2024, the State currently has 643 public charging stations. Chennai, Coimbatore and Salem are the top three cities with respect to availability of charging stations in the State (see figure 6).

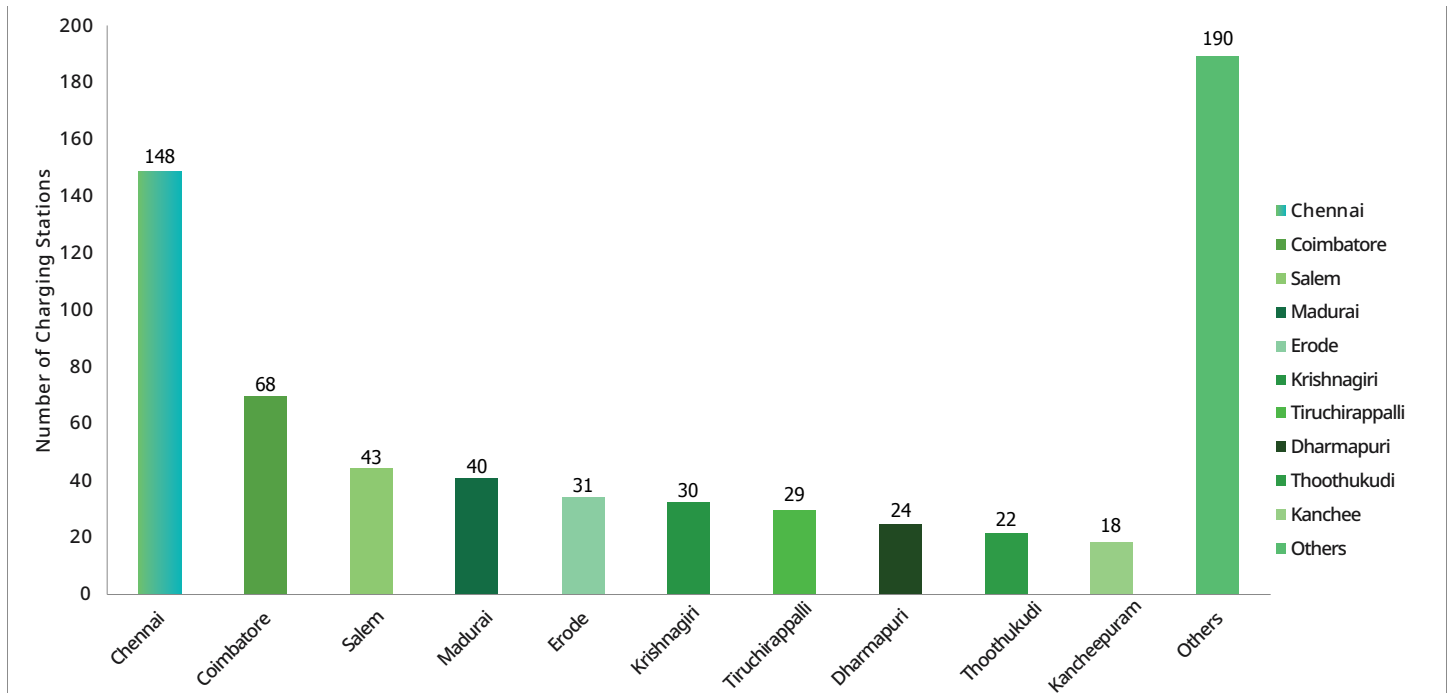


Figure 6: Top 10 cities by public charging stations in TamilNadu; Source: BEE EV Yatra Portal accessed on 3 July 2023

5.2. Availability of Battery Swapping Stations for Two-Wheelers

Tamil Nadu EV Policy 2023 has adopted a technology-agnostic approach towards charging infrastructure. Additionally, the policy places a strong emphasis at building a robust battery swapping infrastructure within the State. Thus, the policy has announced that the first 200 public battery swapping stations set up in the State shall be eligible for a capital subsidy of 25% on the cost involved in the purchase of equipment and machinery, limited to INR 2 lakh per station.

The approach is based on recent developments and empirical evidence, as battery swapping has emerged as an effective way to improve the uptime of commercial vehicles and address range anxiety issues in tandem with a well-distributed charging network. The Government of India has drafted a policy on it, which can be accessed on the NITI Aayog website (NITI Aayog, 2022). This policy draft notes the following advantages for battery swapping:

1. With existing technologies for e-2Ws and e-3Ws, regular charging takes at least 3 to 4 hours, adding to inconvenience and creating range anxiety. The resulting vehicle downtime is particularly challenging for freight and shared mobility vehicles. Whereas, battery swapping is done in minutes, as the batteries are pre-charged in swapping stations.
2. Charging stations require more space, since vehicles need to be parked next to the chargers during the charging process. Battery swapping stations can stack multiple batteries on top of each other, and require limited parking, which would address space constraints in urban areas.
3. While battery swapping involves a greater number of batteries than conventional batteries, each swappable battery can be smaller in capacity (kWh), since range anxiety is a smaller concern.

Globally, Gogoro is a leader in battery swapping. It claims to carry out 400,000 battery swaps each day across its 12,500 battery swap stations (Borrás, 2023). This arrangement allows driver partners to swap a charged battery at a nearby battery swapping station in less than 5 minutes, eliminating the prolonged charging time. This has led to some states actively attempting to create an ecosystem that supports battery swapping too. In Indian states like Delhi, Maharashtra and Goa, the state government has approved a purchase subsidy for E2Ws sold without pre-fitted batteries. These states offer a 50% subsidy to the battery swapping operator (BSO) and the remaining 50% to the vehicle OEM or owner, as applicable (ICCT and NITI Aayog, 2022).

Battery swapping as a model can also reduce the upfront cost of the vehicle by delinking the battery and the vehicle, and introducing subscriptions through battery-as-a-service. Delivery aggregators like Swiggy are conducting battery swapping pilots in Bengaluru (Autocar India, 2021). While companies had shown interest in setting up stations following the 2022 Union Budget announcement (The Times of India, 2022), The state is actively collaborating with both private and public entities to innovate business models for charging infrastructure, aiming to enhance the on-the-ground situation. Previously, in 2021, Hindustan Petroleum Corporation Limited (HPCL) and GoFuel had announced plans to set up battery swapping stations in Tamil Nadu at the HPCL retail outlets (The Hindu, 2021) but, but further updates on their progress was scarce. As battery swapping gains momentum, it is crucial to recognize the potential complications surrounding insurance and liability in case of battery or vehicle damage, as well as possible injuries to the riders resulting from any malfunctions of a swapped battery. To effectively mitigate these risks, insurance products will have to be developed or updated to appropriately address the unique challenges associated with battery swapping

5.2. Availability of Battery Swapping Stations for Two-Wheelers

The government of Tamil Nadu has planned public charging infrastructure every 25 kilometres on state and national highways (Government of Tamil Nadu, 2023). These guidelines are in line with those issued by the Ministry of Power (Ministry of Power, 2022). Special emphasis has been laid on making Tamil Nadu Generation and Distribution Company (TANGEDCO) responsible for leading the charging infrastructure installation across the State (see box below).

Tamil Nadu's EV Policy on Charging Infrastructure: A brief overview

As per the Tamil Nadu EV Policy, 2023 outlines the State Government's commitment to development of charging infrastructure, and it includes various measures to achieve this goal. The measures are as follows.

- * Government shall undertake demand assessment to ascertain State's peak electricity requirements triggered by faster EV adoption
- * Identification of sites for public slow and fast charging stations in Government offices and public places, Smart City Missions/Corporations in the "EV Cities".
- * Identify and prioritise the establishment of charging stations on National and State Highways at 25 km intervals on both sides
- * Undertake measures to simplify requirements for establishment of public charging stations in the State
- * To encourage decarbonisation in the charging network the cost of renewable energy equipment such as rooftop solar panels shall be considered as a part of the equipment and machinery cost for charging/swapping stations provided at least 75% of the energy produced is used by the charging station.
- * Firms, which establish public charging stations in Tamil Nadu complying with the guidelines and standards issued by the Ministry of Power, Government of India will be eligible for 25% subsidy of the cost involved in the purchase of equipment & machinery during the policy period for the first 500 slow charging stations and the first 200 fast charging stations.
- * The first 50 private charging stations set up in Tamil Nadu shall be eligible for a capital subsidy of 25% on the cost involved in the purchase of equipment and machinery during the policy period
- * The first 200 public battery swapping stations set up in Tamil Nadu shall be eligible for a capital subsidy of 25% on the cost involved in the purchase of equipment and machinery limited to Rs. 2 lakh per station
- * The Government of Tamil Nadu shall also undertake the development of public charging infrastructure in EV cities Chennai, Coimbatore, Madurai, Trichy, Salem, and Tirunelveli through public private collaboration.

Tariff for the supply of electricity to Public Charging Stations (PCS) is determined by the Tamil Nadu Electricity Regulatory Commission (TNERC) and the policy stated that every effort shall be made to keep the tariff within 15% above the average cost of supply (ACS). The Tariff Order (TNERC Order No: 7 in of 2022 in T.P.No.1 of 2022 dated: 09.09.2022) (TNERC, 2022) which classified private charging stations as domestic consumption, while classifying charging of EVs through PCS under separate categories, LT-VII and HT-V. A Time of Day (ToD) pricing was also announced for public charging stations (Tables 7 and 8) (TNERC, 2022). Charging station operators have expressed concerns that the rates for public charging, which range from INR 8 to INR 12 per kWh, are considered high (Balachandar, 2022).

Thanks to sustained efforts by the state, there have been improvements in charging station tariffs. In late June 2023, the TNERC took the initiative to reduce the tariffs through a suo motu order (TNERC, 2023). The revised tariffs, ranging from INR 6 to INR 9 per kWh, have reduced public charging costs, albeit they still remain a two-part tariff structure, posing financial challenges for the emerging public charging industry.

Tariff Category	Time slot in hours	Energy charges in INR/kWh (unit)	Fixed charge in INR/kW/month	
High Tension Tariff V	06.00 to 09.00 hrs. and 18.00 to 22.00 hrs	9.00	INR/kVA / month	138.00
	09.00 to 16.00 hrs	6.00		
	16.00 to 18.00 hrs and 22.00 to 06.00 hrs	7.50		

Table 7: TNERC's HT Tariff for Public Charging Stations including swapping stations for FY 2023-24.



Tariff Category	Time slot in hours	Energy charges in Rs/kWh (unit)	Fixed charge in Rs/kW/ month	
Low Tension Tariff VII	06.00 to 09.00 hrs. and 18.00 to 22.00 hrs	9.00	0-50 kW	25.00
	09.00 to 16.00 hrs	6.00	Above 50-112 kW	75.00
	16.00 to 18.00 hrs and 22.00 to 06.00 hrs	7.50	Above 112 kW	138.00

Table 8: TNERC's LT Tariff for Public Charging Stations including swapping stations for FY 2023-24.

The challenge of low utilisation rates for public charging infrastructure persists due to several factors, such as lack of real time information on available charging infrastructure, inadequate parking facilities and high tariff for public charging. Across India, utilisation rates for public stations have ranged from as low as 0% and as high as 50%. Rates as high as 90% have been achieved in highly optimised captive fleet operations where the fleet operator has a great deal of control over fleet charge management (RMI India, 2020).

This situation emphasises the significant responsibility placed on TANGEDCO to develop a strong and widespread network of public charging stations. According to the existing policy framework, TANGEDCO is charged with leading the efforts to enhance charging infrastructure in the state. However, this ambition places considerable demand on both the state's and the utility's resources. Encouraging contributions from the private sector is therefore essential. Insights from Europe indicate that a synergistic approach, combining private and public investments, is crucial for the successful expansion of the charging network, which in turn supports the growth in EV adoption (Conzade et al., 2022).

5.4. Density of Electric Two-Wheeler Charging Infrastructure

One of the important factors for enabling the penetration of electric vehicles is the density of charging infrastructure that comes up. While some argue that charging infrastructure development should wait until electric vehicle numbers reach critical mass, it is widely accepted that wider adoption cannot occur without an appropriately adapted charging infrastructure that takes into account the deployment environment and the behaviour patterns of electric vehicle users (Metais et al, 2021).

Determining what constitutes an adequate number of chargers has become a challenge. Even among countries with fairly developed EV markets, there are no standard ratios for vehicle to chargers (Hall and Lutsey, 2020) (Table 11). The number of EVs per charger in advanced countries are healthier compared to lags behind sales.



Country/ Cities	Number of EVs per Public Charger
Finland	40
United Kingdom	40
Norway (Oslo, Bergen)	20 - 25
Sweden (Stockholm)	23 - 26
United States of America (some markets)	20 - 30
Tamil Nadu*	43
Uttar Pradesh*	94
Maharashtra	27

*Assuming 5 chargers for every public charging station

Table 9: Public Chargers Density Across Different Markets; Source: Hall and Lutsey (2020), World Bank (2022), and authors' analysis



6. Opportunities, and Barriers to Electrification

6.1. Opportunities to Electrify Two-Wheelers in Tamil Nadu

6.1.1. Gig and Platform Economy

A combination of rapid urbanisation, widespread adoption of smartphones, and flexibility of work is accelerating the growth of gig economy jobs in India. India is the first country globally to recognise the new forms of labour prevalent and booming in the 21st century: gig and platform jobs. The Code on Social Security 2020, a landmark labour legislation introduced by the Government of India, defines two new categories of workers in India today: gig and platform workers (Raman, Ramachandran and Sasikumar, 2021). Gig workers are those who operate outside the traditional employer-employee arrangements. Platform workers are gig workers who use the medium of digital platforms (websites, smartphones) to earn a living (Ramachandran and Raman, 2021). A NITI Aayog study estimates that there are 77 lakh (7.7 million) workers engaged in the gig economy in 2020-21, and this number is expected to reach 2.35 crore (23.5 million) by the year 2029-30 (NITI Aayog, 2022). In terms of industrial classification, about 13 lakh workers were reported to be working in the transportation sector which includes delivery aggregators, fleet operators, and fleet aggregators (NITI Aayog, 2022).

In the platform economy's two-wheeler commercial segment, various vehicle ownership models have emerged. These models differ based on the ownership of the vehicle and the specific purpose for which they are utilised (Figure 8).

Two-wheelers in aggregators and fleets categorised by type of vehicle ownership



Vehicle owned by
driver/delivery partner

Vehicle leased by
driver/delivery partner

Vehicle owned by
delivery/fleet operators

Vehicle leased by
delivery/fleet operators

Figure 8: Two-wheelers in aggregators and fleets categorised by type of vehicle ownership; Source: Authors' assessment

- a. **Vehicle owned by driver/delivery partners:** In this model, the driver or delivery partner owns the vehicles and registers with the delivery or fleet aggregator through the application.
- b. **Vehicle leased by driver/delivery partners:** In this model, the driver or delivery partner leases the vehicle from a B2B rental operator or directly from the OEM. The drivers or delivery partners pay a fee for renting the vehicle, and register with the delivery or fleet aggregator through the application.
- c. **Vehicle owned by delivery/fleet operators:** In this model, the vehicle is owned by delivery/fleet operators. The vehicle can be operated through a delivery/driver partner on lease basis with deduction of a certain amount from delivery/driver partner earnings to cover the lease. Alternatively, the operating delivery/driver partner are treated as salaried employees. One extension of this model is the contract approach, where e-commerce entities can choose to subcontract delivery operations to a select few existing delivery operators who in turn adopt these approaches.
- d. **Vehicle leased by delivery/fleet operators:** In this model, the vehicle is leased by delivery/fleet operators from B2B rental operators or through the OEM. The vehicle can be operated through a delivery/driver partner either in a lease model with a deduction from their earnings or as salaried employees.

EV adoption in the commercial segment is experiencing rapid growth, particularly in the model where vehicles are leased and owned by the delivery/fleet operators. This model faces fewer barriers like financing and charging infrastructure. B2B providers like Zyp Electric, etc. play a crucial role in this segment by providing electric vehicles and also supporting the charging infrastructure.

Another benefit that the platform economy unlocks for workers is that it enhances access to formal credit. Drivers of taxis, rickshaws, delivery vehicles etc. with hitherto no record of daily or monthly earnings now have detailed statements of their past and current earnings and future earning potential, thanks to digitalisation of jobs by platforms. This information helps banks, NBFCs as well as new-age fintech companies to extend credit to platform workers. Since platformisation of the mobility economy began as early as 2010, mobility platforms have partnered with banks and NBFCs to support workers in accessing loans to buy vehicles. Furthermore, fintech companies such as Avail Finance and KarmaLife, among others, extend microcredit to platform workers based on their repayment patterns, thanks to digitalisation (Ramachandran, Singh and Narain, 2021). In all these new instances of platform workers accessing credit, there is no system of collateral but financial institutions are extending cash flow-based loans to the new-age workers. OMI Foundation finds in a study that a single fintech company such as Avail Finance (now Ola Insure) alone has disbursed over INR 250 crores as cash flow-based loans to 150,000 borrowers through its partnerships with delivery aggregators (platforms), and staffing agencies across 300 cities (Ramachandran and Raman, 2021). Thus, thanks to cash flow-based credit, we have an emergent class of asset owners in India, i.e. platform workers (ibid).

It is also noteworthy that platform jobs offer higher earning opportunities than any other type of blue-collar work in the formal or informal sector (ibid). It is also estimated that by next decade the gig economy in India can see USD 250 billion transactions, accounting for 1.25% of the country's Gross Domestic Product (NITI Aayog, 2022). This indicates the significant potential for income generation through the gig and platform economy. potential for income generation through the gig and platform economy.

6.1.2. Energy security

Energy security has become an increasingly important concern due to geopolitical tensions and depletion of oil reserves. As the world's third largest consumer of oil, for the year 2021-22, after the USA and China, India heavily relies on imported crude oil, with 85% of its energy needs being met through imports. In the same year, India spent USD 122.5 billion on crude oil, with Iraq, Saud Arabia and UAE being the top three suppliers (figure 9). Crude oil constitutes one-fifth of the total imports of the country and contributes significantly to foreign exchange.



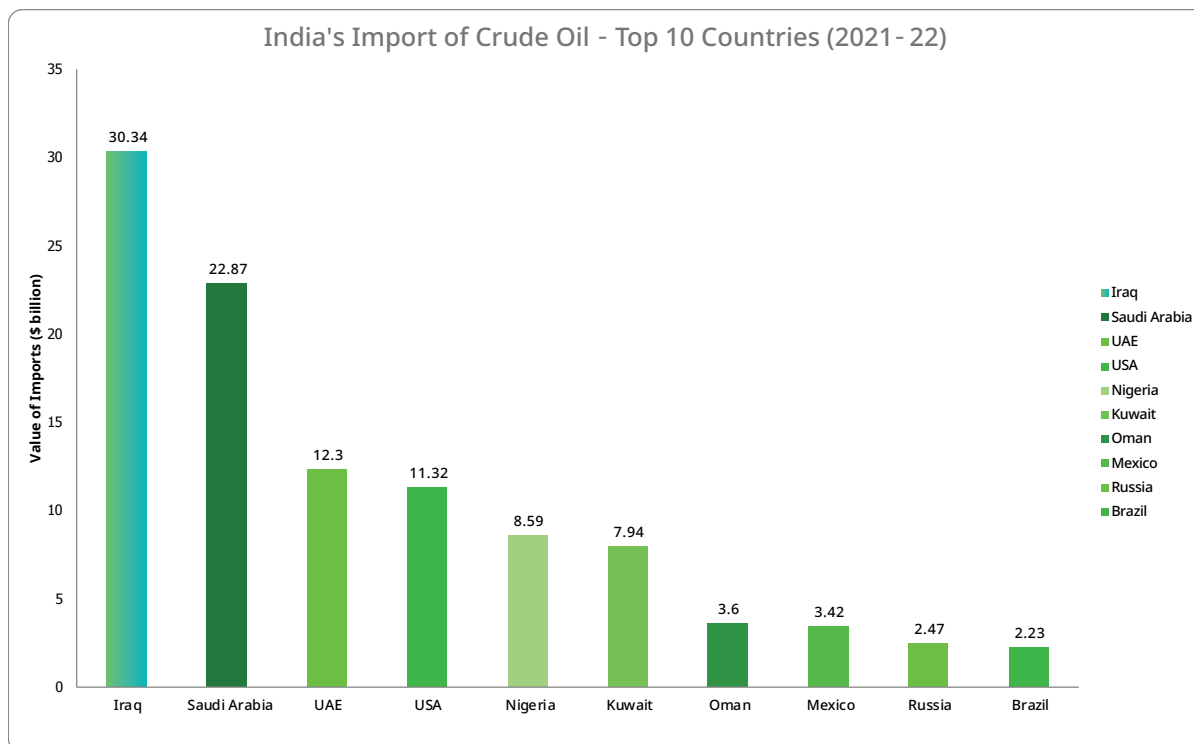


Figure 9: Import of crude oil for India - the top contributing countries (source: EXIM Data, Ministry of commerce, Government of India)

Energy security plays a pivotal role in India to become a 5 trillion economy. According to a study by CEEW, India can save INR 1 lakh crore annually in crude oil imports if India achieves 30% electric vehicle penetration by 2030 in new vehicle sales (Soman et al, 2020).

This dependency is also emphasised by state level consumption data. Tamil Nadu was India's fourth largest consumer of petroleum products, with a share of 6.4% of the total consumption for the year 2021-22 (MoPNG, 2022). Closer inspection reveals that the State exhibits high levels of consumption in fuels relevant for the transport sector particularly petrol and diesel. (see table 12). Based on the past consumption trends, it is anticipated that the consumption would reach 4,297 thousand metric tonnes (assuming no change occurs). A reduction in the consumption of these fuels, therefore, undoubtedly contributes to the economic gains.

Table 10: Petrol and Diesel Consumption of Tamil Nadu for 2021-22; Source: Ministry of Petroleum and Natural Gas (MoPNG, 2022)

Fuel	Total Consumption (Thousand metric tonnes)	Share of overall national consumption of fuel type
MS Petrol	2,758.1	8.9%
High Speed Diesel	5,371	7.8%
Light Diesel Oil	35.8	3.5%

6.1.3. Policy Direction to Reduce Emissions

Over the past 50 years, as the global population continues to double, concentrations of CO₂ have exceeded 400 Parts Per Million (PPM) from 323 PPM in 1972. This increase has been accompanied by extreme weather events like heat waves, cyclones, and droughts.

During the 26th Conference of Parties (COP 26) in Glasgow the year 2021, Prime Minister Narendra Modi proposed a five-fold strategy called Panchamrit, outlining India's commitment to meet the Climate change goals. The strategy includes targets to reduce non-fossil energy capacity to 500 gigawatts by 2030, to meet 50% of energy requirements till 2030 with renewable energy, to reduce carbon emissions by one billion tonnes by 2030, to reduce the carbon intensity of its economy by 45 per cent by 2030 and to achieve net-zero by 2070. Decarbonising the transport sector will be critical to achieve the net-zero ambition.

Keeping in line with its national responsibility, Tamil Nadu has designed a state action plan to combat climate change (Krishna Chaitanya, 2021). The State has shown leadership by launching the Tamil Nadu Climate Change Mission in 2022 (Indian Express, 2022). Decarbonising the transport sector will be vital in achieving the desired reductions in GHG emissions.

Electrifying platform economies, especially in the transport sector, offers multiple benefits, including reduced operational costs and the carbon footprint. Many platform economy businesses like Zomato, Flipkart, Swiggy and Big Basket have started electrifying their fleets (Deccan Herald, 2022). Other major companies like Ola (Goenka, 2023) and Uber (Singh, 2022) have also made announcements of fleet level electrification, which would also extend to two-wheeler bike taxis where applicable. Clearly, there is a window of opportunity to increase the adoption of electric two-wheelers in the commercial sector.

6.1.4. Mitigating air pollution

As per a Lancet study in 2019, air pollution was responsible for 16.7 lakh deaths or 17.8% of total deaths in India for the year (Sharma, 2022), and this number is expected to increase further with the rise in urbanisation. Transport sector has been identified as a major contributor to air pollution in India, and electric mobility has been identified as one of the reduction measures under the NCAP. This has also emerged as a factor driving interest in increasing the penetration of electric mobility. Consequently, there is a growing interest in promoting the adoption of electric vehicles, particularly electric two-wheelers, to address the issue.

These interests are particularly relevant to the state of Tamil Nadu. There are four cities in the state - Thoothukudi, Tiruchirappalli, Madurai, and Chennai - which have been identified as non-attainment cities (see Figure 10). The Clean Air Action Plans for these cities have identified transport as a contributing factor and increasing electric mobility in the cities as one of the strategies. The state government is also taking active measures to reduce the emissions and has selected Chennai, Madurai, and Trichy as pilot cities to deploy e-mobility solutions.

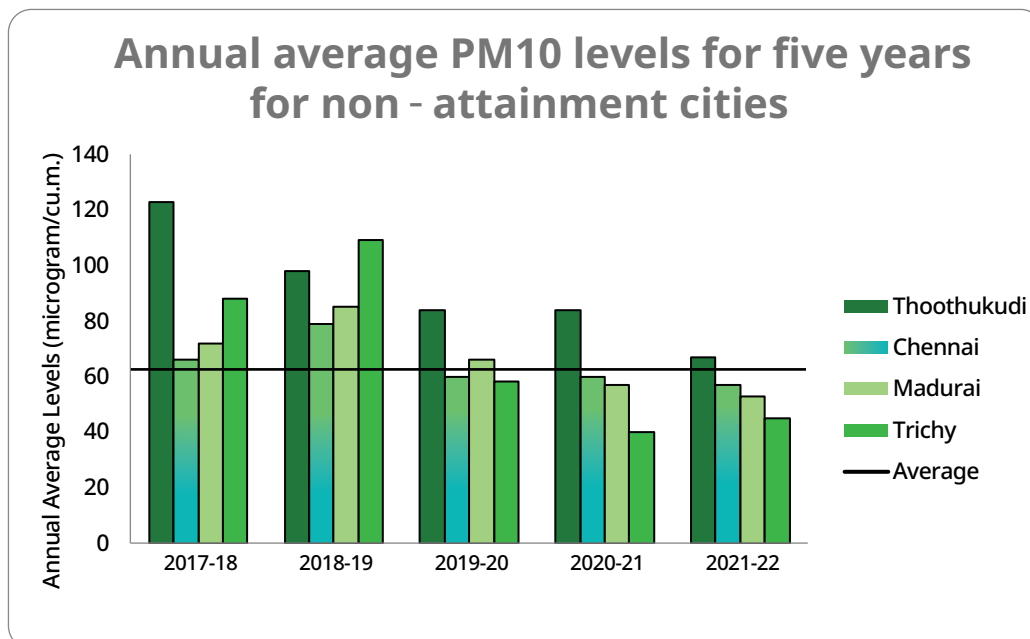


Figure 10: The four non-attainment cities of Tamil Nadu still have emissions higher than the state average (CPCB, 2022)

6.2. Barriers in Electrifying Two-wheelers for Commercial Applications

6.2.1. Vehicle Availability

Vehicle availability is a barrier. Compared to two-wheeler ICE vehicles, there are limited options available in the market when it comes to electric two-wheeler models. As per NITI Aayog e-AMRIT portal, there are currently 39 models in electric two-wheelers approved by FAME II (e-AMRIT, 2022). In contrast, the top three two-wheeler companies in India - Hero Motocorp (18), Honda 2 Wheelers (15), and TVS (13) - offer 46 ICE model vehicles in the Indian market (including scooters and two-wheelers). Additionally, commercial applications often require special vehicle features like increased boot space especially in the case of grocery delivery and e-commerce. Also driver/delivery partners prefer using the same vehicle for commercial and personal use. This means there are even fewer two-wheeler models available for the purpose of commercial applications.

6.2.2. Vehicle Affordability

Vehicle affordability remains a challenge, especially considering that the electric mobility industry is still in its early stages. A study conducted by AEEE found that the average ex-showroom price of an electric two-wheeler is INR 74,093 (table 11) (Natarajan et al, 2022). Range and speed often gets compromised for affordable variants in the electric two-wheeler vehicle segment consequently. As a result, finding an electric two-wheeler that strikes a balance between affordability and performance can be a challenge for potential buyers.

Table 11: Descriptive Statistics of Key Electric two-wheeler model specifications; (Natarajan et al, 2022)

Descriptive Statistics	Average Showroom Price (INR)	Battery Capacity (kWh)	Motor Capacity (W)	Range (km)	Max speed (km/h)	Fuel Economy (km/kWh)	Charging Time (hours)
Mean	74,093	2.23	1,700	98	47	51.53	4.5
Median	67,440	1.8	1,000	86	42	50	4
Min	19,999	0.5	250	50	25	12.2	1.08
Max	1,58,887	8.8	12,000	236	120	124.21	9
Range	1,38,888	7.2	11,750	186	95	112.02	7.92
Standard deviation	23,982	13.6	2,008	36	26	19.26	1.81

6.2.3. Access to Finance

Access to affordable finance for electric two-wheelers, particularly for commercial applications has been a significant barrier. It faces several challenges, including high interest rates (16%-24%), low loan-to-value ratio, high insurance rates and limited availability of EV financing products in the market. Limited availability of integrated financing models with OEMs, banks, NBFCs etc. further hamper the accessibility of EV financing. Additionally, there's a lack of awareness among potential buyers, particularly driver partners, regarding the availability of financing options. Inadequate financial credit history of the driver partners also presents a major hurdle in accessing credit for buying electric vehicles.

6.2.4. Charging Infrastructure Inadequacy and High Two Part Tariff

The lack of reliable, accessible and affordable charging stations poses a barrier to rapid electrification. Utilisation of existing charging infrastructure remains low due to a host of challenges, such as difficulty in identifying the charging infrastructure, insufficient parking provisions at the charging station, limited real-time information about the charging station leading to longer wait times, and charger compatibility issues, among others.

The above mentioned challenges are further magnified in case of commercial applications, as they lead to additional time spent locating and charging the vehicles, ultimately reducing earning opportunities of driver partners. This time lag leads to missed earning opportunities for platform workers.

Another issue associated with charging is the tariff. Tamil Nadu's tariff also follows a two-part tariff structure wherein fixed charges are levied on the charge point/ charging station service provider. Fixed charges compel the charge point/ charging station service provider to incur recurring monthly costs regardless of the utilisation of their service, thereby making public charging an expensive business. Removing fixed charges will help create a conducive environment for service providers, as they will not be billed in the absence of sale of energy for electric vehicles. The state has recently revised the tariff structure, resulting in lower rates compared to the previous tariff. This revision is part of the state's ongoing efforts to make the EV charging infrastructure more affordable and efficient, thus facilitating the growth and adoption of electric vehicles throughout the state.

6.2.5. Low User Awareness

Electric Vehicle technology is still evolving and details like usage, maintenance, and vehicle performance are still unknown to the potential users. There are myths surrounding range anxiety and safety. For instance, it was noted by NITI Aayog, GIZ, ICCT and Deloitte in 2021 that low public awareness continued to be a barrier for increasing electric vehicle penetration in India (NITI Aayog, 2021). This NITI Aayog led study also found that Tamil Nadu policy framework lacks a robust public awareness strategy to address the issue.

6.2.6. Ambiguity in Commercial Applications of Two-wheelers

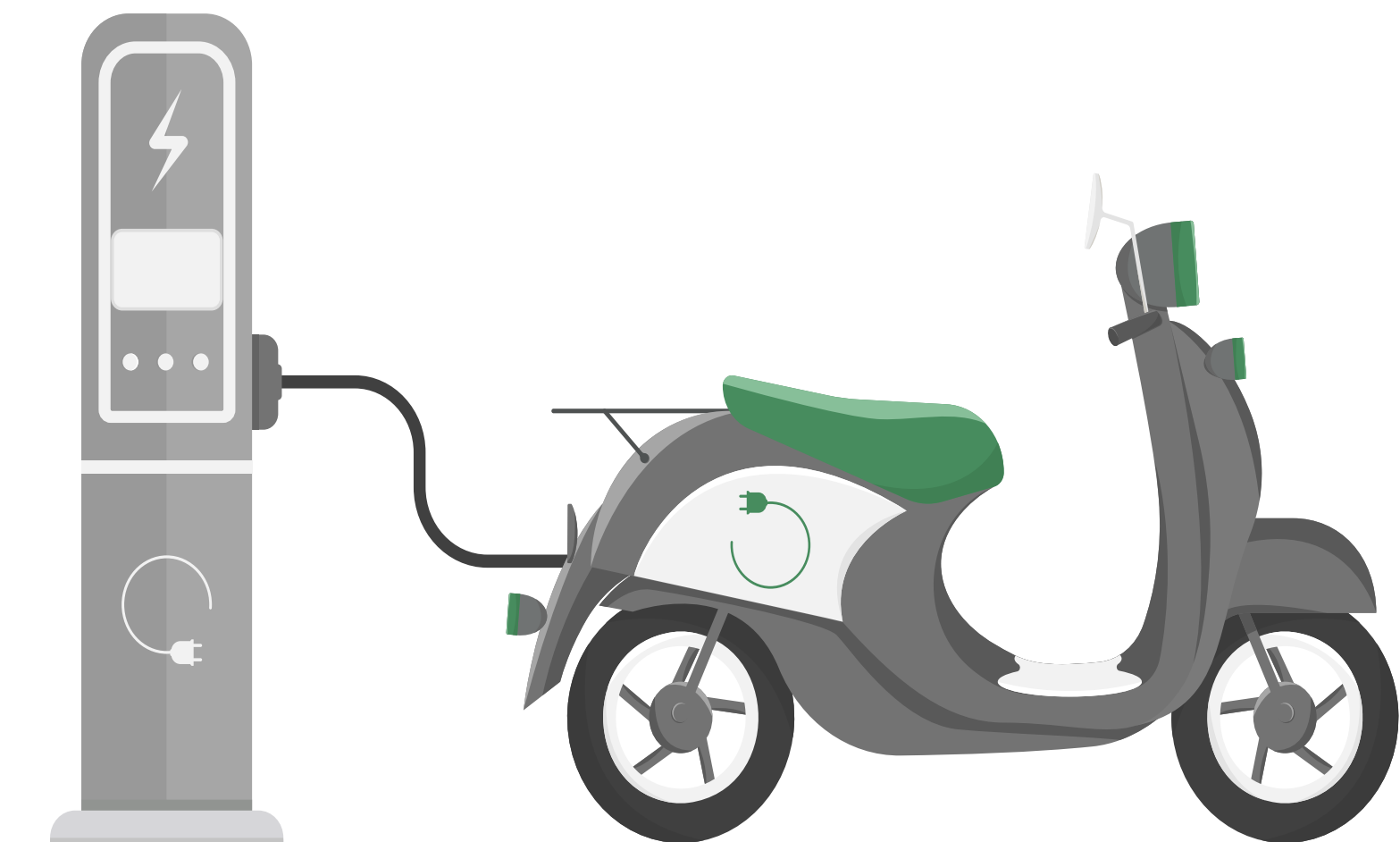
In many states, regulations categorise two-wheelers as non-transport vehicles. As a result, they cannot be used for commercial operations such as a taxi, rentals, or deliveries that require yellow registration number plates. (World Bank, 2022).

Government of India by Notification S.O 5333(E) dated October 18, 2018 has exempted battery operated vehicles from provisions of sub-section (1) of section 66 which mandates every vehicle to get permit to use it as goods or passenger vehicle. Tamil Nadu, which has shown interest in allowing transport operations (i.e. commercial operations) for two-wheelers, has also tried to address this issue. Recently, it has allowed all battery operated transport vehicles to secure a permit without paying any permit fee through G.O. (Ms.) No. 319 dated 28 June 2023 by referring to S.O 5333(E). There are provisions for states to grant contract carriage and goods carriage permits to transport vehicles. Section 73 and 74 of the Motor Vehicle Act, 1988 empowers the State to issue contract carriage to all vehicles including two-wheelers. Using this provision, the union territory of Chandigarh, for instance, invoked section 74(2) of the Motor Vehicles Act, 1988 to allow the operation of bike taxis.

The Central Motor Vehicles Act legalised bike taxis in 2004. The union government has also issued a guiding framework for state governments aiding their issuance of licences to transport aggregators and for the purposes of regulating the business conducted by such aggregators, as per the Motor Vehicles (Amendment) Act, 2019 (MoRTH, 2020). Thus, 16 states and union territories such as Gujarat, Haryana, Punjab, West Bengal, Mizoram, Telangana, Andhra Pradesh, Madhya Pradesh etc. have allowed operation of bike taxis (Raman, 2020), as seen elsewhere in this report.

In addition to policy and regulatory ambiguity, bike taxis face other kinds of challenges too. For instance, in Maharashtra and Karnataka, taxi and autorickshaw unions have been protesting against the introduction of bike taxis as commercial transport vehicles, citing potential detrimental impacts on their services (Jha, 2022). Similar protests have also been witnessed in Karnataka (Hindustan Times, 2022) and Maharashtra (Hindustan Times, 2022) recently. Furthermore, digital platforms, due to cross-cutting nature, have to register under a wide range of laws in India like Companies Act, 2013, Information Technology Act, 2000, Consumer Protection Act, 2019e, Income Tax Act, 1961, and Central and State Goods and Services Tax (GST) Act (NITI Aayog, 2022).

Overall, aggregators and fleet operators have a growing list of compliances which may prove to slow down the rapid growth of India's booming gig and platform economy.



7. Impact of Electrification of Two-wheelers in Commercial Applications

The penetration of electric vehicles in the commercial services space offers a unique opportunity to unlock a range of benefits for the state of Tamil Nadu, aligning with India's overall ambitions. This potential stems from the growing EV penetration in the automotive fleet operational in the State, particularly in terms of new registration of electric two-wheelers. Given that electric two-wheelers constitute 80% of all electric vehicles operational in the State, there are several positive outcomes and impacts to expect.

7.1. Environmental Impacts

Environmental impact of the electrification of two-wheelers used for commercial space is significant, given their existing widespread operations across the country.

The average operation of around 120 km/day for ICE 2Ws if taken for an entry level motorcycle or scooter would imply significant emissions from each vehicle (table 12) (Anup and Deo, 2021).

Vehicle Type	Small Motorcycle	Electric Motorcycle (3.5 kWh)	Scooter	Electric scooter Type (2.9 kWh)	Max speed (km/h)	Fuel Economy (km/kWh)	Charging Time (hours)
Life Cycle CO ₂ emissions (g/km)	54.2	35.7	60.9	37.5	47	51.53	4.5

Table 12: Emission factors for entry-level two-wheelers (Anup and Deo, 2021)

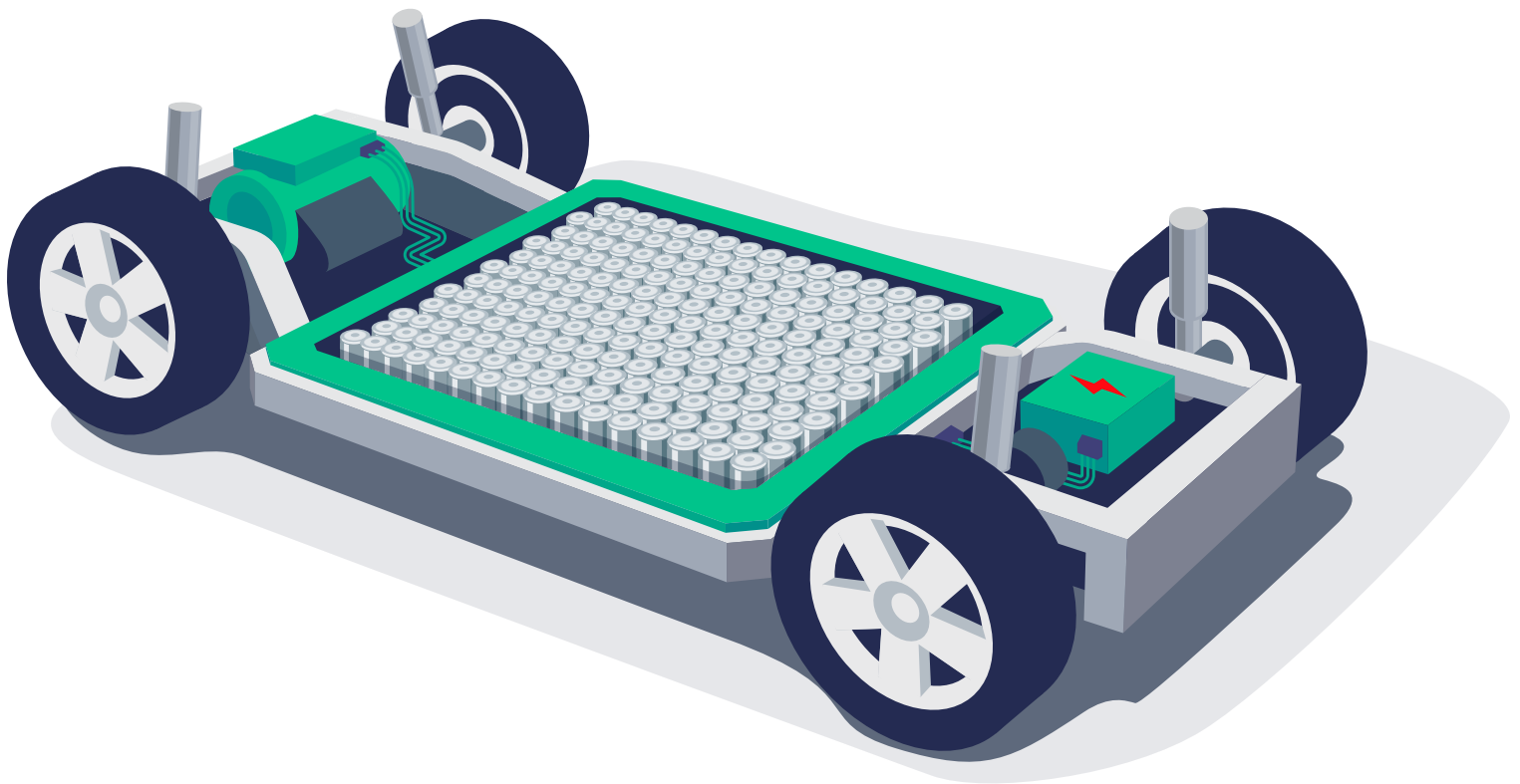
Thus, an annual reduction of at least 23.4 g/km of CO₂ is evident. Assuming an average of 100 km per day operations, an annual avoidance of 854 kg of CO₂ per vehicle is possible. As mentioned elsewhere in this report, there are more than 2 lakh (i.e. 200,000) 2Ws used for commercial applications in Tamil Nadu. Even if 50% of all two-wheelers utilised for commercial applications were to be electric, an avoidance of at least 85,410 tonnes of CO₂ can be achieved annually. This will provide an unparalleled impetus towards Tamil Nadu achieving its ambition of carbon neutrality. It is important to note that as Tamil Nadu intends to move away from fossil fuel-based power generation (The Hindu businessline, 2022), CO₂ avoidance will only rise.

From an air pollution perspective too, there are several benefits. Switching from an ICE to an EV eliminates all toxic tailpipe pollution, e.g. NO_x, HC (hydrocarbons) and carbon monoxide (CO). Also, EVs tend to result in net decrease of particulate matter emissions (Barisione, 2021).

7.2. Economic Impacts

The current prices of fuel are rather high and have a direct bearing on the pockets of the common people within the State. It is well known that the two-wheelers used for commercial work are primarily petrol driven. Given the socio-economic backdrop of the workers, who are usually at the lower end of the socio-economic pyramid, the high fuel prices directly erode their earnings and savings, making them vulnerable to exigencies.

Electric mobility improves the savings of the ordinary people, as the operating cost is significantly lower than conventional motorcycles run on fossil fuels. **For instance, comparing the total cost of ownership of an electric bike used for commercial purposes with that of a petrol bike, we find that the user of electric two-wheelers can save more than INR 115,000 - 135,000 over a period of three years (see Table 13).** This money can be spent for a better lifestyle, improving the quality of life and enhancing savings for the future as well. Thereby, improving the lives of people while also generating economic benefits via greater spending for the State.



Cost Element	Petrol Bike	EV Bike ⁸	
		100% domestic charging scenario	100% public charging scenario
Daily Running (km)	100	100	100
Mileage/running (kmpl or km/kWh)	60	45.1	45.1
Fuel cost (INR per litre/ INR per unit)	102.63 (PPAC, 2023)	4.6 (TNERC, 2023)	14.0 (TNERC, 2023 and stakeholder consultation)
Time period (years)	3	3	3
A) Vehicle Cost (INR)	80,000	86,540	86,540
B) Fuel Expenses (INR)	169,340	10,098	30,733
C) General servicing (INR)	30,000	5,000	5,000
D) Part replacement (INR)	10,000	15,000	15,000
E) Battery replacement (INR)	0	37,427	37,427
Total costs: A+B+C+D+E (INR)	289,340	154,065	174,700
Savings of the electric bike compared to a petrol bike (INR)		135,275	114,640

Table 13: Total Cost of Ownership (TCO) Analysis: Petrol bike vs. Electric bike

Source: Authors' analysis and Kaur (2021)

Overall, electric bikes bring in savings against petrol bikes. Savings can be optimised further if the high tariff to charge EVs at public charging stations can be reduced.

⁷Assumptions: 330 operating days; 100 kms daily running; battery price of US\$151/kWh, and USD 1 = INR 81, LT -1 A slab for domestic charging scenario. For the public charging scenario, we used the landed cost of power as mentioned by our stakeholders who operate public charging businesses as the selling price for the consumer.

⁸Hero NYX HS500 ER <https://heroelectric.in/bike/nyx-hs500-er/#features>; (Hero Electric, 2023)

8. Recommendations

The following recommendations are derived from review of national and state level policies and schemes, stakeholder surveys and expert consultations. The recommendations aim to accelerate the electrification of two-wheelers used for commercial purposes in Tamil Nadu. These recommendations are mapped with stakeholders including government, aggregators, fleet operators and civil society.

8.1 Policy and Regulatory Support

8.1.1 Financing and Upfront Cost Reduction

1. Risk-sharing mechanisms could be encouraged by creating guarantees that partly or entirely cover loan repayment risk. State-owned financing companies can collaborate with multilateral banks to address this issue.
2. Innovative financing models like cash flow-based lending may be encouraged. Through this process, the guarantee of repayment is on the borrower's account activity, signalling payback capacity. Emphasis is placed on the age and vocation of the borrower to determine their creditworthiness, rather than the holding of physical assets. With added layers of security ensured through new ledger technology like blockchain, these transactional records can reliably serve as proof of account activity (Ramachandran, Singh and Narain, 2021; Ramachandran and Raman, 2021).
3. Interest rates subventions may be considered to improve the affordability of the loans by creating a dedicated EV fund.
4. Dedicated EV financing products and insurance products for battery swapping may be encouraged.
5. Purchase incentives may be extended to vehicles sold without batteries to encourage battery swapping.
6. State could form an industry working group to develop guidelines on resale of electric vehicles and provisions that could enable the certification of used batteries.

8.1.2 Guidelines and Seamless Enforcement for Commercial Applications

1. Clear guidelines could be brought out with respect to the usage of electric two-wheelers for transport purposes.
2. Capacity building of Road Transport Authorities (RTA) may be undertaken to expedite registration process.

8.1.3 Single Part Tariff, Adequate Charging and Swapping Infrastructure

1. Public charging tariff may be reduced to a single-part tariff as suggested by the Ministry of Power, Government of India, in 2022.
2. Land banks may be identified in the six model EV cities for setting up public charging/swapping infrastructure..
3. Adequate parking provisions could be provided in public places for setting up charging/swapping infrastructure. This may be achieved by updating Combined Development Building Rules (CDBR) to include specific provisions for parking spaces dedicated to charging infrastructure.
4. Necessary demand assessment can be done to support EV infrastructure in future including upgrading the grid infrastructure.

8.1.4 After Sales

1. Providing incentives to upskill existing workforce for repair and maintenance services, with a special thrust on working on power trains and high voltage tools.
2. Upgrading roadside assistance to cater to electric vehicles.

8.1.5 Awareness Programmes

Awareness campaigns should be designed and implemented in partnership with the industry and civil society organisations to create awareness to delivery/driver partners about the benefits of transition to electric vehicles and the benefits provided by the government for commercial adoption of electric vehicles.

8.2 Industry Recommendations

1. Aggregators and fleet operators may partner with OEMs and run pilots to choose the right vehicle models that cater to their operations.
2. Integrated financing models with OEMs and financial institutions could be explored to make financing more affordable.
3. Partnerships could be entered into with energy operators to make charging/swapping a hassle free experience for the delivery/driver partners, thereby reducing the downtime, and increasing remunerative opportunities.
4. Maintenance and repair services could be enhanced by increasing their availability through partnerships with repair centres.



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Annexure – 1: Study participants

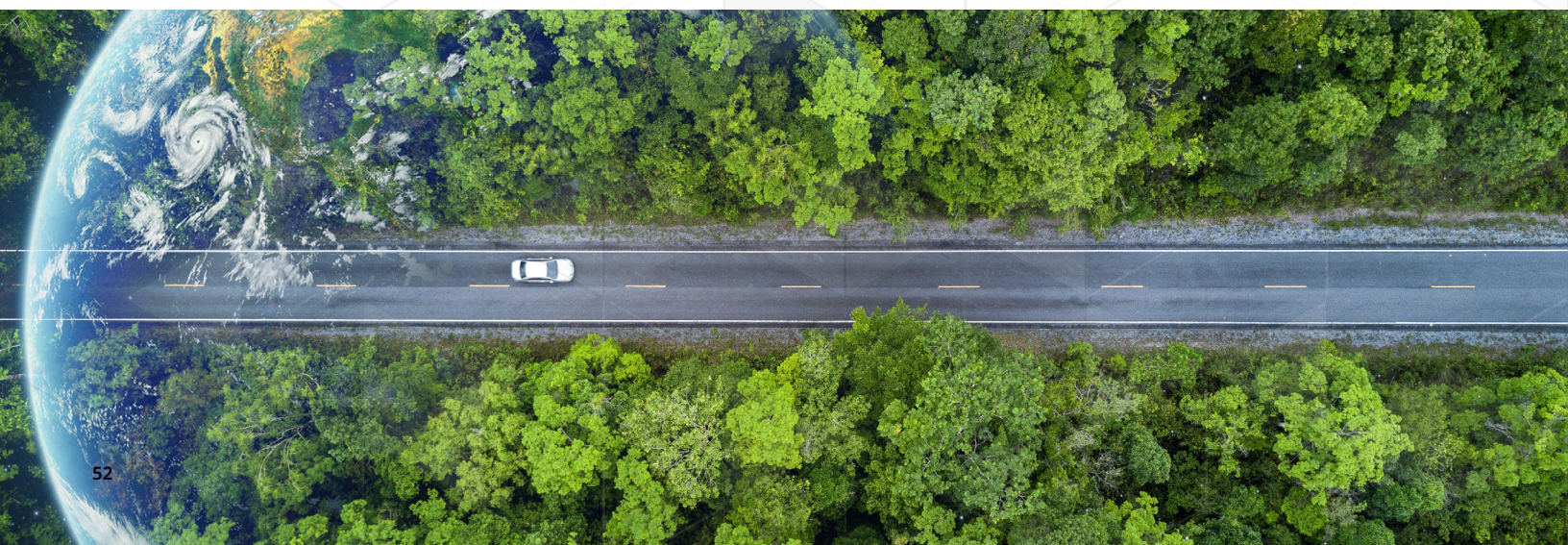
The participants of this study ranged from businesses providing aggregation, fleet operations, energy operation services, as well as trade unions, experts, and the public sector supporting and enabling the electric mobility transition in the State. Stakeholders who participated in the consultation are enumerated below.

1. Amazon
2. Bounce
3. Dunzo
4. Jio BP
5. Flipkart
6. Fortum
7. Vogo
8. Ola Cabs
9. Ola Electric
10. Zepto
11. Zeon Charging
12. Zomato
13. Hero MotoCorp
14. Rapido
15. Statiq
16. Sun Mobility
17. Swiggy
18. Indian Federation of App-based Transport Workers (IFAT)
19. Purpose
20. TERI
21. Chennai Unified Metropolitan Transport Authority
22. Municipal Administration Department, Government of Tamil Nadu
23. Transport Department, Government of Tamil Nadu

Annexure – 2: Indicative Interview Questionnaire

1	What percentage of the total fleet (2-W) in Tamil Nadu are electric?
2	What is the average daily kilometre run by electric two-wheelers?
3	What is the average range of electric two-wheelers? < 50 kilometres, 50- 75 kilometres
4	What is the average dead mile per trip travelled by electric 2-W in your fleet right now (For charging and to pick-up commuter)? 1 - 3 kilometres, 3 - 5 kilometres, 5 - 10 kilometres , > 10 kilometres
5	How much time does the driver/delivery partner spend (if at all) charging a vehicle while they are on duty? < 30 minutes, 30 - 60 minutes, 1 hour - 2 hour > 2 hours

- 6 What is the average time taken to charge each electric 2-W in your fleet?
- 7 What is the peak hour of the day for charging?
- 8 What are the challenges driver/delivery partners are facing in access to loans for the purchase of EVs ?
- 9 What kind of policy support are aggregators/fleet operators looking for a transition into EVs? (Fiscal and Non Fiscal)
- 10 What is the density of charging/battery swapping stations in the cities you have operations?
- 11 What are the upstream infrastructure challenges faced in installing charging/battery swapping infrastructure?
- 12 What are the challenges faced for increasing the usage of charging/battery swapping infrastructure?
- 13 What is the average time taken for regulatory clearances to set up a charging/battery swapping station? (< 7 days, week - 1 month, > month)
- 14 What kind of policy support are you looking at to increase the penetration of charging infrastructure? (fiscal and non-fiscal)
- 15 What are the critical requirements (key parameters) to bring the TCO down for electric 2-Ws?





Notes





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