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Tamil Nadu's EV Transition: Applying a Just Transition Framework for Livelihood Protection

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Abstract

In this paper, I explore the market disruption from the electric mobility shift in Tamil Nadu using the framework of just transitions. I use the methodology of secondary content analysis supplemented with expert interviews to ground the case study for the case of Tamil Nadu.

The paper finds that Tamil Nadu ranks high on the metric of distributive justice, but needs to formulate a comprehensive policy to address inclusive procedure and recognition of the workforce. The population at highest risk in Tamil Nadu are informal and contract labourers who work on shop floors, road-side mechanics who do not get trained to repair electric vehicles (EVs), rickshaw drivers, and trucking service-related workers. Next, microenterprises and component manufacturers of Internal Combustion Engine Vehicles (ICEV), particularly those involved in ferrous foundries, are vulnerable to market disruptions.

The paper presents policy recommendations to protect each of these vulnerable groups, and make the EV shift an inclusive transition.

Contents

1. Introduction

The objective of this study is to explore how the electric mobility shift in India can be just and inclusive through a case study of Tamil Nadu, a leading state in manufacturing. This paper addresses the research gap in understanding livelihood generation and protection in the context of electric mobility in Tamil Nadu using the just transition framework by identifying stakeholders and their vulnerabilities. It provides insights for policy additions as per the rubric of justice proposed in the literature review. The report identifies the nature of vulnerability for various stakeholders in relation to the policy measures enacted to date, which is meant to ground the supply chain research in reference to state-specific policies and recommendations. The action points for furthering livelihood protections are mapped against distributive, procedural, and recognition dimensions of justice.

Using the just transition framework in the context of electric mobility in India is important to climate and economic policy discourse for several reasons. One, it identifies supply chain vulnerabilites in the electric mobility shift, which is an important objective of economic and climate policy that seeks to scale-up EV adoption. It contextualises the just transition framework in the Indian electric vehicle market, which is an understudied but crucial lens in framing climate policy. Finally, it identifies economic opportunities for the state of Tamil Nadu, which can be extrapolated for the context of other states across the country on the cusp of an electric mobility shift.

2. Electric Mobility Shift in India

The automotive sector accounts for 24% of greenhouse gas emissions worldwide. Within the automotive sector, the road and transport sector contributes to close to 75% of emissions, which is a leading cause for air pollution in urban areas. This problem has necessitated the electric mobility shift across the globe. In India, electric mobility is one of the key components of its climate commitments. Since the pledge to achieve net-zero emissions by 2070 in the Paris Agreement, India has fleshed out key pillars for achieving its energy transition and aims to transform the electricity, metals, agriculture, transport, and manufacturing sectors to curb emissions (Climate Action Tracker, 2024). In the transport sector, the development of battery technology and increased access to raw materials like lithium and cobalt have been a fillip to the industry.

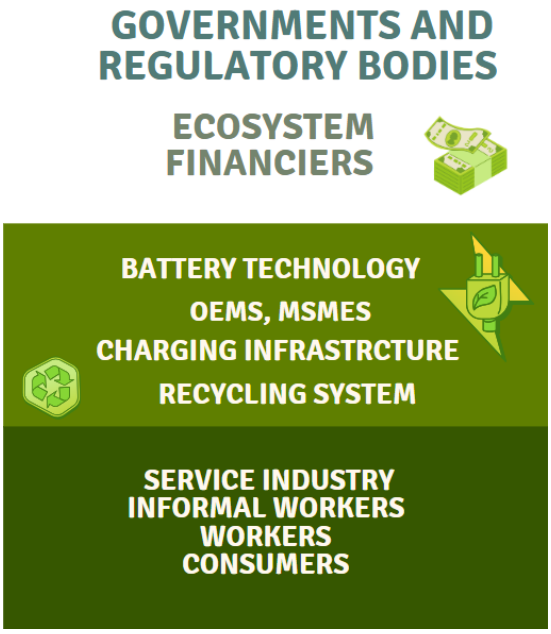
In terms of environmental benefits, EVs improve air quality, decrease carbon emissions, and offer significant employment potential for skilled labor. The electric mobility shift could be particularly transformative for India, which is home to 14 of the 20 most polluted cities in the world. India's EV transition goals are quite ambitious—India hopes to have 30% of private sales of EVs by 2030, 70% of commercial EVs, and 80% of two-wheeler and three-wheeler EVs (Lewis, 2024). As of 2023, India recorded sales of 1.2 million EV vehicles, consisting of

E-Bus, e-car, e-cargo, etc. As of 2023, the E2W (electric 2-wheeler) captured the largest market share of EV sales in India, followed by 3W (3-wheeler); larger vehicles have not as yet taken off.

Over the past decade, the Indian government has been rolling out policy incentives to encourage the manufacturing and adoption of EVs across the country. India launched the National Mission for Electric Mobility in 2011, and the National Electric Mobility Mission Plan 2020 in 2013 to encourage the manufacturing and utilisation of electric vehicles. The plan also created a policy ecosystem for EV adoption by instituting subsidies. In 2019, the National Mission on Transformative Mobility launched multiple endeavours that aimed to enhance local EV production. However, India's EV environment is in its nascent stages, and regulation, technology, infrastructure, and economics are still developing in most states, which makes it an opportune moment to understand the labour market shifts that may occur.

Although the potential for climate impact is clear, effective central and state legislation is necessary to manufacture EVs at scale and encourage rapid adoption. The Indian EV system comprises six important players—the government and regulatory bodies, manufacturers, financiers, component suppliers such as for battery technology, and consumers and users. The infographic below sets out the major stakeholders.

I) Players in the Indian EV Ecosystem



Source: Compiled by Author, Adapted from TFE Consulting, 2018, IIT Kanpur, 2024

The current policy focus across the country has been to ensure robust policy to facilitate EV adoption by building confidence among the manufacturing and start-up industries and

increasing the EV demand. However, this shift in technology and production has serious labour market implications that will result in serious economic losses to the established ICE (internal combustion engine) industries. Briefly, 45-84% of powertrain components could become obsolete, and 31% of the job roles in the auto sector in India would be impacted. *The Wire* estimates that 14% will become obsolete, and 17% of the jobs would require re-skilling (Sharma, 2024). However, comprehensive policies to address the labour market disruptions that accompany an electric mobility shift have not been drafted (TN EV Policy 2019, 2023).

The problem of equitable transition with a growth in livelihoods is particularly complex in states like Tamil Nadu, where the ICEV market is already well established. For this paper, I attempt to draw insights for policy using the just transitions framework. The next section discusses the importance of the concept of just transitions in climate policy across sectors.

3. Just Transitions in Climate Change Policy

Across the world, countries are starting to centre justice in energy transition policy. The concept of the just transition is said to have originated in the context of the 1970s labour movement in North America when labour and environmental activist Tony Mazzochhi coined the term in reference to the existing federal programme to clean up environmental waste (International Labour Organisation (ILO), 2022). He fought to create a superfund for workers exposed to toxic chemical waste that guaranteed them a minimum income and educational benefits throughout their lives. Since the term "superfund" carried too many negative connotations that removed the onus of responsibility from the state, the term was changed to "just transition."

The conception of just transition is significant for climate policy and discourse, particularly for tech-centred energy transitions. As a tool of policy framing, the framework of just transitions has the potential to bridge the concerns of the labour and environmental justice movements, because it acts as a bridge between the language of labour and environmental justice movements across various domains like the international trade union movement, public policy circles, and the private sector (International Labour Organisation, 2022). According to the United Nations and the ILO, “just transition” is characterised by: "no one left behind, stakeholder engagement, and a social dialogue between unions, workers, and companies."

Institutions across the world have since expanded on the concept of just transitions and laid out principles and key tenets that form the analysis framework. According to The London School of Economics, creating a just transition is meant to ensure that climate justice can be an important step to eliminating existing inequalities and enabling social inclusion and equity (Hizlioch, Scheer, 2024). Reflecting their central concerns of economic and labour equity, the just transition framework focuses on workers in regions that will be mainly

affected by decarbonisation, for example, mining districts. These principles are recognised as universally applicable to create a comprehensive just transition policy:

Principles of Just Transitions:

- Social Dialogue: Fostering discussions between workers, businesses, and governments in the form of negotiations, consultations, or knowledge transfers.
- Social Protection: Providing compensation for job losses that ensue as a result of decarbonisation.
- Decent Jobs and Skill Development: Creating decent jobs for regular and laid-off workers that are green and satisfy other local and region-based needs.

Source: International Labour Organisation, 2015

These principles have been expanded and analysed through various lenses like legal implications, socio-economic implications, a rights-based approach, etc. Theoretical explorations of the concept of just transitions examine the various legal dimensions of the concept and fully flesh out the associated principles. With regard to the electric mobility sector, there is significant research worldwide that identify conflicts and issues of justice at scale for the global south. However, the research for the Indian context is still being undertaken only by a handful of organisations, and sector and region-specific studies are still scant. As of now Indian Just transition research focuses on the Renewable Energy (RE) market or decarbonisation at the national level. They are focused on the national level concerns and questions, and state specific research has largely been focused on Gujarat and Andhra Pradesh, and Karnataka, which are home to large solar parks (Haldar, Peddhibhotla, Bazaz, 2023).

In this brief literature review, I highlight studies at the intersection of just transition principles and electric mobility in the context of India, thematically organised to understand the key considerations that will inform policy-making for the EV market.

4. Literature Review

I) Electric Mobility and Justice

A handful of organisations have conducted both theoretical and sector specific studies on creating just transition frameworks for India. The International Forum for Environment, Sustainability & Technology (iForest) has led one of the pioneering reports on grounding the concept of just transitions in India, and their principles and framework are used extensively in structuring the analysis in the forthcoming sections. They identify key vulnerabilities for

India and discuss the role of the state and central governments in addressing these. According to iForest, Indian policy focus should be multi-faceted, focusing on economic diversification and innovation, labour support and human resource development, social welfare, and social and physical infrastructure development (iForest, 2023).

A large scale study on conceptualising just transitions for India by Halder, Peddhibhotla, and Bazaz in 2023 presented an analysis on the key dimensions of justice that are applicable for the Indian context (Haldar, Peddhibhotla, Bazaz, 2023). They conceptualise justice for energy justice within these dimensions—distributive, procedural, and recognition justice. Distributive justice is concerned with the question of how benefits and harms are distributed across the population; procedural justice is concerned with making the decision-making system more inclusive; recognition justice recognises the respect for rights, needs, and values for the communities involved with the transition (Haldar, Peddhibhotla, Bazaz, 2023). The paper argues that these forms of justice need to be mainstreamed in policy discourse in India by contextualising them in energy transitions research (Haldar, Peddhibhotla, Bazaz, 2023). For the electric mobility field, IIT Kanpur's 2024 Electric Mobility Report bridges the gap in conceptualising just transitions for electric mobility. The 2024 Electric Mobility Report factors in the various elements of justice for the EV transition in India and identifies key concerns (IIT Kanpur, 2024). They shed light on various aspects of making the electric mobility shift inclusive and just.

Affordability of electric vehicles is a crucial policy pillar that determines the level of distributive justice in the electric mobility transition. Procedural justice has to be ensured by creating participatory mechanisms where various stakeholders are involved in the process of decision-making. Policies have to recognise and protect the rights of the workforce through the process of the shift (IIT Kanpur, 2024). Given the extensive labour market shift caused by EVs, a supply-chain approach emphasises the recognition of workforce rights and the need to protect livelihoods.

Both these reports form the basis of analysis in the section titled ‘Applying the Just Transition Framework.’

II) Workforce Changes

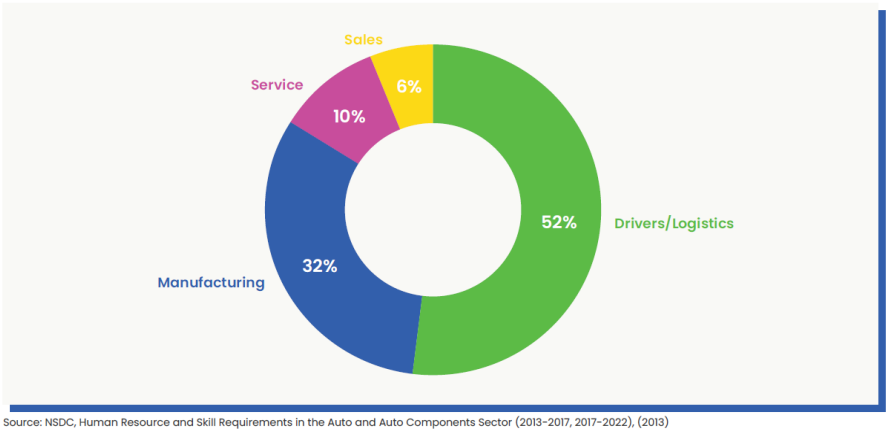
One of the key questions of livelihood is to understand the exact nature of the change to the workforce that can be expected in the years to come. For this, several labour market and demographic studies focus on understanding the market disruptions from the perspective of existing ICE networks of employment. One of the key questions addressed in these studies is: what will be the net increase or decrease in employment with a shift to electric mobility? In essence, studies tend towards the conclusion that the EV shift will certainly create an increase in the number of skilled jobs available for experts in the fields of electrical or allied engineering and technology. However, the total number of jobs generated for manufacturing will decline due to the low-labour, high-skill method of EV production (IIT Kanpur, 2024). Just transition studies have focused on identifying the existing workforce and their core competencies in the ICE sector, and the expected changes for an electric mobility

shift. However, most of these studies are at the national level, mainly providing final estimates of workforce distribution. Going forward, district-wise data would be necessary to draft effective policy that is context-sensitive and thorough (iForest, 2024).

The literature identifies key features about the ICE industry in India, which supports around 37 million people both directly and indirectly. Direct employment refers to those workers in employed by the Original Equipment Manufacturers (OEMs) and auto component manufacturers. Indirect labour consists of labour that sustains the industry that is most often of a service kind like drivers, cleaners, automobile financing providers, etc. (NSDC, 2013).

Auto Sector: Workforce Distribution

Figure 14: Auto Sector Workforce Distribution



Source: IIT Kanpur, 2024

In a shift from ICE to EVs, it is predicted that it is the drivers' logistics and manufacturing sectors that may find it hardest to recover (IIT Kanpur, 2024). Several region-wise reports also highlight that the service-related chain of the ICE market is anxious about the shift to EVs. For instance, in Haryana, the CNG drivers, who are a pivotal component of the cities' transportation network, are most concerned by the shift to EVs and the environment-friendly transport policies of the state (IIT Kanpur, 2024).

iForest has created one of the first case studies of the just transition framework in the Indian automotive sector, with a focus on Maharashtra. The case study identifies MSMEs as one of the major stakeholders to protect in the electric mobility shift, and provides recommendations and opportunities for at-risk businesses. This case is one of the first roadmaps for just transition designed in the Indian context (iForest, 2024).

iForest's research has had practical spillovers, and organisations like the World Resources Institute have begun making practical advancements into the field by creating workshops and training sessions. Conference proceedings from the World Resources Institute (WRI)

and the NITI Aayog inform the later parts of this study, but remain out of the scope of this review. iForest's case study is seminal, and has identified geographical-level vulnerabilities and opportunities (World Resources Institute, 2024; iForest, 2024). In terms of just transitions, these studies go a step further in conceptualising key policy components that will ensure the creation and protection of livelihoods—technology and skilling of workers, vibrant green manufacturing, making sustainable mobility choices, and promoting circularity to reduce the life-cycle impact of an EV. This report factors these pillars in assessing Tamil Nadu's policy and making actionable recommendations.

One of the key concerns that emerges from the research and practical forays of these international organisations is the need for formulating plans for skilling and re-skilling workers (Climate Trends, 2023). It is also essential that this is reflected in the political will of the state governments. However, only 6 states have identified targets for job creation in the EV sector: Andhra Pradesh, Telangana, Tamil Nadu, Bihar, Karnataka, and Himachal Pradesh (Climate Trends, 2023). The case studies also shed light on two more dimensions for just transition policy in the Indian electric mobility sector.

One, these case studies stress the importance of pivoting from understanding the EV shift as the production of a product, to offering mobility as a service (EY, 2022). In this model, emphasis is placed on sharing the mobility benefits of electrification by empowering the consumer to plan, book and pay for mobility through a platform (EY, 2022). This furthers the distributional aspect of justice and transforms the public transport system in the state. Second, the case studies highlight the importance of the circularity approach to reducing emissions through the lifecycle of the EV through comprehensive EV scrapping policies (World Resources Institute, 2024; iForest, 2024). These policy elements are extremely important in understanding both the environmental and social justice elements in electric mobility, and have been analysed in the case of Tamil Nadu in later sections.

III)Technological Changes

Consultancies with technical expertise and experience in the climate change field like McKinsey and the World Resources Institute have been at the forefront of conceptualising the supply chain shift that will be ushered in this electric mobility shift (Mc Kinsey, 2022). Essentially, the shift to EVs will demand a restructuring of labour that favours high levels of electrical skills in handling electronic parts, IT, etc., compared to the conventional mechanical engineering skills used in ICEVs. Following are the changes that are identified (CleanMobilityShift, 2022).

First, the ICEV engine will be replaced by the electric motor, which makes several of the engine components of the ICEV vehicles and their manufacturing chains obsolete; for instance, pistons, crankshaft, flywheels, and sparkplugs will become obsolete in the transition to EV (Mc Kinsey, 2022). The MSMEs that specialise in the production of these engine components are at the highest risk, and they will need the most support by offering them alternative sources of employment in the EV supply chain and providing them with the training to survive the market change. The pump and motor industries are the best suited to

manufacture EV engines. They will need to be financed, reskilled, and trained to follow industry best practices and standards (Gupta, Hingne, et al, 2023).

Next, the ICEV fuel delivery and exhaust systems will be replaced by battery, controller, and battery management systems (Mc Kinsey, 2022). In ICE vehicles, fossil fuels are fed into the engine from the fuel tank by a fuel delivery system, and the exhaust system discharges the burnt gases from the engine after power generation. Whereas, in the EV vehicle, the electricity is generated by controllers that convert the energy stored in the battery. A battery management system (BMS) maintains the battery's optimum thermal conditions. Thus, the transition from ICE to EV leads to the replacement of the cast metal components of fuel delivery and exhaust components of fuel delivery and exhaust systems with electric components—battery, motor controller, and BMS (Gupta, Hingne, et al., 2023).

Finally, most cast components of the transmission systems of the ICE will continue to be a part of the EV supply chain, but there could be a significant shift in the material, number, and size of the components. The revenue of the existing ferrous casting MSMEs may decline as EVs will use a higher amount of aluminum by weight but a lower number of components (Gupta, Hingne, et al, 2023). The MSMEs involved in the process of casting will have to evolve their production process to integrate modules such as giga castings, using lightweight aluminium and alloys, and improving their precision. EVs generate a complex aluminium components market for the production of internal transmission parts, housing structures for power electronics, electric motor housings, electric recovery components, and fuel cell stacks. Other major components of the ICEV remain the same in EV, but the MSMEs involved in the production will have to upgrade their skills accordingly (Gupta, Hingne, et al., 2023). These components are the body, chassis, suspension, braking, and lights (Mc Kinsey, 2024).

Within the manufacturing sector, the OEMs, MSMEs, and workers are the major stakeholders that have to be considered during the transition (Gupta, Hingne, et al., 2023; Mc Kinsey, 2024). These consultancy reports that assess the technical shifts that will occur in manufacturing and related opportunities are referred to in later sections of the paper.

The brief literature review covers the studies in India on electric mobility and just transitions, with the recurring themes highlighted. Considering that the just transition framework and the field of electric mobility has a widely applicable set of tenets and insights, the scope of the literature review has been limited to focusing on the intersection between just transition research and electric mobility in India. In terms of theory, the large scale study by Halder, Peddhibhotla, and Bazaz on the conception of justice in the energy shift in India provides a robust conceptual rubric to analyse policy and the needed action. In addition, a case study by iForest analyses the case of Maharashtra in its EV transition, highlighting the various geographical strengths and weaknesses; the approach and insights from iForest's study inform the analysis for this paper. However, case-specific focus on creating and protecting livelihoods remains scant. **This exploratory study attempts to address this gap by analysing the policy environment in Tamil Nadu with a focus on livelihoods.**

Tamil Nadu emerges as a significant research gap across the themes covered in this paper. Despite a legacy of socialist governments, just transition studies have not been detailed in many sectors. Electric mobility in Tamil Nadu is identified as a good starting point for this for a few reasons. One, Tamil Nadu's natural strength in the automotive sector leaves it poised to be competitive in the EV production field (KL, 2024). Two, it is one of the states across the country to make commitments for job creation through the EV sector, which is allied to the central questions of just transitions (IIT Kanpur, 2022). Finally, Tamil Nadu is one of the most important state players in the EV market of India, producing 40% of the country's vehicles (Shivkumar, 2024).

5. Methodology

This study is an exploratory study using secondary resources and content analysis of government policy documents, industry reports, and news articles. The following steps were undertaken to complete this study. First, a thorough literature review of international publications on the concept of just transitions helped understand the tenets of the framework and why they are particularly important for countries with a large labour force. This established the relevance of the framework in understanding the electric mobility shift in Tamil Nadu. The literature review synthesised studies on various intersecting topics of relevance to this paper—the electric mobility shift and supply chain changes, technological changes, changes for the work force, and conceptualising components of justice in this context. The scope of the literature review was narrow and tight, selecting studies that touched upon themes and problems that directly informed the analysis.

The analysis centred around the state government EV policy documents, supplemented by newspaper articles and expert interviews from the fields of climate change, technology, and transport. Finally, the recommendation and action points were developed in reference to the just transition framework set out by Halder, Peddhibhotla, and Bazaz, to provide a snapshot of the current status of policy protections for livelihoods in Tamil Nadu.

6. Analysis and Discussions

I) Encouraging Electric Mobility in Tamil Nadu

According to the nationwide report on just transitions in the EV sector by iForest, Tamil Nadu is home to a highly developed manufacturing market, making it an apt site to apply the just transition framework for the EV supply chain. Chennai, Tamil Nadu's capital, has acquired the status of the "Detroit of Asia", and has attracted several EV projects from international players (KL, 2024). Several of the EVs sold nationwide have the "made in Chennai" tag and the government of Tamil Nadu announced its historic EV Policy 2023, which seeks to significantly transform the transportation system of the state (Shivkumar 2024, KL, 2024).

Tamil Nadu wants 50% of its road transportation to be dominated by EV vehicles like cars, two-wheelers, three-wheelers, and commercial vehicles (IIT Madras, 2023). The National Highways for Electric Vehicles has rolled out its Tech Trial Run of electric vehicles, with a goal of upgrading 5 national highways into e-highways. This is meant to assess the cost-effectiveness of zero-emission-trucking and total cost of ownership (Pall, 2024).

Being a highly technically capable state, the Tamil Nadu government is also investing in creating an EV and Future Mobility Park for research and development in Shoolagiri, located in the Krishnagiri district. Tamil Nadu has been expanding various aspects of the supply chain and investing in R&D and increasing component players like e-Royce, Relux Charging, Zeon Charging, and startups that specialise in various aspects of the supply chain.

i. Manufacturing and Investments:

Tamil Nadu has some natural advantages in making the shift to EVs a reality. Some of them are the availability of highly skilled and competent workers, a highly developed network of ancillary suppliers, and an already existing auto and auto manufacturing system (Shivkumar 2024, KL, 2024). According to Ambrin Moinuddin, from Guidance Tamil Nadu, the government is looking at building alternative competitive ecosystems like Krishnagiri, Manallur, Coimbatore, and Chennai. To facilitate the shift from ICE to EV, the state is building several charging stations across the state to encourage ease of use and a faster rate of consumer adoption. Under the policy of FAME-II, the Ministry of Heavy Industries has sanctioned the construction of 651 charging stations in Tamil Nadu (TOI, 2022).

One of the most significant entrants to the market has been Ford Motors, which has announced re-entry into the EV sector. Vietnamese EV manufacturer VinFast has also entered the Tamil Nadu market and has committed a 2bn-dollar investment for a new plant in the state. Tamil Nadu aims to set up a new auto-cluster in the district of Thoothukudi to utilise VinFast's investments, with an annual capacity of 1,50,000 units. Two more facilities for EV charging and testing are also in the works (Balachandar, 2024). The Tata Motors Jaguar Plant is also set to be initiated by the Chief Minister in September. Renault and Nissan companies will join hands to upgrade their Chennai plant to manufacture EVs with an investment of Rs 5300 crore (KL, 2024). Three of the top five manufacturers in India have already set up a base in Tamil Nadu—Ola Electric, Ather Energy, and TVS Motor. Tata Motors JLR has committed to investing Rs 9000 crore, VinFast up to $2 billion, Royal Enfield up to Rs 3000 crore, and Hyundai and Stellantis up to Rs 2000 crore (Business Standard, 2024).

Tamil Nadu leads the country with its two-wheeler EV production, with 68% of its EV scooters produced locally. At the moment, the production capacity of the state is 10 million units, but the government aims to expand production drastically by setting up manufacturing hubs in Coimbatore, Trichy, Tirunelveli, Salem, and Chennai (KL, 2024). In addition, India's lithium-ion cell manufacturing unit is to be established in Hosur, which will help the state pioneer the EV transition. Interestingly, in terms of manufacturing, the western

districts of Tamil Nadu have become hotspots for manufacturing, like Hosur, Dharmapuri, and Krishnagiri (Seetharan, 2022).

Currently, most EV components in Tamil Nadu are said to be imported, but the EV market is said to grow at a projected rate of 22% by the end of the decade. With continuous investment and growth, Tamil Nadu is poised to be a leader in the sector.

ii. Policy Measures

According to the Industries Minister of Tamil Nadu, T R B Raja, where each state has a unique policy environment for the promotion of EVs, Tamil Nadu has initiated a series of policy measures to foster the adoption of EVs through its electric vehicle policies of 2019 and 2023. The Tamil Nadu government has initiated road tax and registration fee waive-off, special tariff for EV charging, subsidies for EV manufacturing, promotion for R&D, promotion for skill development, incentives for EV charging, and manufacturing incentives (Clean Mobility Shift, 2021). Tamil Nadu is the only state that incentivises retrofitting on the demand side, which could be significant in electrifying public transport. Tamil Nadu's EV policies have given the state an edge in some key aspects—manufacturing and investments because of an existing thriving automotive sector, and a significant push for electrifying public transport through upfront capital subsidies and public charging infrastructure. Tamil Nadu also leads in the scrapping initiative, which can lead to significant economic and environmental gains (ITDP, 2024).

In this backdrop, the next section applies the just transition framework to explore the nature of the vulnerability of various stakeholders, existing relevant policy measures, and opportunities for growth.

II) Applying the Just Transition Framework

In India, the International Forum for Environment, Sustainability, and Technology (iForest) provided a detailed snapshot of the economic reality of India in 2023 and the relevant principles for the framework.

The principles of just transition in India's energy shift are widely applicable and diverse. These principles are cognisant of the quasi-federal structure of India and lay out clear action points for the state and the Centre. According to this report, the state governments can be at the forefront of developing comprehensive just transition policies by developing plans, programmes, and institutional and governance mechanisms (iForest, 2023). The district plans have to address the issues faced at the level of the district and should be aligned with the visions of development pathways. State-level task forces can be engaged to develop the plan. A just transition fund appointed at the state level will allow the state to take unplanned interventions to protect the welfare of workers (iForest, 2023).

The first step to creating a comprehensive just transition policy would be to create a multistakeholder baseline study that discusses the economic, social and environmental impact of the electric mobility transition on the stakeholders (London School of Economics, 2024).

Relevant Stakeholders

Workers	Suppliers	Communities	Consumers
Involving workers by anticipating employment shifts, respecting rights at work, ensuring dialogue, developing skills, protecting health and safety, and providing social protection, including pensions and benefits. Suppliers	Supporting suppliers in taking account of social impact on the path to net zero, strengthening local supply chains, applying labor, human rights, and environmental due diligence along the supply chain.	Understanding the spillover effects for communities, respecting rights around impacts and involvement, focusing on vulnerability, enabling innovations such as community energy.	Prioritizing implications for consumers with inadequate access to sustainable goods and services, including energy, removing barriers to consumers to support the transition, including through financial services.

Source: Grantham Research Institute, 2022

In this section, the report attempts to explore multi-stakeholder implications of the EV transition in Tamil Nadu. This paper assesses the vulnerabilities of stakeholders across the supply chain and highlights the perspectives of small-scale workers, suppliers, and allied communities. The literature about electric mobility and just transitions highlights the possibility of job losses and the imperative to upskill workers and employees for the EV transition. In the coming paragraphs, the report analyses the various stakeholders in the Tamil Nadu supply chain, and presents the policy progression and opportunities to protect them. Newspaper articles, expert interviews, government reports, conference proceedings summaries are used here to identify vulnerable groups, and possible pathways for them in the process of EV transition.

i. Component Manufacturers

Key Vulnerability: The MSME sector for ferrous castings and forgery are at high risk of becoming obsolete, followed by engine manufacturers.

According to the World Resources Institute, MSMEs contribute significantly to the state's economy. MSMEs are financially vulnerable and highly dependent on fossil fuel sources for their functioning. Tamil Nadu's auto manufacturing sector contributes to 8% of the state's GDP. EV manufacturers are keen to localise their component base, which will bring them greater flexibility, capacity for customisation and control over performing quality checks (Hingne, 2024).

Being closer to the manufacturing base is significant for EV manufacturers also because it allows them to cut costs, reduce dependence on imports, and protect them from disruptions in the supply chain. Expanding the manufacturing base for a new industry also means that newer manufacturing capabilities can be built into the newer components like motors, controllers, systems for battery management, chargers, and charging stations. Thus, MSMEs are well poised to benefit from the EV transition if they increase their capacity and become EV-ready. In addition, MSMEs that are at risk of becoming obsolete have to ensure that they can reskill their workers to tackle EV or EV-allied manufacturing (Hingne, 2024). Both skilling and upskilling would be needed to promote a just transition.

In this EV shift, specific MSMEs are in danger of going out of business and becoming obsolete. The demand for ferrous castings that are used in ICE vehicles will go down significantly in the shift, making several MSMEs in the region of Coimbatore obsolete (Nagaraj, 2022). According to Usha Kelkar, the director of Climate in the World Resources Institute, there are hundreds of MSMEs involved in ferrous casting production in Tamil Nadu. In terms of components to the final vehicle, there is a major threat in the shift to EVs. In ICE vehicles, there are about 2000 moving parts, whereas, in an EV, there are only about 20 moving parts (Balachandar, 2023).

According to the iForest report on just transitions in India, a case study of Hosur, Tamil Nadu was conducted. An analysis of the 759 component manufacturers in Hosur shows that 20% would be at moderate to high risk of becoming obsolete (iForest, 2023). 95% of these manufacturers were MSMEs, making them highly susceptible (The Hindu, 2024). According to the Foundry Information Government portal, Coimbatore and Chennai are important clusters for pump set castings, which are used in cooling systems (Foundry Information, 2024). A closer look at newspaper articles also sheds light on the geographical distribution of auto-component manufacturers in the state—Tamil Nadu has around 100 major auto component manufacturers, employing about 45,000 people. Over 350 tier I to tier III suppliers, apart from 4000 MSMEs under the tier IV segment, are located in Chennai; Chennai is also home to some of the best auto component manufacturers, like Visteon and Delphi. These auto component manufacturers produce over 25% of the auto components

in the city, and will not be at a very high risk in the case of transition (Industry Outlook, 2024). However, smaller component manufacturers near Avadi and Ambattur may be at higher risk of business losses, with around 1000 MSMEs spread across 1200 acres. Supporting these MSMEs are 2500 tiny industries around the region, which will have to be supported and protected during the transition. These MSMEs and tiny enterprises in Chennai, Coimbatore and other belts will have to be protected through guarantees, incentives and training under the EV policies, MSME policies, and possibly included under a state-level just transition fund (Industry Outlook, 2024).

As per the Tamil Nadu MSMEs policy of 2021, a capital subsidy scheme is set up for MSMEs engaged in EV component or charging infrastructure. According to the MSME Policy 2021, MSMEs can avail up to 20% of the value of the plant and machinery in the form of a subsidy, with a cap at Rs 150 lakh. The EV Policy of 2023 also offers a subsidy for new or expansion of projects in EV manufacturing, manufacturing of components, electrical vehicle equipment supply—a subsidy of 15% of Eligible Fixed Assets. However, the existing capital subsidy requires an investment of over Rs 50 crore with more than 50 employees, which leaves micro-enterprises dominated heartland with only the MSME support guarantee option (TN EV Policy, 2023). The government has initiated a training workshop for MSMEs, garnering attention from 180 MSMEs in Tamil Nadu. These workshops have to continue in regular intervals for sustained growth and reach.

Opportunities: MSMEs involved in the forging of shafts and rods, gear and engine small forgings can expand into E-motor shafts, reducer shafts, drive gear and reduced gear production. MSMEs involved in the production of engine small castings, housing and covers can shift to manufacturing battery pack casing, enclosures, motor casings, gearbox casings, casings for charging infrastructure.

However, other unconventional opportunities also exist. Dr. L V Krishnan, atomic scientist, explains that the new EV vehicles will experience a lot more wear and tear. *Manufacturing different types of wheels that are more resistant* to this will become an opportunity for entry. Other options for MSMEs also include the production of sensors that come in new-age EV designs—*sensors that detect position, direction, and come with a lens can be supplied to manufacturers* (L V Krishnan, Telephonic Interview, 2024).

In Tamil Nadu, the most vulnerable component makers are engine and transmission part makers, tooling and machine OEMs, coating and treatment services, foundries, and casting units. They are located near various industrial hubs. Some of these hubs are Ambattur, Guindy, Hosur, Ambattur Industrial Estate, Guindy Industrial Estate, Coimbatore, Hosur, Sriperumbudur, Trichy, Madurai, Ranipet, Perundurai, and Salem. According to the World Resources Institute, each automotive cluster has its own unique features that can be leveraged to create a healthy EV manufacturing ecosystem. Different firms within an EV cluster can diversify into EV manufacturing by leveraging their own strengths.

Engine and transmission part makers can shift to manufacturing the following: transmission systems tailored to EV needs, specialised EV gearboxes with optimised torque and efficiency, and regenerative braking systems for enhanced energy recovery. Tooling and machine OEMs can shift to battery management services. Foundries and casting unit manufacturers can shift to castings and extrusions required in EVs, R&D, and innovation for new technologies in casted and extruded motor casings (Kanuri, 2024). The case for pushing for R&D integration in Tamil Nadu's EV market is particularly strong because of the presence of the Global Automotive Research Centre in Tamil Nadu (Tamil Nadu EV Policy, 2023). Its electric vehicle lab offers testing facilities for battery lifecycle and safety, electric motor analysis, and component durability.

ii. OEMs

Key Vulnerability: Smaller-scale OEMs that do not have the resources to switch to EV production are most vulnerable.

As identified in the literature on just transitions, technological shifts, and market changes, OEMs across Tamil Nadu are vulnerable to becoming obsolete. A study by McKinsey and Company and the Automotive Components Manufacturing Association revealed that 75% of the new inventory for EV vehicles will require new design and manufacturing processes. In Tamil Nadu, there exists a mix of OEM companies—large players like Hyundai, Nissan, and Ashok Leyland; however, smaller companies in tier-2 cities will face a hit unless they are able to shift (McKinsey, 2024).

In an electric vehicle supply chain, OEMs have to be well-connected with the components supply. For this, the government will promote Logistics Parks and Free Trade Warehousing Zones for better management of inventory, where vendors and OEMs can undertake production with minimal capital investment in buildings and land (TN Govt, 2023).

Once manufacturing is able to take off, EV producers have to be incentivised and held accountable for the full life-cycle of the EV, as per an extended product responsibility framework where they are held accountable for disposal and recycling of their products (Chigbu, 2024).

Opportunities: OEMs can also be utilised to the maximum by involving them with a wide range of activities along the supply chain—OEMs, in tandem with suppliers, could engage in R&D, innovation, development. They could focus on quality control and process improvement, and help suppliers upskill themselves (McKinsey, 2022).

iii. ICE manufacturing and Services

Key Vulnerability: Roadside mechanics, auto-rickshaw drivers are most vulnerable to shifts in EV if they are unable to afford to shift to a new EV vehicle.

At a stage where EV technology is developing, several European countries are following a method of retrofitting ICE vehicles to incorporate EV technology. In Tamil Nadu, a similar incentive model is being adopted, wherein retrofitted vehicles comply with the Automotive Research Association in India's standards. Tamil Nadu is following this incentive model:

Vehicle Category	Incentive (Rs.)	Maximum Incentive (Rs)	Number of Vehicles (#) to be incentivised
E-2Wheelers	10,000/ KWh	15,000	30,000
E-3Wheelers (autos/ Light goods carriers)	10,000/ KWh	20,000	15,000

(Source: Tamil Nadu Electric Vehicle Policy, 2023)

Incentivising retrofitting among small businesses that cannot afford to make an EV transition allows them to reduce emissions and continue using their existing vehicles, which makes the EV transition more equitable. The process of retrofitting is also more labour-intensive, which is an opportunity to absorb low-income and low-skill workers who may face job losses. However, according to Lydia Powell, Energy Researcher at ORF, retrofitting ICE vehicles with EV batteries may lead to efficiency losses in the vehicle, as the typical ICE vehicle is much heavier than the EV vehicle, leading to inefficient energy consumption (Powell, Telephonic Interview, 2024). In addition, according to Dr. L V Krishnan, "*retrofitting does not seem to be a viable option to me; the entire design of the vehicle will have to be changed*." However, according to Sanjay Krishna from the ITDP, Tamil Nadu has been the only state to identify retrofitting opportunities for those who cannot afford a full shift to EVs. He says, " *Efficiency losses are to be expected in retrofitting large vehicles. However, in the long run, it is still more environmentally friendly, and should not cause any serious damage to vehicles*."

While there is a significant focus on manufacturing in conceptualising the just transition, it is imperative to focus on small-scale car-related service suppliers as a vulnerable market. In fact, services related to the car industry employ more people than the manufacturing industry (Amelang, 2021). Roadside servicers will need to be upskilled to be able to service EVs. It is prudent to start upskilling workers situated in tier-1 or tier-2 cities where EV adoption may be higher. In the case of auto rickshaw drivers and gig workers or transport-related workers, without access to retrofitting measures, they may find themselves excluded from sharing the impact of the green transition.

In the case of auto rickshaws, although a ban of ICE vehicles is not a realistic forecast, rickshaw drivers will be excluded from the monetary benefits of EV adoption and low-cost maintenance. Auto rickshaw owners need to be given small-scale loans to assist them in

either purchasing an EV vehicle or retrofitting their existing vehicles with the electric battery. As of now, in the case of Tamil Nadu, the state government has been offering subsidies for auto-rickshaw drivers to adopt EV vehicles (Lydia Powell, Telephonic Interview, 2024).

iv. Women

Key Vulnerability: Women are particularly vulnerable in the manufacturing industry of Tamil Nadu. Unless they are given targeted reskilling and skilling opportunities, they stand the risk of being excluded from the EV shift.

Inclusion of women in the workforce presents another unique opportunity in creating a just transition framework for Tamil Nadu. In the past, women's representation has been low due to structural sexism and prevailing gender prejudices and biases (OMI, 2024). Despite being the top state for women's representation in the manufacturing industry, women form just 15% of the manufacturing chains in Tamil Nadu. In this shift to EVs, there is a significant potential to integrate women in the workforce further. Tamil Nadu is poised to implement this, being the top state in the country for women's representation in manufacturing. In Krishnagiri, the Ola Future Factory aims to employ an all-women team. The Ranipet Facility in Ampere, Tamil Nadu, is one of the first OEMs to be founded by a woman in India, and it consists of a workforce of 70% women. In 2014, the Tata Motors 'Women in Blue' initiative enrols educated and skilled women from economically deprived areas. Currently, it employs 6500 women on the EV manufacturing shop floors (OMI, 2024).

Opportunities: In the case of women's employment, there are multiple pathways of entry. Considering that the EV market employs a high number of IT professionals, women can be employed in high-end IT jobs as well. R&D and manufacturing are areas in the automotive supply chain that are currently suffering the most from an under-representation of women (OMI, 2024).

v. Graduates

Key Vulnerability: Currently, automobile-related placements and college curriculums are oriented towards mechanical engineering and ICE-related auto knowledge. There needs to be a shift towards creating more graduates in middle-tier colleges who are able to handle EVs.

One of the core competency changes that needs to be made is the shift from a mechanical sciences model of automobile expertise to an electrical engineering approach. Upgrading and upskilling different sections of the population is critical to effective capacity development and upgradation. According to the Tamil Nadu EV policy, the state is identifying the nature and level of skills required to improve the quality of EV design, development, and manufacturing (TN EV Policy, 2023). The Higher Education Department of Tamil Nadu has started to redesign college curriculums that leave graduates more job-ready. In engineering

and polytechnic colleges, there is now a greater emphasis on electrical, electronics, mechanical, and automobile courses to suit the industry requirements. The TNDSC will provide finishing and short-term skilling to the personnel for EV-based skill qualifications. Within Guidance Tamil Nadu, the government has set up WorkLabs, a cell that is dedicated to expanding partnerships between industry and academic experts. The cell is committed to upskilling graduates through hands-on experiential learning (TN EV Policy, 2023).

The EV policy does acknowledge the importance of OEMs in the EV transition and has allocated an upskilling allowance of 10% of their workforce engaged in the EV production line. The transition support for workers can also be availed in the form of a training subsidy of Rs 4000 per worker (per month) for a period of 6 months. For women, specially-abled, workers from the SC/ST community, the subsidy extends to Rs 6000 per month for the same period (TN Govt, 2023).

Opportunities: The EV transition will create a niche of new jobs that centre around R&D. This may be towards battery technology, disposal, electrical systems, and retrofitting technology, to name a few.

vi. Informal Workers

Key Vulnerability: The network of informal workers and unorganised sectors is large in the automotive sector, and contract labourers do not come under company protection.

Informal workers and contractual labourers that work on shopfloors are at the highest risk of job losses, and possibly may be pushed to destitution. Creating a policy intervention to protect informal workers through a rights-based approach is crucial for a transition policy. Tamil Nadu can protect informal workers through a 'Right to Repair and Service Policy', which should enable and incentivise employers to offer low-skilled workers employment opportunities in fields allied to the ICE counterparts (iForest, 2024).

Currently, there is a major EV waste sector, that will now engage with the mass recycling of EV batteries. According to Tamil Nadu's EV Policy of 2023, the EV system in Tamil Nadu is meant to be a circular system where batteries are re-used at special centres set up by manufacturing facilities. In the case where lithium batteries are used, upskilling of workers has to be done with great caution, possibly in collaboration with technical institutes like IITs and the companies. As of now, the policy does not come with employment regulations, which can be dangerous for workers. Regulations to govern the worker rights in these re-cycling stations must be enacted in coming policy decisions. Moreover, given that battery recycling can absorb low or semi-skilled labourers, manufacturing industries have to be incentivised to hire laid-off or at-risk workers for a smoother transition. However, battery-related waste can be hazardous to workers, which necessitates immediate regulation. According to Sanjay Krishna from Guidance Tamil Nadu, the Ministry of Environment and Pollution Control Board will be drafting policy that recognises and regulates the scrapping industry (Sanjay Krishna, Telephonic Interview, 2024).

vii. Consumers

Finally, consumers are the end-points of the chain of production and analysis in the livelihood framework, and Tamil Nadu has initiated purchase subsidies for the EV market such that mobility remains affordable for the masses. However, EV adoption in Tamil Nadu has been largely market-driven, compared to the states across India (Vahan, Ola Electric Database, 2024).

This means that all of Tamil Nadu's subsidies have been catering to public transport facilities in the state, creating potential for generating opportunities in mobility as a service. Policy support to startups is encouraging, and the policy of 2023 discusses the start-ups that have mushroomed for various levels of the EV chain. These start-ups are in varied fields like commercial vehicle production and charging, which can create a conducive ecosystem to transition to mobility as a service in the state. However, as of now, trucking and larger-scale transportation systems are receiving more momentum in Tamil Nadu. (TN EV Policy, 2023)

Opportunities: Given its manufacturing strength, the Tamil Nadu government has the opportunity to transform public transport and draft a more inclusive policy by extending loans to private schools and colleges across the state to electrify their transport or shift to EVs (TN EV Policy, 2023). Higher market adoption rates frees policy focus for mobility as a service.

7. Recommendations

This study has discussed the implications of the electric mobility shift on various components of the existing ICE supply chain and allied stakeholders. It has identified the current policy environment and opportunities and shed light on gaps in policy directives. International and national studies on climate discourse necessitate the creation of a just transition committee and comprehensive policy plan at both the central and state levels. Even if the creation of a dedicated state community may be a few years away, the following section provides insights and recommendations that integrate just transition principles and concerns to improve the existing policy environment in Tamil Nadu.

Distributive Justice	**Mobility as a Service** • Subsidising schools and private colleges to adopt Electric Vehicles for public transport can enhance adoption and make the EV shift affordable for mid-level educational institutes (Gowande, Kohli, 2024). • Creating protective policies for trucking clusters in Tamil Nadu that can enhance affordability and adoption rates (Krishnan, Kumar, Sen, 2024). • Creating city-level roadmaps for electrifying public transport in consultation with stakeholders to ensure a comprehensive approach to electrifying public transport (ITDP, 2023). • Furthering mobility as a service through encouraging start-ups that offer affordable rides and transportation using even smaller vehicles like 2 and 3 wheelers.

Procedural Justice	• **Creating an Open Data Hub:** District-level data collection and streamlined supply chain data mapping, and creating a unified dashboard in collaboration with industry and private research partners can help understand and thoroughly map the vulnerabilities and opportunities for OEMs and MSMEs. [1] • **Facilitating Social Dialogue:** Fostering regular discussions and inclusive stakeholder meetings in collaboration with private partners and labour unions. • **Conducting Awareness Camps:** Conducting reach workers and inform them of the career options in EV. Focus on industrial belts like Coimbatore and Hosur can be a good starting point for stakeholder discussion and involvement. As of now, institutes like the World Resources Institute are being involved in training MSMEs and workers. These processes need to be regularised for sustained interaction, and the government needs to utilise these sessions to initiate discussions on informal sector workers.

[1] Currently, the Tamil Nadu government has initiated the process of supply chain mapping in collaboration with private players and research organisations, which is an important first step in this direction. For the government, providing open-access data could be a cost-effective but highly impactful endeavour.

Recognition Justice	• **Conducting Training:** Given the disparate skill levels of the Indian workforce, the Tamil Nadu government will have to focus on blue-collar skill development such that it is catered towards the needs and opportunities for blue-collared workers. • **Strengthening Social Protection:** One of the major next steps for the state is to develop a fund for the support of workers who may be facing career breaks or job losses. These are predominantly contract labourers who work on contract basis with either MSMEs or even larger companies. These people are difficult to target from the state perspective since they are not full-time employees, making them a tricky population to protect (Powell, Telephonic Interview, 2024). • **Regulating the Battery Recycling Industry:** Given the emphasis on the circular economy in the Tamil Nadu Electric Vehicle Policy, regulating the re-cycling industry is an essential step for the government. The regulations have to ensure that workers receive proper training and payment for their work and are protected from the hazard of the batteries. As of now, the regulatory measures are yet to be announced. • **Developing a Curriculum:** Tamil Nadu can mirror some of the policy moves made in Telangana and Karnataka. Telangana's Skill Development Agency is very well prepared to assess, prepare, and train workers for employment opportunities. Industry connections can help assess the kind of knowledge that would be useful for each type of stakeholder. Karnataka has collaborated with industry stakeholders like Tata and Siemens to develop a curriculum (Bansal, Sen, Kanuri, 2024).

8. Conclusion

As of now, the EV policy of Tamil Nadu is highly catered towards accelerating manufacturing and R&D. Overall, the policy provides several incentives to its existing manufacturing base to expand into the EV sector and has begun to include MSMEs into the transition through training in collaboration with private players like the World Resources Institute. At a broad level, there are some factors to keep in mind while exploring the EV shift.

One, geopolitical factors like the US elections may influence the foreign investment in areas like EV production. Two, the rate of adoption of EVs on the demand side will be heavily dependent on the market demand and adoption of the EVs, which is tied to governments' consistent subsidising. Given this model, MSMEs and OEMs have the time to tackle the EV shift gradually in phases. It is estimated that the EV industry will take 10-15 years to take off completely in the state, which allows the state time to draft a comprehensive policy for livelihood generation and protection. In the case of Tamil Nadu, having concentrated industrial belts with regional variations and expertise levels may in fact make it easier for the government to target specific businesses and populations involved in components for upskilling and protection. Therefore, it is the roadside mechanics, tiny businesses, and service related stakeholders that are really highlighted through the just transition framework.

A priority action would be to garner political support for social protection of informal workers for the electric mobility shift and allied sectors. At this stage, what is crucial is that MSMEs and OEMs are provided with enough awareness training such that they are able to experiment with adopting EV-related technology. Essentially, this implies that associated processes have to be made easier for the Tamil Nadu government's approach to building industrial parks for this innovation as it is an important step in this direction and could benefit the technical growth of the automobile sector. However, they have to ensure that small and medium-sized enterprises benefit from this, and can access land and have subsidies access to capital equipment. Given the strong establishment of the legacy industries in Tamil Nadu and the phased and slow nature of the EV transition, it is likely that they can adapt to the changing market. In the case of Tamil Nadu, having concentrated industrial belts with regional variations and expertise levels may in fact make it easier for the government to target specific businesses and populations involved in components for upskilling and protection.

With reference to the question of justice, Tamil Nadu ranks highly in the distributive dimension of justice, with a strong manufacturing market and adoption rates. Measures from the government that align with the concerns of procedural justice are centred around MSME training. The question of recognition for informal workers is severely lacking if not absent in policy formulations thus far.

This research paper is an exploratory study into applying just transition principles and concerns in the EV shift in Tamil Nadu. It is an attempt to further just transition research

and contextualise it for the reality of India through the case study of Tamil Nadu. It furthers just transition research and electric mobility policy by providing a review of Tamil Nadu's policy in relation to ensuring justice for multiple stakeholders.

There are some limitations to this study. Considering that the EV market is still emerging, data unavailability for district-cluster-specific study has been high. Thus, existing policy documents and insights from other case studies have been used to explore the possibilities for Tamil Nadu. Second, this paper highlights the just transition approach largely on the side of manufacturing and does not delve deep into consumer protection. This is a significant area that can be studied under this framework for future research, particularly through the lens of EV adoption rates. Another area for future research is to investigate the raw material supply chain of lithium, cobalt and semiconductors that will become essential in EV production. However, given the state-specific focus, it may be premature to build the supply chain around these materials; however, it is a promising area for future research.

In conclusion, Tamil Nadu's EV environment is robust for the creation of livelihoods across the supply chain, particularly in high-skilled jobs. The state cells like Guidance and WorkLabs are well positioned to push the frontier of manufacturing and research through robust industry-academia connections (ITDP, 2024). With governance and city-wide planning initiatives, Tamil Nadu could pioneer the electrification of public transport in the country.

However, a serious shortcoming is the fundamental structural problem of informal labour and micro-enterprises. Although informal labourers of all sectors are vulnerable in the energy transition at large, it is particularly easy to gloss over worker rights in policy discourse around EVs by highlighting higher-value job additions. Creating reliable open access data for just transitions at the state level is an important step in promoting good governance and accountability. Regulating new markets like battery recycling and scrapping is also an important dimension to ensuring justice in the newer labour markets.

Foregrounding justice in energy transition policy by creating more dedicated committees, funds, and accessible data can alleviate these concerns and, over time, transform socio-economic equity in the state at large.

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