Accelerating Electric Vehicle Adoption in Rajasthan (EV Raj)

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Executive Summary

The electric automobile industry in India is almost nearing a tipping point. In the last few years, the industry witnessed momentum, after years of stagnation. This was largely fuelled by the global economic downturn, resulting in steep hikes in petrol and diesel prices in India alongside various developments, both inside and outside the automotive sector. Once hailed as a "disruptive technology", electric mobility today has crossed a critical threshold in India and is expected to grow steadily in the coming years as it gains recognition as an economical alternative to internal combustion engine (ICE) vehicles alongside the growing consciousness regarding carbon emissions and its outcomes for climate change.

However, electrification of the automotive sector is not simply a progressive step towards more advanced and better technology, it also necessitates the presence of an equally supportive ecosystem that is inclusive of charging, delivery, and servicing infrastructure, but not limited to these. Therefore, the adoption of electric vehicles (EV) to a large extent will depend on the presence of appropriate ecosystem and policy frameworks, which can play a significant role when it comes to a seamless fundamental transition from ICE to EV.

The Indian transport sector is responsible for 13.5 percent of India's energy-related CO2 emissions, with road transport accounting for 90 percent of the sector's total final energy consumption followed by rail and domestic aviation (both at 4 percent).[1] In addition to GHG, the transport sector is also a major emitter of other, poisonous gases, such as Nitrogen oxide (NOx), which cause local air pollution, resulting in adverse health outcomes and premature deaths. Twenty-one of the world's 30 most polluted cities are located in India.[2] In 2015, approximately 1,800 premature deaths were attributed to noxious gases stemming from the transport sector in New Delhi alone, with about 74,000 premature deaths registered across India.[3] Further growth in transport emissions will only exacerbate this, placing an increasing strain on an already overburdened public health system.

Given this background, the Indian government, in a bid to decarbonise its automotive sector, came out with the National Electric Mobility Mission Plan (NEMMP) 2020 in January 2013, through the Ministry of Heavy Industry, to have 6 –7 million EVs on the road by 2020.[4] As

1 https://iea.blob.core.windows.net/assets/c3de5e13-26e8-4e52-8a67-b97aba17f0a2/Sustainable_Recovery.pdf

2 https://www.iqair.com/world-most-polluted-cities

3 https://theicct.org/publication/health-impacts-of-air-pollution-from-transportation-sources-in-delhi/

4 https://heavyindustries.gov.in/writereaddata/Content/NEMMP2020.pdf

part of the NEMMP 2020, the Department of Heavy Industry also introduced the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme in 2015 to promote the manufacturing of electric and hybrid vehicle technology and to ensure its sustained growth in the country.[5]

Phase-I of this Scheme was initially launched for a period of 2 years - from 1st April 2015, up to 31st March 2019 and targeted four critical areas namely (i) Demand Creation, (ii) Technology Platforms (iii) Pilot Project, and (iv) Charging Infrastructure. It primarily aimed to incentivise all EV segments by providing demand and supply side incentives to enable wider adoption of EVs.

After a successful run and owing to encouraging feedback from industry stakeholders and users alike - the Fame scheme was redesigned and Fame II was launched in June 2021 with an outlay of INR10,000 crore to incentivize demand for Electric Vehicles (EVs) by providing upfront subsidies and deploying EV charging infrastructure.[6] Under this scheme demand incentive for e-two wheeler was raised from INR10,000/kWh to INR15,000/kWh with the maximum cap increased from 20 percent to 40 percent of the cost of vehicles. This resulted in EV sales rising from 700 per week during the first phase to over 5,000 per week during the second phase of Fame. Given the success of Fame II, the scheme was extended by the central government for a period of 2 years i.e., up to March 31, 2024.

Apart from these central subsidies, several states have introduced respective state EV policies each with its own set of incentives to further facilitate EV penetration there. While some states focussed on supply-side incentives such as setting up of incubation centres (Tamil Nadu, Karnataka, Telangana, Andhra Pradesh) and power rebates to manufacturing plants (Haryana, Madhya Pradesh, Maharashtra, Tamil Nadu), some focussed more on incentivising EV demand by exempting EV registration fee (Tamil Nadu, Haryana, Maharashtra, Bihar, Meghalaya) and reimbursing SGST (Haryana, Uttar Pradesh, Tamil Nadu).

While Rajasthan did have an incentive scheme for EVs, which comprised of incentives for end-users like road tax and permit fee waivers, SGST reimbursement, and upfront cost incentives of up to INR10,000 for e-two wheeler and up to INR20,000 e-three wheeler based on the battery capacity[7] of the vehicle - very recently the Rajasthan government in principle approved the state EV policy.[8] For charging station operators, the policy has incentives such as land price

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5 https://pib.gov.in/newsite/PrintRelease.aspx?relid=191377

6 https://pib.gov.in/PressReleasePage.aspx?PRID=1784161

7 https://transport.rajasthan.gov.in/content/dam/transport/transport-dept/pdf/officeorders/Officeorder2021/office_order_10_2021.pdf

8 https://economictimes.indiatimes.com/industry/renewables/rajasthan-government-approves-ev-policy/articleshow/91764838.cms

concession for renewable energy-based EV charging stations[9], electricity duty exemptions as well as subsidised electricity costs.[10]

The current study aims to identify current supply and demand side gaps impeding the transition to EVs in the state of Rajasthan and subsequently suggest a policy roadmap for addressing these gaps. To supplement this, the project also aimed to analyse various policy practices (policy interventions, regulations, non-legislative steps, innovative regulatory mechanisms, and collaborative efforts from corporates) in the EV space and draw from the best practices of states championing this transition.

The study employed the PESTEL framework for primary data collection from supply-side and demand-side stakeholders on various factors which were respectively classified into political, economic, social, technological, environmental and legal indicators to get an overall picture of the fledgling EV- ecosystem in the state and to capture inputs from every stakeholder in this sector- from manufacturers (about 39 percent of total supply side stakeholders interviewed), dealers (about 27 percent of total supply side stakeholders interviewed) who also provide repair and after sales service at the moment, a few EV-financiers and charging station operators, fleet aggregators (about 21 percent of total demand side stakeholders interviewed), end-users (311 users interviewed) to capture their experiences. These preliminary insights have been presented in the form of infographics, while the inferential analysis streamlines these insights to bring out the relatively more important policy gaps that pose a threat to successful EV penetration in the state and need immediate redressal in the much-anticipated Rajasthan EV policy.

The study found out that as per supply-side stakeholders such as original equipment manufacturers (OEM) and dealers, the most significant factor driving EV sales from the policy viewpoint was the Rajasthan EV subsidy which is reflective of the importance of supportive regulatory frameworks in driving down upfront costs and increasing EV adoption. From the economic viewpoint, the low maintenance cost of EVs was one of the major selling points while the importance of consumer awareness from the social viewpoint revealed the need for greater awareness generation campaigns focussing on the benefits of electric mobility. On the technological front, we observed that owing to the nascency of the sector, EV manufacturers were enthusiastic about testing out new ideas and eager to come up with innovations that could put EVs one step ahead of their ICE counterparts. Hence incubation centres are the need of the hour. Besides that, dealers were also excited about the inclusion of automation technology like artificial intelligence and the internet of things in EVs. However, supply-side responses on environmental and legal factors were rather lukewarm as currently there are hardly any provisions for end-of-life management of vehicles and batteries as the majority of EVs sold were yet to complete one life cycle. Also, there was hardly any clarity regarding legalities such as EV charging provisions and waste management rules amongst them.

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9 https://urban.rajasthan.gov.in/content/dam/raj/udh/udh%20department/pdf/Orders-and-Circulars-1/28092021.pdf

10 https://www.rajras.in/wp-content/uploads/2020/06/Draft-Suo-Moto-Order-EV-eb13b8c.pdf

To get a complete picture of the demand side experience, we divided our stakeholders into-

1) Current and potential EV fleet aggregators
2) EV users

Fleet aggregators mostly consisted of businesses and corporations that were either looking to or had already included EVs in their fleet. From our interviews, we found that on the policy front, incentives such as registration fee exemption and tax benefits had a significant impact on buyer behaviour. Again, on the economic front, consumers stressed on the the need for low operating and upfront cost of EVs along with better payload capacity. On the technological side, the performances of EVs on undulating terrain and under higher ambient temperatures were the most prominent factors considered by buyers when making a purchase decision. Apart from these, environmentally conscious consumers were also interested in EVs owing to their zero tailpipe emissions. However, the single most important factor for buyers was registration as it is the primary factor determining whether an EV was eligible for state subsidies or not.

For the user surveys, 311 EV users across various segments were interviewed and it was found that most of them were satisfied with the aesthetics, operating cost, speed, ground clearance, and loading capacity - however, most of them complained about range anxiety and the associated lack of public charging infrastructure. Another common complaint in the e-two wheeler and e-three wheeler segments was the performance of EVs on hilly terrain due to their poor build quality.

Apart from surveys the study also took the initiative to look at the best practices in other states in order to understand the essential aspects of an enabling EV ecosystem that could also be emulated in Rajasthan, albeit with some state-specific modifications. For this, we selected two states- Maharashtra and Tamil Nadu and through scoping visits and consultations with requisite stakeholders, analysed their demand and supply-side incentives.

While the Maharashtra EV policy is highly pro-industry facilitating collaborations to ease the EV transition in the state, it also provides EV manufacturing plants the status of ‘mega projects.’ The state EV policy also includes incentives across all categories of public charging stations and also encourages reservation of land for EV - related infrastructure within City Development Plans, conferring a ‘critical amenity status’ to charging infrastructure.

Tamil Nadu, on the other hand, has an investor-centric EV policy that offers several lucrative incentives for EV manufacturing units in the state. This is largely to make the most of the state’s locational advantages of being one of the prime automobile manufacturing hubs of the country. As a result, the state has successfully managed to attract investments from leading EV manufacturers such as Ola Electric, TVS Electric, Ather Energy, and others. The state EV policy also offers 100 percent SGST reimbursement on EV purchases amongst other incentives.

This is followed by a section assessing the impact generated by a two pronged awareness campaign consisting of a physical along with a digital campaign that was launched to address the immediate issues that emerged from our primary data analysis.

In the final section, the study ends by presenting a road map with key actionable insights which can accelerate EV adoption in Rajasthan. These have been further categorised into separate timeframes depending on the urgency with which they have to be addressed i.e., short-term focus, mid-term focus, and long-term focus.

2 Introduction

According to the World Health Organisation, India is home to nine out of the ten most polluted cities in the world. A significant contributor to this air pollution is the transport sector, within which road transport accounts for over 95 percent of the total emissions. To tackle the rising emissions and their impact, the Government of India committed to reducing emission intensity to 33-35 percent by 2030 from 2005 levels at the COP21 Summit. Further, during the recently held COP 26 India reiterated its stance on decarbonisation and committed to reducing total projected carbon emissions by one billion tonnes by 2030. Such global commitments fuel India's transition to alternative modes of transport, especially electric vehicles (EVs).

In recent years, both the Central and State governments have been introducing policies and schemes to increase the production and adoption of electric vehicles including the FAME I and II schemes, State EV policies and Production Linked Incentive Schemes. State Electric Vehicle policies have introduced a range of incentives, including demand incentives for buyers, charging infrastructure incentives, and production incentives for industry players. States with existing EV policies are learning from experiences on the ground and also making dynamic revisions accordingly.

Simultaneously, states without EV policies are working swiftly towards drafting and notifying their EV policies. Besides that, many state governments are imposing additional road tax on ICE vehicles, green tax on re-registration of old vehicles, cess on petrol and diesel, and a congestion fee on ICE cabs to encourage people to shift greener options like EV. Meanwhile, some other states are focusing on attracting thousands of crores of investment from EV makers in the next few years by providing them subsidies on capital investment, taxes, power tariffs, etc.

While Rajasthan has not yet finalised the EV policy, it has already announced demand-side incentives for promoting the adoption of EVs across the state. Currently, EVs sold in Rajasthan account for 6.21 percent of overall sales in India, with 76 percent being two-wheelers and 24 percent being four-wheelers.[11]

[11] http://fame-india.gov.in/index.aspx

However, the teething challenges of lack of charging infrastructure, poor after-sales service and limited awareness are impeding the growth of EVs in the state. While Rajasthan had developed a plan to encourage sustained and inclusive growth by attracting investment in the manufacturing and petroleum industries during the last decade, a similar strategy is required for EV and battery manufacturing to succeed. Given this context, the state must develop and implement a holistic policy to promote EVs' production and adoption.

3 Methodology

The objective of this project was to identify current supply and demand side gaps impeding the transition to EVs in the state of Rajasthan and subsequently suggest a policy roadmap for addressing these gaps. To supplement this, the project also aimed to analyse various policy practices (policy interventions, regulations, non-legislative steps, innovative regulatory mechanisms, and collaborative efforts from corporates) in the EV space and draw from the best practices of states championing this transition. Thus, to achieve the multifaceted objectives of the project, a mixed-methods approach was adopted.

1. Secondary Research and Selection of Project Locations

To understand the current policy and adoption landscape in India and Rajasthan, a thorough review of relevant literature and policy/regulatory documents was conducted. Based on this and suggestions from the PAC[12], the five non-attainment cities[13] in Rajasthan i.e., Jaipur, Jodhpur, Udaipur, Kota and Alwar, were selected as project locations. This is because they have poor air quality and require a transition to greener transport options, amongst other mitigation measures.

Along with the selection of cities, a thorough review of various methodologies was also conducted to determine the framework for collecting and analysing the data on supply and demand-side gaps. Additionally, quantitative data related to EVs, and transport sector statistics was collected from several secondary sources, including the Ministry of Road Transport and Highways website and the Vahan dashboard.

2. Stakeholder Mapping

Based on insights from secondary literature, an extensive map of stakeholders in each of these five cities was carried out. This was done to identify the key stakeholders in this sector whose perspectives had to be included and represented in the research. The stakeholders were mapped into two broad categories as discussed below:

1) Supply-side stakeholders included manufacturers of EVs, their components, and allied equipment such as battery chargers, charging stations, dealers of electric two-wheelers, three-wheelers and four-wheelers and auto-financiers.

[12] Project Advisory Committee: https://cuts-ccier.org/pdf/pac-list-ev-raj.pdf

[13] https://cpcb.nic.in/list-of-non-attainment-cities/

2) Demand-side stakeholders – It included demand-side operation enablers responsible for generating demand and end-use of EVs i.e., vehicle aggregators and users.

3. Survey Design and Data Collection

Following the initial mapping of stakeholders, the PESTEL[14] framework was chosen to capture the perspectives of the diverse set of stakeholders. Indicators were identified and questionnaires were developed to gauge the relative importance of various factors on demand and supply side, such as the impact of central and state government subsidies, financing options, after-sale service options, charging infrastructure, range, safety and so on, when it comes to EV sales or purchase decisions. The survey was divided into three components for effectively capturing the insights. A separate set of PESTEL indicators was developed for Demand-side and Supply-side stakeholders (refer to the Data Analysis section for details on indicators).

1. Supply Side PESTEL – This component was used to capture the insights of manufacturers, dealers and financiers on each of the identified indicators. A sample of 10 - 12 stakeholders from each city was selected using purposive sampling methods and exhaustive KIIs[15] were conducted for this purpose.
2. Demand Side PESTEL – This component of the survey was used to capture the perspectives of current and potential demand aggregators to understand what factors would influence their EV purchase decisions. A sample of 8 - 12 stakeholders from each city was selected using purposive sampling methods and exhaustive KIIs were conducted for this purpose.
3. User Satisfaction Survey – Along with the Demand-side PESTEL a User Satisfaction Survey was designed to capture users' experience of electric two-wheeler, three-wheeler and four-wheelers. A set of indicators including looks, build quality, range, subsidies, financing options, charging options and after-sales service was defined and questionnaires were prepared accordingly. The sample size for each city was determined based on the current proportion of segment-wise EV sales to total sales (please refer to table below for details). A total of 311 user surveys were conducted across the 5 selected cities.

[14] Political Economic Social Technological Environmental Legal: https://research-methodology.net/theory/strategy/7137-2/

[15] Key Informant Interviews

Table 1: Category wise User Surveys carried out in Each City

Cities	Total Sample Size for User Survey	Two-Wheeler	Three-Wheeler (Commercial and Passenger)	Four-Wheeler (Passenger)
Jaipur	99	49	46	4
Kota	62	31	29	2
Jodhpur	49	24	23	2
Udaipur	34	17	16	1
Alwar	67	33	31	3
Total	311	154	145	12

4. Methods of Analysis

The primary framework used for data analysis was PESTEL. It is a macro-environment analysis framework that is used for qualitative assessment. PESTEL is an acronym for political, economic, social, technological, environmental and legal factors, which play a vital role in the success of a technology. Political factors measure how the government can influence the EV industry through policies, announcing subsidies etc. Economic factors comprise the factors that impact the cost of EVs and the associated infrastructure. Social factors consider the core values and beliefs specific to Rajasthan, which influence the EV industry.

Under technological factors, developments and improvements related to EVs are monitored and their implications are assessed with regard to the EV industry. Environmental factors consist of factors affecting ecology. In the case of EVs, proper management of batteries and vehicles after their use is of paramount importance. Lastly, legal factors take care of the laws and regulations that enable or cause a hurdle in developing the EV ecosystem. The following factors and indicators were considered for the supply - side PESTEL.

The data collected for each of these factors (PESTEL and User Satisfaction) was analysed through descriptive statistics. For the Demand and Supply-side PESTEL the data represents the nature of influence (positive, negative or neutral) or a particular factor and the importance (low, medium and high) of the particular factor. For the User survey, the data represents the satisfaction (very dissatisfied, satisfied, ok, satisfied and very satisfied) of a user with various aspects of an electric vehicle. Each of these data points has been represented in stacked bar charts to highlight the relative percentage of the different responses collected for different factors.

Following this, a rank analysis was conducted to get more nuanced insights and comparisons between the vehicle segments/cities.

5. Ethical Considerations

Ethical considerations are critical for conducting social research involving interaction with human respondents. For this purpose, the following ethical codes were adhered to at all stages of the study.

- Participation: The research methodology considered the importance of participation of different stakeholders in the automotive ecosystem and ensured the same. Further, there has been no discrimination based on gender, class, or any other social construct throughout the research activities.
- Consent: The research team ensured informed consent of all participants to eliminate information asymmetry and ensure participation that is just and responsible.
- Confidentiality and Anonymity: Due to the sensitive nature of the quantitative and qualitative data, care was taken to maintain the privacy and anonymity of respondents.

6. Limitations of the Study

The scope of the research is limited by the time and resources that were available for this purpose. Also, due to the unavailability of uniform samples or data due to the nascent stage of EV adoption in the state, wherever possible, the most consistent datasets have been used. This may have a connotation on the estimates provided by the research.

4

Data Analysis

Through the data analysis component of this study, we attempted to understand the barriers faced by different stakeholders regarding the existing EV ecosystem in Rajasthan, which the Rajasthan EV policy could potentially address. Besides that, it also attempts to analyse the policy steps that could be taken to identify current supply and demand side gaps as well as various policy practices (policy interventions, regulations, non-legislative steps, innovative regulatory mechanisms, and collaborative efforts from corporates) that could be undertaken by the state-level authorities to ease the transition from ICE to EVs in the state of Rajasthan.

Supply-Side Stakeholder Survey

For supply-side stakeholder analysis, we interviewed manufacturers of EVs, its components, and allied equipment such as battery chargers and other charging equipment across the five selected cities of Rajasthan namely Jaipur, Jodhpur, Udaipur, Alwar, and Kota. Insights from the interactions with these stakeholders have revealed several factors that significantly affect the EV ecosystem.

The respondents were selected after careful consideration and were interviewed on a number of factors (shown in the following section) that can be broadly classified under political, economic, social, technological, environmental, and legal heads to present a complete picture of the nascent EV industry in Rajasthan. The surveys were designed to capture the nature of influence that each of these factors had on the overall EV ecosystem as per each stakeholder and their level of importance for every stakeholder interviewed. The table below lists the indicators considered for each of the PESTEL factors.

Table 2: Supply-side Factors

Political Factors	Economic Factors	Social Factors	Technological Factors	Environmental Factors	Legal Factors
Rajasthan EV subsidy	Ease of processing subsidy for end consumers	Consumer awareness for EVs	Incubation facilities	End of life management of vehicle	Separate electricity connection for charging station
Concession on land for renewable energy-based charging station	Innovative Business Models	Environmental awareness of citizens	Testing facilities (for component and vehicle)	End of life management of batteries	Waste management rules (such as producer responsibility laws, e-waste management rules etc.)
EV Policy of Rajasthan	Financing options	Workforce readiness	Battery recycling/repurposing facilities		Amendment in Model building by laws
Rajasthan industrial development policies and scheme	Electric vehicle demand	Employment generation	Advancement in battery chemistry		
RERC electricity tariff order for EV charging stations	Electricity tariff		Inclusion of AI and IoTs		
Subsidy under FAME II Scheme	Inverted Duty Structure on EVs (Difference between GST on EV and that on components)		Standardization of batteries		
Allowing subsidy on lead-acid battery vehicles in Rajasthan	Import duty on components		Standardization of charging connector		

Political Factors	Economic Factors	Social Factors	Technological Factors	Environmental Factors	Legal Factors
	Testing cost		Battery swapping		
	Maintenance cost of EVs		Potential of Cyber-Security threats		
	Indigenisation				
	Cap on LT connection				
	Availability of charging infrastructure				
	Availability of service centres				
	Availability of EV substitutes (E.g. CNG) at comparable prices				

Political Factors

Under Political factors, there were seven components on which respondents were surveyed. These were related to the Rajasthan EV Subsidy, concession on land for renewable energy-based charging stations, the upcoming EV policy of Rajasthan, Rajasthan Industrial development policy, and the Rajasthan Electricity Regulatory Commission (RERC) electricity tariff order for EV charging stations.

Figure 1.1: Nature of influence of various political factors from supply-side stakeholder survey

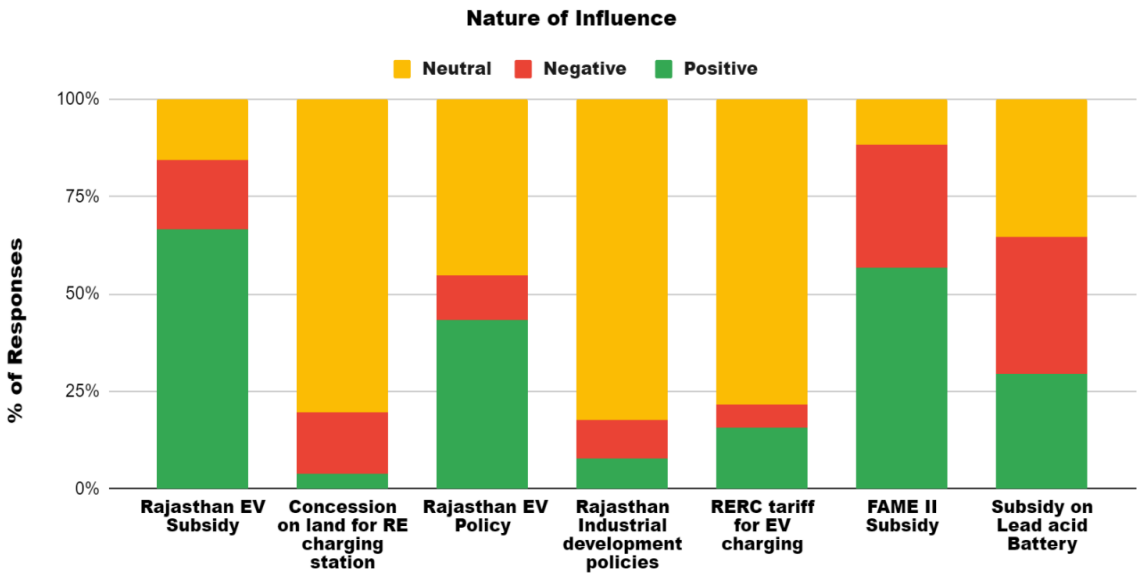
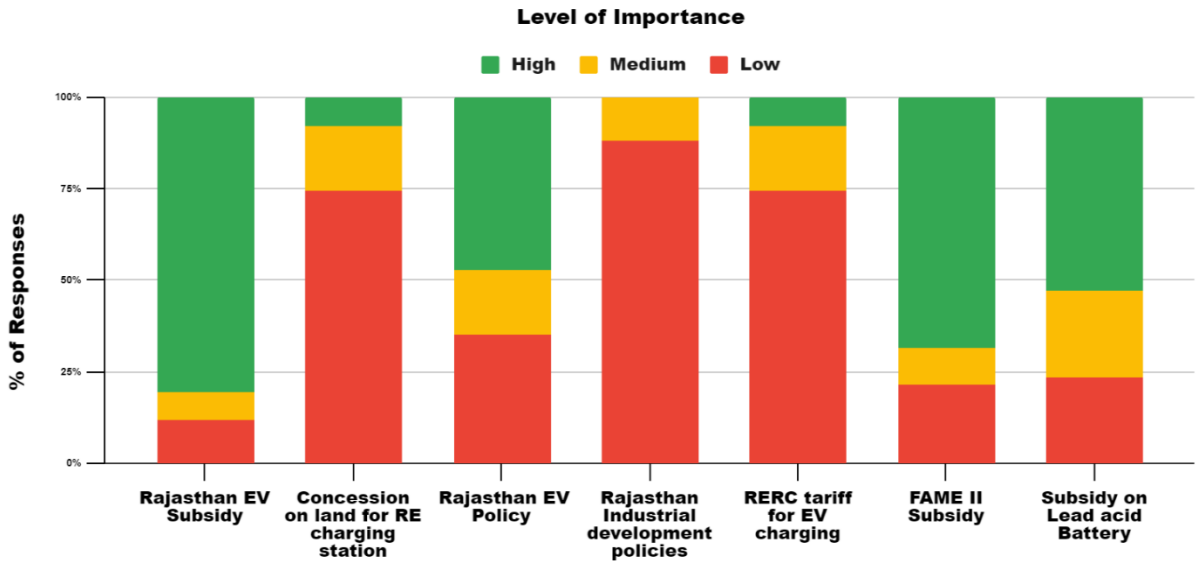


Figure 1.2: Level of importance of various political factors from supply-side stakeholder survey



1. **Rajasthan EV Subsidy:** In July 2021, the Rajasthan government announced subsidy up to INR10,000 for e-two wheelers and up to INR20,000 for e-three wheelers registered between April 1, 2021, and March 31, 2022, depending on their battery capacity.[16] Moreover, SGST for all EV purchases made during this period would be refunded. However, the government did not extend any cash subsidies for electric cars or buses. When questioned about this subsidy, most EV dealers and manufacturers surveyed across

[16] https://transport.rajasthan.gov.in/content/dam/transport/transport-dept/pdf/officeorders/Officeorder2021/office_order_10_2021.pdf

the five cities felt that this move had a positive influence on EV sales as it made EVs more affordable.

Especially in the case of e-three wheelers, it positively impacted the lower-middle class population, mainly consisting of daily wage-earners, who otherwise preferred cheap ICE vehicles with high emissions or non-motorised vehicles like peddle rickshaw and hand-carts due to the high upfront cost of EVs (figure 1.1). Owning an EV for this section of the population is extremely significant as it helps them earn more profits and work longer hours by freeing them from the worries of rising petrol prices and hard physical labour. As a result, the level of importance of the EV subsidy is also high which was further confirmed by our survey as per figure 1.2.

2. **Concession on land for renewable energy-based charging stations:** On September 28, 2021, the Rajasthan government passed an order to allot the government land at 50 percent concession for the first 500 renewable energy-based EV charging stations for five years.[17] However, due to an existing lack of public charging infrastructure in the state this move did not garner the expected response. As per this survey, most EV dealers and manufacturers were not aware of this policy. The few ones who were, did not expect it to impact the charging infrastructure in the state (Figure 1.1). Hence, just providing land concession is not enough. The government must develop further incentives to push the EV charging infrastructure in the state as the policy hardly made any difference to the existing situation (figure 1.2).

3. **EV Policy of Rajasthan**: A comprehensive EV policy has been instrumental in fostering the production and adoption of EVs in several states across the country. States such as Maharashtra, Gujarat and Delhi among others have already come out with extremely well-formulated EV policies with substantial incentives to foster the growth of this sector in their respective states. The EV policy of Rajasthan is expected to be out soon, which was further confirmed by Rukmani Riar, Executive Director of state-owned Rajasthan State Industrial Development and Investment Corporation Ltd (RIICO) at a Roundtable conference held on October 01, 2021 by CUTS International.[18]

   While conducting the survey, we received mixed responses from various supply-side stakeholders, who were unaware of the imminent arrival of this policy and the ones that were familiar with developments in the EV sector were anticipating the policy to affect a positive change in the sector (figure 1.1). However, the majority agreed that if formulated properly, it could really prove to be the tipping point that the EV sector in the state needs to grow and enter the mainstream market, thus having a high level of importance.

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17 https://urban.rajasthan.gov.in/content/dam/raj/udh/udh%20department/pdf/Orders-and-Circulars-1/28092021.pdf

18 https://www.energetica-india.net/news/ev-policy-of-rajasthan-will-be-out-soon-ed-riico

4. **Rajasthan Industrial Development Policy:** During the Roundtable conference held on October 01, 2021, by CUTS International on "Accelerating Electric Vehicle Adoption in Rajasthan", Rukmani Riar, Executive Director, RIICO, spoke about extending the benefits of the Rajasthan Investment Promotion Scheme (RIPS), 2019 for EV manufacturing. The focus would be on sectoral development by creating EV Zones, emphasizing the ease of doing business, facilitating charging and swapping infrastructure in the RIICO Industrial area, and providing interest and capital subsidy.19 However, when stakeholders were surveyed, most of them were not aware of RIPS (figure 1.1), which has EV promotion as one of its thrust areas. Hence it also came as no surprise that the majority of respondents did not anticipate RIPS to affect the existing state of affairs in the sector (figure 1.2).

5. **Rajasthan Electricity Regulatory Commission (RERC) electricity tariff order for EV charging stations:** In the draft Suo-Motu order by RERC for EV charging tariff, for Low Tension connection, the charges are INR6 per unit plus fixed charges of INR40 per hp per month, and for High Tension connection, the charges are INR6 per unit plus fixed charges of INR135 per kVA per month. Beyond this, there is a 'time of day (ToD)' rebate of 15 percent on power charges for recharging EVs at night from 11:00 pm to 6:00 am.20 Similar to the preceding question on RIPS, stakeholders were not aware of the RERC tariff for EV charging stations (figure 1.1) and did not anticipate it to have any effect on the EV sector (figure 1.2). This also reveals that dealers and manufacturers do not really consider electricity tariff as a prominent factor affecting EV sales.

6. **Subsidy under FAME II:** FAME II was launched with a budget outlay of INR1,000 crore in April 2019, to support 7,000 e-buses, 500,000 e-three wheelers, 55,000 e-passenger vehicles and a million e-two wheelers.[21] Under this scheme, 205 charging stations have been sanctioned for Rajasthan[22] and the government offers a subsidy of INR15,000 per kWh on battery.[23] During our surveys, most EV dealers reported that the subsidies had made EV affordable for a large chunk of the population who would otherwise have not considered it an option, thus having a positive impact on EV sales (figure 1.1). Also, the FAME subsidy is a significant factor that has helped mobilise the EV sector in many states, including Rajasthan, thus proving to be of high importance for the sector (figure 1.2).

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19 https://cuts-ccier.org/pdf/report-cuts-roundtable-conference-on-accelerating-electric-vehicle-adoption-in-rajasthan.pdf

20 https://www.rajras.in/wp-content/uploads/2020/06/Draft-Suo-Moto-Order-EV-eb13b8c.pdf

21 https://www.autocarindia.com/bike-news/fame-ii-scheme-extended-till-2024-421231

22 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1778958

23 https://www.zigwheels.com/news-features/ev-guide/ev-simplified-what-are-fame-2-and-state-wise-subsidies/44627/#:~:text=If20a%20product%20passes%20the,of%20the%20vehicle's%20total%20cost.

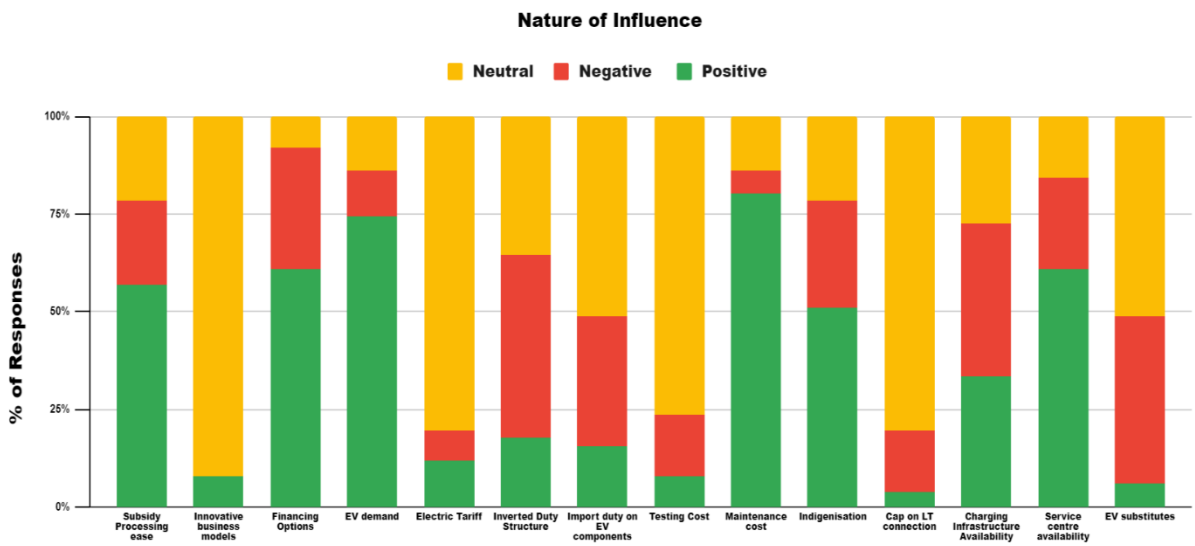
7. **Allowing subsidy on Lead Acid Battery:** On September 28, 2018, the central government extended the FAME I subsidy to March 2019, and withdrew the incentives for lead-acid battery powered e-two wheelers and e-three wheelers i.e. central subsidies would only be released for EVs with advanced battery chemistry.[24] On the other hand, the EV subsidies released in Rajasthan are also applicable to the lead-acid variants. Therefore, there is a clear non-alignment between the central and state policies for EV adoption. A number of the respondents were indifferent to this as they reported that the more expensive Li-ion battery-powered vehicles were in majority, which would further grow eventually due to their technological benefits.

   Another section of stakeholders reported that the lack of subsidy on lead-acid batteries affects EV sales negatively. The FAME subsidy, in conjunction with the state subsidy, would have further reduced the cost of lead-acid battery powered EVs, increasing its market penetration (figure 1.1). However, most stakeholders agreed that this change had a significant positive impact on EV sales in the state. Lead-acid battery operated vehicles are still a popular choice (figure 1.2).

Economic Factors

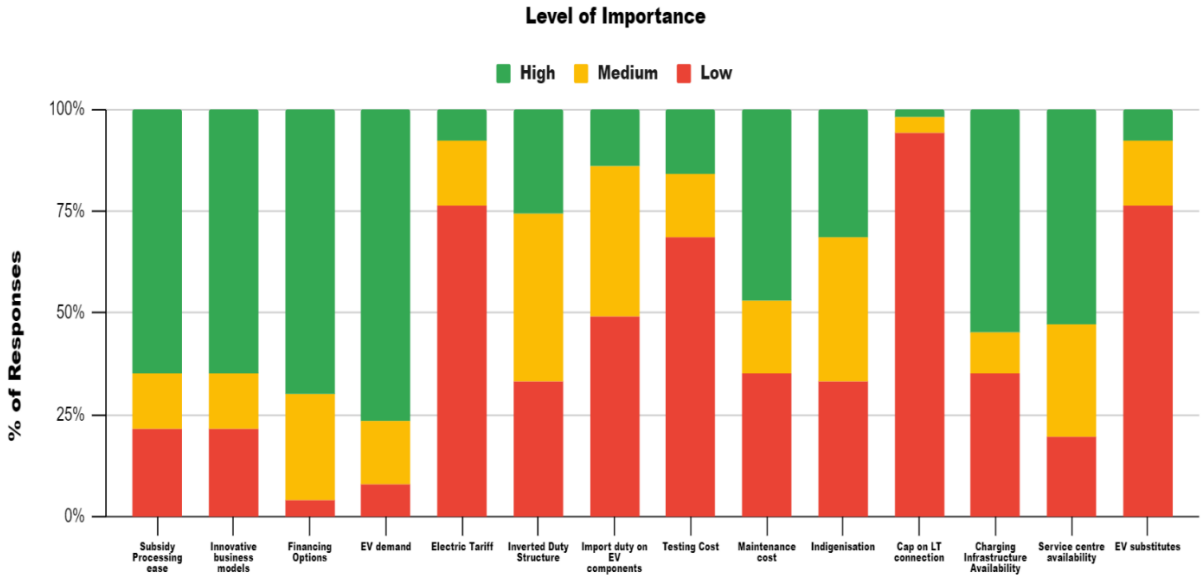
Under economic factors, there were fourteen components on which supply-side stakeholders were surveyed. These were ease of processing subsidy for end consumers, financing options, EV demand, inverted duty structure, import duty on EV components, testing costs, the maintenance cost of EVs, indigenisation, availability of charging infrastructure, availability of service stations and availability of EV substitutes.

Figure 1.3: Nature of influence of various economic factors from the supply-side stakeholder survey



24 https://energy.economictimes.indiatimes.com/news/power/govt-withdraws-sops-to-conventional-battery-vehicles-under-fame/65990495

Figure 1.4: Level of importance of various economic factors from supply side stakeholder survey



1. **Ease of processing subsidy for end consumers:** During the survey it was observed that central subsidies on EVs were already applied when it reached the end consumer. In contrast, the state subsidy is reimbursed once the registration on the vehicle is done. The dealer mainly carries out the registration process for claiming state subsidy, which involves submitting the consumer's relevant documents and bank details to the Regional Transport Office. Claiming subsidies, or the period from the dealer initiating the subsidy claim to the end user receiving the subsidy, is of great concern. However, during our surveys, most dealers claimed that they had successfully managed to file subsidy claims for their customers who had received their subsidies within a span of 1-3 months (figure 1.3).

   Owing to this, Rajasthan's EV subsidies have been quite successful in boosting the growth of this sector in the state (figure 1.4). However, the only complaint that dealers faced was regarding the time taken by state government offices to process the subsidy claim, which often went up to 3 months and, in some cases, even beyond that. Here several dealers suggested that if this time period could be reduced, it would be highly beneficial for the sector.

2. **Innovative Business Models:** To drive up the adoption and manufacturing of EVs innovative business models would be necessary, especially for the players like the charging station providers and after-sales service providers. They have to wait longer to start making returns. While the majority of the dealers and manufacturers agreed that such models are extremely important to address the chicken-egg dilemmas that arise in the case of charging station installation and service centres (figure 1.4). However, they were

not aware if any state or dealer had used such model in the EV sector to improve the EV ecosystem (figure 1.3).

3. **Financing Options**: EV buyers currently face financing challenges, such as high-interest rates, low loan-to-value ratios, and limited specialised financing options from public and private banks. Dealers felt that a large section of their customers financed EV purchases through their savings while the rest were financed by private financiers and were mostly satisfied with that. Thus, the lack of varied financing options did not affect the sector largely because of a lack of awareness regarding financing options and a consumer preference for self-financing (figure 1.3). However, they agreed that in order to break into the mainstream market, the sector would need more financing options for customers and this factor would become highly important going forward (figure 1.4).

4. **EV Demand:** The supply of EVs is invariably dependent on consumer demand. It also determines the economy of scale achievable by investing in the sector. While EVs have been in the market for quite some years yet, they haven't been able to enter the mainstream market. Only in recent years has the demand for EVs been significant, owing to the rising prices of petrol and the increased support for the sector from the government through subsidies, tax incentives, and registration fee exemptions. Considering these majority of stakeholders were positive that if the current state of affairs remains unchanged, especially with respect to petrol prices, the demand for EVs would surely keep growing in the future (figure 1.3) and this is an extremely important factor since greater demand will lead to higher EV sales (figure 1.4).

5. **Electric Tariff**: When it comes to setting up new charging facilities or expanding the existing ones, the electricity tariff is one of the major economic deciding factors for charging infrastructure providers/charge point operators. In this regard, RERC has set an electricity tariff of INR8/kWh for domestic charging. Also, Jaipur Vidyut Nigam Limited has specified a fixed charge of INR135/per KVA of billing demand per month and INR6/unit for EV charging stations.[25]

   However, during or surveys we observed that stakeholders were largely indifferent to tariff structures (figure 1.3) and did not anticipate it have any significant impact on EV sales because of the apparent lack of public charging infrastructure (figure 1.4). In all of the five cities, e-two wheelers and three wheelers are the segments witnessing higher sales and these vehicles are being marketed as those which can be charged at home.

[25] https://swcs.rajasthan.gov.in/Upload/3d2b0b51-cf1b-42bf-85a5-21648e2e21aaTariff%20Order%202020.pdf

6. **Inverted Duty Structure:** The current GST on EVs is five percent, on batteries 18 percent and that on other components is 28 percent. Owing to this inverted duty structure, dealers reported that while the lower GST on the EV itself helps lower the upfront cost of the EV, the 18 percent and 28 percent GST on battery and components make after-sales service, i.e., battery and parts replacement very expensive. Hence the majority of the supply side stakeholders felt that the inverted duty structure could impede growth affecting EV sales negatively, especially given the fledgling state of this sector (figure 1.3). However, the sample consisted largely of dealers which mainly sell EVs but also had provisions to supply parts subject to demand. Thus, the stakeholders did not consider the inverted duty structure to be extremely significant because when demand of EV increases, the demand for parts will also increase irrespective of GST rates (figure 1.4).

7. **Import Duty on EV Components:** Under the Phased Manufacturing Programme of FAME II, from April 2021 onwards, the import duty on EV components was raised to 15 percent, while that on lithium-ion cells was doubled to 10 percent in a bid to promote indigenous manufacturing of EV components and batteries.[26]

   However, EV dealers, who formed the majority of the respondents, were largely indifferent to this move (figure 1.3), while manufacturers welcomed this move as it would give a huge push to the local EV manufacturing industry. However, both agreed that in the long run, this factor would not be as significant to the EV sector as other factors like demand for EV and availability of financing options (figure 1.4).

8. **Testing Cost-** Testing is required during the R&D phase and for certification. For component testing, the manufacturer has to bear the cost of all specifications of components and the certification is done as per the requirement of the OEM. Dealers were largely indifferent to testing costs (figure 1.3) and did not consider it significant to the EV sector (figure 1.4). However, there were many complaints from manufacturers in Jaipur and Alwar. According to one manufacturer, the amount of money spent on obtaining certifications and testing on one vehicle with either different batteries or different motors is unjustifiably large. They have to spend close to INR20 lakh every time to get one vehicle approved to be eligible for the FAME subsidy. Thus, testing is sometimes neglected to avoid the testing cost, which may ultimately affect vehicle quality.

9. **Maintenance Cost of EVs**: The maintenance in EVs includes mainly the replacement of the powertrain components and the tightening of body parts. Hence, the maintenance frequency is relatively less than ICE vehicles due to the lesser number of parts in EVs. For example, an electric four wheeler would need approximately INR25,000 in maintenance over a five-year period which is about 40 percent less than its ICE variant.

[26] https://heavyindustries.gov.in/writereaddata/fame/famedepository/1-pmp.pdf

According to the dealers and manufacturers surveyed, low maintenance costs have led to many customers opting for an EV. It reduces the total cost of ownership and results in higher EV sales (figure 1.3). Also, low maintenance costs become important when considering the amount of money spent on ICE vehicles simply for periodic maintenance and mandatory certifications like the Pollution under Control (PUC) certificate.

10. **Indigenisation:** Considering the rise in import duties on EV components and li-ion cells, it is clear that through the FAME II subsidy, the central government is pushing for indigenisation of EV manufacturing in a phased manner. But due to the low economy of scale, the pace of indigenisation is slow. While dealers and manufacturers welcomed this move because if EV manufacturing could be localised then it would further drive down EV prices which would attract more customers to this sector (figure 1.3).

    However, coming to the importance of this move for the sector, stakeholders mostly had mixed responses where majority felt that while it is necessary to promote indigenous manufacturing of EVs and its components - its impact on current EV sales was not extremely significant for (figure 1.4).

11. **Cap on LT Connection:** Rajasthan has an LT connection limit of up to 50 kW, and beyond this limit, the HT tariff applies to EV charging stations. The majority of the respondents surveyed were unaware of this upper limit on LT connection (figure 1.3) and hence did not consider it significant to the EV sector in the state (figure 1.4).

12. **Availability of Charging Infrastructure**: The adoption of EVs depends highly on charging stations' availability. Else, it creates associated concerns of range anxiety and battery discharge mid-route, making people hesitant to invest in EVs. The majority of the supply side stakeholders felt the need for a proper public charging infrastructure as its lack negatively affected EV sales (figure 1.3). The idea of being stranded midway on the road made many customers hesitant to buy an EV as it limits them from covering long distances. Additionally, they felt that the lack of a public charging infrastructure was one of the most important barriers to the growth of the EV sector in the state, thus indicating its high importance in developing an EV ecosystem (figure 1.4). During our scoping visits, we also observed that among the five cities, only Jaipur had a significant number of public charging stations, while the remaining four cities had either none or very few charging stations.

13. **Availability of Service Stations**: Repair and maintenance service forms an integral part of any automotive value chain ICE or EV. However, in the case of EVs, service providers and service centres were very sparse in all five cities since the EV ecosystem in the state is still nascent. Once EVs take up a significant market share, the service network will also pick up the pace. Owing to the scarcity of dedicated service stations, most EV dealers provide after-sales repair and maintenance services. In our interviews, most dealers

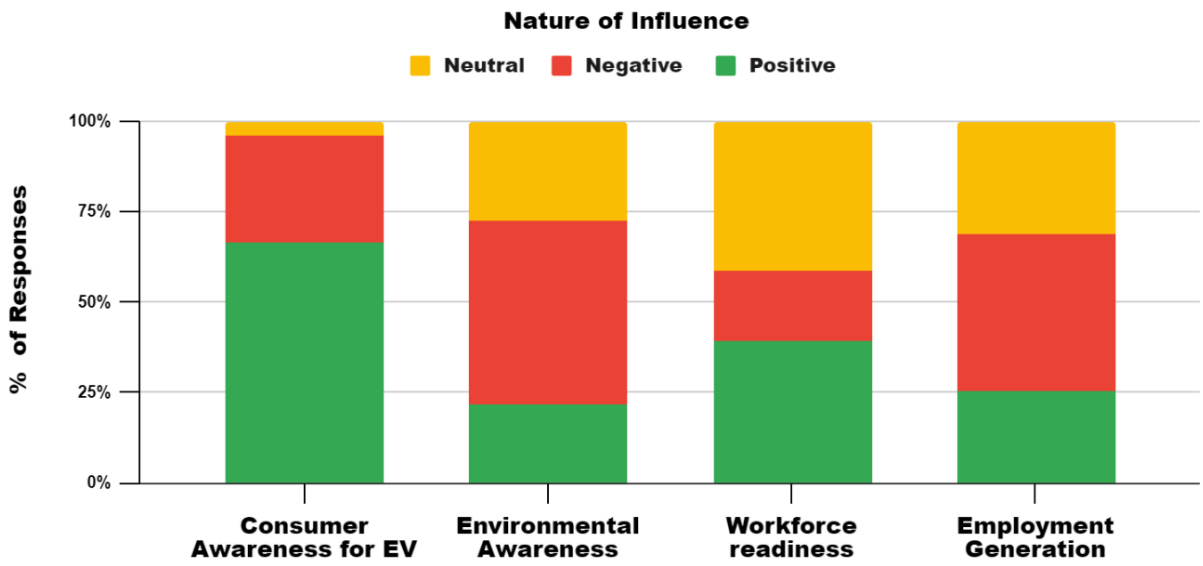
reported that the lack of service stations affects EV sales negatively as it makes customers sceptical about buying EVs (figure 1.3) especially because a proper service network is of high importance to the EV industry, the lack of which can seriously impede the growth of the sector in the state (figure 1.4).

14. **Availability of EV Substitutes**: During our interviews, we observed that CNG is a clear alternative to EV when it comes to three wheeler and four wheeler segments, especially in Jaipur, where more than 40 CNG stations have been installed recently. Also, there is close parity between the two in terms of upfront cost and total cost of operation.[27] However, manufacturers and dealers don't consider CNG to be a threat to the EV industry as CNG kits can only be fitted in petrol-powered vehicles and not diesel-powered ones. Hence, they were indifferent to CNG (figure 1.3) and didn't consider it important enough to impact the EV sector (figure 1.4) significantly.

Social Factors

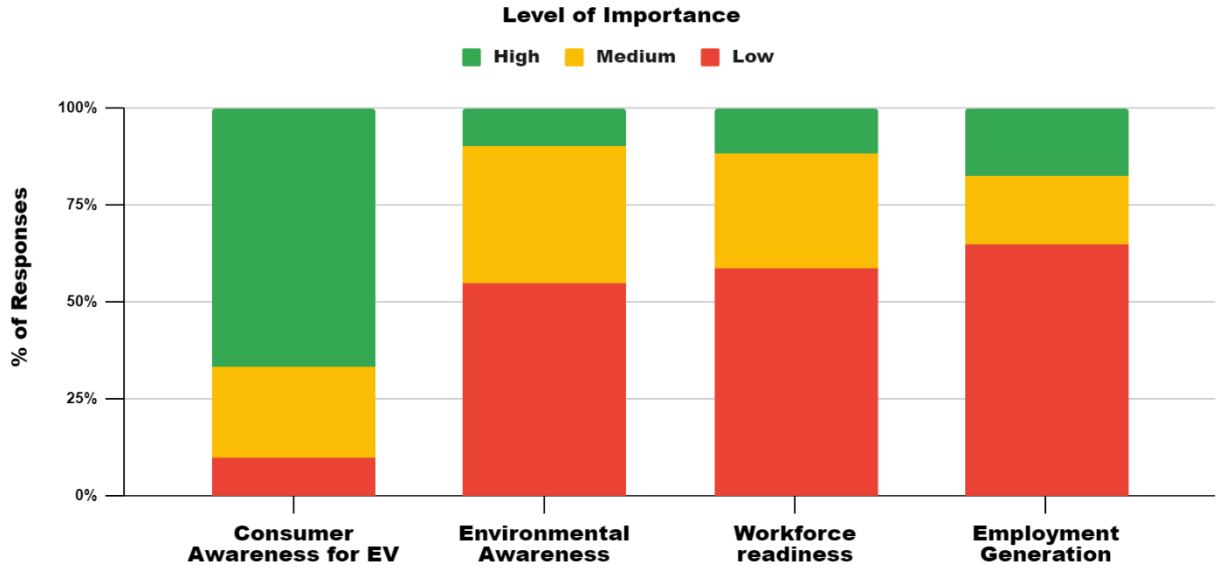
Under the Social factor, Consumer awareness for EVs, Environmental awareness for citizens, Workforce readiness, and Employment generation were the components on which stakeholders were surveyed.

Figure 1.5: Nature of influence of various social factors from the supply-side stakeholder survey



[27] https://wri-india.org/blog/total-cost-ownership-electric-vehicles-implications-policy-and-purchase-decisions

Figure 1.6: Level of importance of various social factors from supply-side stakeholder survey



1. **Consumer awareness for EVs:** Public awareness regarding EVs has been growing consistently, given the rising consciousness towards environmental pollution. Also, rising petrol prices have motivated an increased interest in EVs. All of these have had a positive (figure 1.5) and high (figure 1.6) impact on EV sales.

2. **Environmental awareness for citizens**: Dealers reported that while people were happy about the reduced pollution levels due to EVs, it is an added bonus and not the primary motivation behind them shifting to EVs. The primary motivation for most customers is the significant savings in their daily petrol/diesel costs. Hence environmental awareness had a low impact on EV sales (figure 1.6) and respondents felt customers were indifferent to it (figure 1.5).

3. **Workforce readiness:** Since EV repair and maintenance work requires special training due to the electrical components and circuits involved, most manufacturers and dealers try to provide training to workers. However, the impact on EV sales has been positive to neutral (figure 1.5) and rather low (figure 1.6).

4. **Employment generation:** Employment opportunities for people in the EV sector are relatively less than the ICE sector, owing to the EVs being mostly low maintenance. Also, the sector is in a nascent stage. As it grows and enters the mainstream market, the scope for employment generation might increase. But as of now, respondents could not comment on this factor and anticipated the impact in driving EV sales as neutral (figure 1.5) and low (figure 1.6).

Technological Factors

Indicators under Technological factors included Incubation facilities, Testing facilities, Battery recycling/repurposing facilities, Advancement in battery chemistry, Standardisation of batteries, and Battery Swapping. They were largely included to gauge the impact of technological innovations on EV sales.

Figure 1.7: Nature of influence of various technological factors from supply-side stakeholder survey

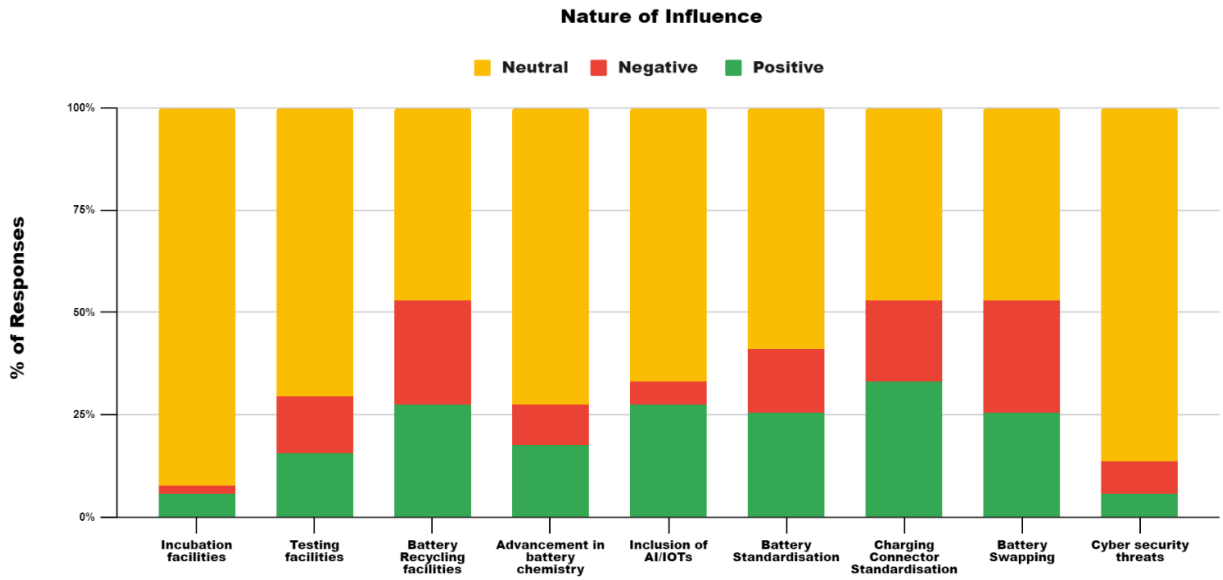
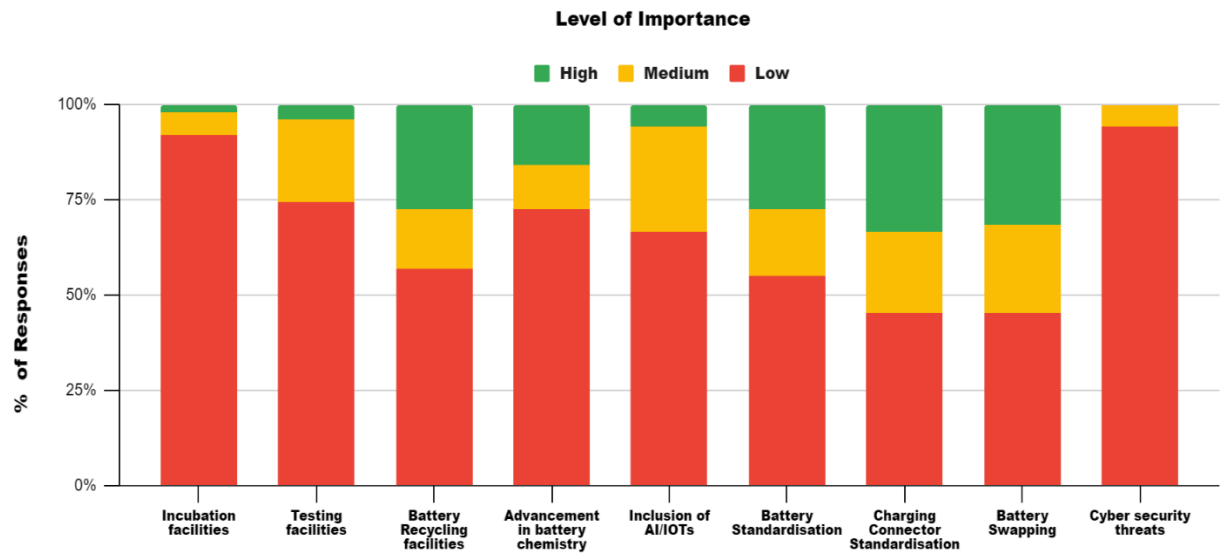


Figure 1.6: Level of importance of various social factors from supply-side stakeholder survey



1. **Incubation facilities:** There are many incubation centres in Rajasthan, like Atal incubation centre, MNIT, and Manipal and a lot of ongoing innovative research and development in EV technology. However, owing to the challenges in fabricating these models, these innovations are not making their way out from the labs into the real world. Supply-side stakeholders also were not much enthusiastic about these and this was reflected in their answers as they believed that these incubation centres had a neutral (figure 1.5) and low influence (figure 1.6) on EV sales.

2. **Testing facilities:** Testing facilities are an important part of product development, and they are required in the R&D phase and for obtaining certifications. For EV certification, there are two agencies in India- ARAI in Pune, Maharashtra and ICAT in Manesar, Haryana. However, most dealers and manufacturers could not comment about their impact on EV sales and hence agreed it was neutral (figure 1.6) and low (figure 1.6).

3. **Battery recycling/repurposing facilities**: Battery accounts for nearly 40-50 percent of the overall production cost of an EV.[28] Achieving a circular economy by repurposing and then recycling batteries could bring down the costs of batteries as a whole. The current recycling and repurposing facilities in the state are currently focused on lead-acid batteries. The adoption of recycling mechanism with lithium-ion batteries is relatively low as most of the batteries are yet to reach their end of life. The majority of dealers and OEMs could not comment on this factor as the state doesn't have a cohesive set of rules for the safe disposal of EV batteries. Hence, they felt that the impact of this factor on EV purchase behaviour was neutral (figure 1.5) and low (figure 1.6).

4. **Advancement in battery chemistry:** Battery power is the most essential element for a vehicle that runs on electricity. Owing to the drawbacks of lead-acid batteries, advanced chemistry cell batteries like Li-ion, Aluminium-ion, Lithium-Air[29] etc. are currently being researched. In India, the FAME II scheme was launched in 2019, under which EVs with advanced batteries are eligible for subsidies. Hence, all major OEMs started manufacturing EVs with Li-ion batteries throughout India including Rajasthan. However, during the surveys, it was observed that while stakeholders were hopeful about this move, they reported that these are not the factors that plague them currently. Hence, they could not comment on its influence on the market stating it was neutral (figure 1.5) and low (figure 1.6).

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[28] https://www.livemint.com/auto-news/major-roadblocks-for-india-s-electric-vehicle-market-11647771170663.html

[29] Bupesh Raja, V. K., Raja, I., & Kavvampally, R. (2021). Advancements in Battery Technologies of Electric Vehicle. Journal of Physics: Conference Series, 2129(1), 012011. https://doi.org/10.1088/1742-6596/2129/1/012011

5. **Inclusion of AI and IOTs**: Accompanying the transition from ICE to EV is the advancement in automobile technology to make the vehicles smarter, safer, and more connected through technologies like Artificial Intelligence and the Internet of Things. While dealers were hopeful about such changes and developments, they felt that these were not factors that drive customers to buy EV. Hence these technologies have a neutral (figure 1.5) and low impact (figure 1.6) on the EV demand.

6. **Standardisation of batteries**: The battery forms the most expensive and most important component of an EV. Due to this, standardisation of batteries is imperative to bring down their costs, which would immediately bring down the upfront cost of an EV. However, this is a challenge for OEMs, preventing them from being unique and dis-incentivising innovation. While dealers felt that such a move would further the growth of the EV sector, no standardisation process is currently in progress. Hence, they felt that it has a neutral (figure 1.5) and low impact (figure 1.6) on the EV sector.

7. **Standardisation of charging connectors:** One of the major barriers to expanding the network of public charging stations is the lack of standardisation of connector type as economies of scale and revenue generation for charging point operators are both associated with standardisation. Ather, in this regard, has opened up the proprietorship of its connector type for other OEMs. This has led to collaboration in the EV sector, as Hero MotoCorp has adopted the Ather's connector type. As standardisation of charging connectors still has a long way to go, the state-dealers felt that presently it has a neutral (figure 1.5) and low impact (figure 1.6) on the EV sector, but they did expect this to change soon.

8. **Battery Swapping:** Battery swapping technology allows one to replace their discharged battery with the charged battery. The process takes less time than required in refuelling ICE vehicles. India did not have a battery swapping policy when we conducted our surveys. However, in April 2022, the government released a draft Battery Swapping policy. Hence supply-side stakeholders were not very enthusiastic about it and felt that it has, at best, a neutral (figure 1.5) but a low impact (figure 1.6) on EV demand.

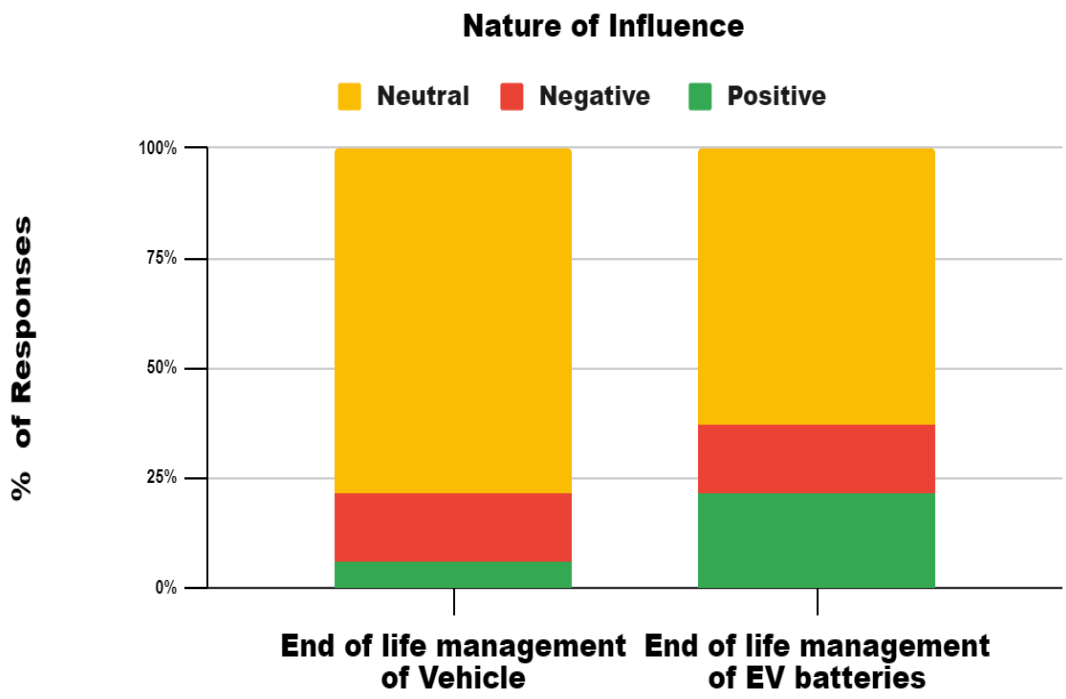
9. **Potential of cyber security threats**: The Internet of Vehicles based only on EVs (IoEV) is a complex system. It comprises vehicles, humans, sensors, road infrastructure and charging stations. All these entities communicate using several communication technologies like cellular networks etc. IoEV is therefore vulnerable to significant attacks such as data theft, false data injection, and modification. Hence, security is a crucial factor for the development and the wide deployment of Internet of

EVs (IoEV)[30]. However, the EV sector is so nascent in the state that these issues are not as concerning currently but will gain prominence in the near future when EV adoption becomes more common. Hence, dealers could not comment on this factor as they had never had their customer encounter such problems and felt that it had a neutral (figure 1.5) and low impact (figure 1.6) on the EV sector.

Environmental Factors

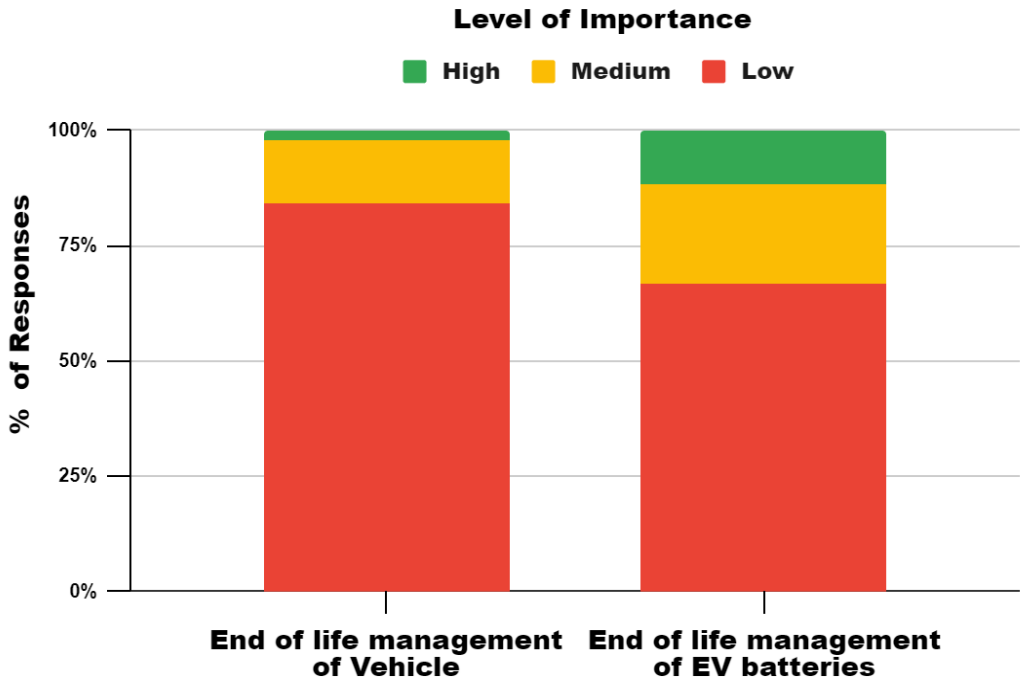
Under environmental factors, two indicators were considered, i.e., end of life management of vehicle and EV batteries.

Figure 1.9: Nature of influence of various environmental factors from supply side stakeholder survey



[30] Fraiji, Y., Ben Azzouz, L., Trojet, W., & Saidane, L. A. (2018). Cyber security issues of Internet of electric vehicles. 2018 IEEE Wireless Communications and Networking Conference (WCNC). doi:10.1109/wcnc.2018.8377181

Figure 1.10: Level of importance of various environmental factors from supply-side stakeholder survey



1. **End of life management of Vehicle:** This factor captures the fate of a vehicle once it has completed its first life. A common form of end-of-life management of old vehicles is converting them to scrap, which may be recycled for other purposes in the automobile or other industries. However, poor end-of-life management may have implications on the environment due to heavy metals and other pollutants in the vehicular components. In the case of EVs, several electronic components also necessitate considering appropriate disposal or recycling methods for e-waste. In this context, The Ministry of Road Transport and Highways has developed an Automobile Industry Standard (AIS 129) for guiding the management of end-of-life of vehicles to minimise the environmental pollution arising out of it.[31] Similarly, MeitY has notified a set of rules for E-waste management.[32]

   However, the majority of the stakeholders surveyed felt that the impact of this factor on demand for EV's is neutral (figure 1.9) and low (figure 1.10) since this does not have direct implications on purchase decisions. This could also be because EVs are in a nascent stage of adoption and are yet to complete their first life in most cases.

2. **End of life management of EV Batteries:** The rapid adoption of EVs means an increase in the consumption of lithium-ion batteries, rechargeable batteries used in several industries including automotive and consumer electronic and the subsequent rise in the

[31] https://hmr.araiindia.com/Control/AIS/35201550654PMAIS-129_F.pdf

[32] https://hmr.araiindia.com/Control/AIS/35201550654PMAIS-129_F.pdf
glish-23.03.2016.pdf

number of spent batteries that would require environmentally sound end-of-life handling. Given the relevance of end-of-life management of batteries in several electronic gadgets and the context of the e-mobility transition, the Government of India has proposed a set of rules for Battery Waste Management, which includes lithium variants. However, due to the nascent adoption stage of Li-ion battery fuelled EVs, stakeholders' knowledge and awareness regarding its end-of-life management was limited. This resulted in a neutral response from stakeholders who did not find it to be an important factor at the moment (figure 1.9).

However, in the case of dealers selling e-three wheelers that run on lead acid batteries, the awareness regarding a secondary market for recycling these batteries exists. They acknowledged its importance for the customers who receive a decent price of INR75 - 85 per kg of battery scrap (figure 1.10).

Legal Factors

Under legal factors, there were three components on which supply-side stakeholders were surveyed. These were separate electricity connections for charging stations, waste management rules and amendments in building laws.

Figure 1.11: Nature of influence of various legal factors from supply-side stakeholder survey

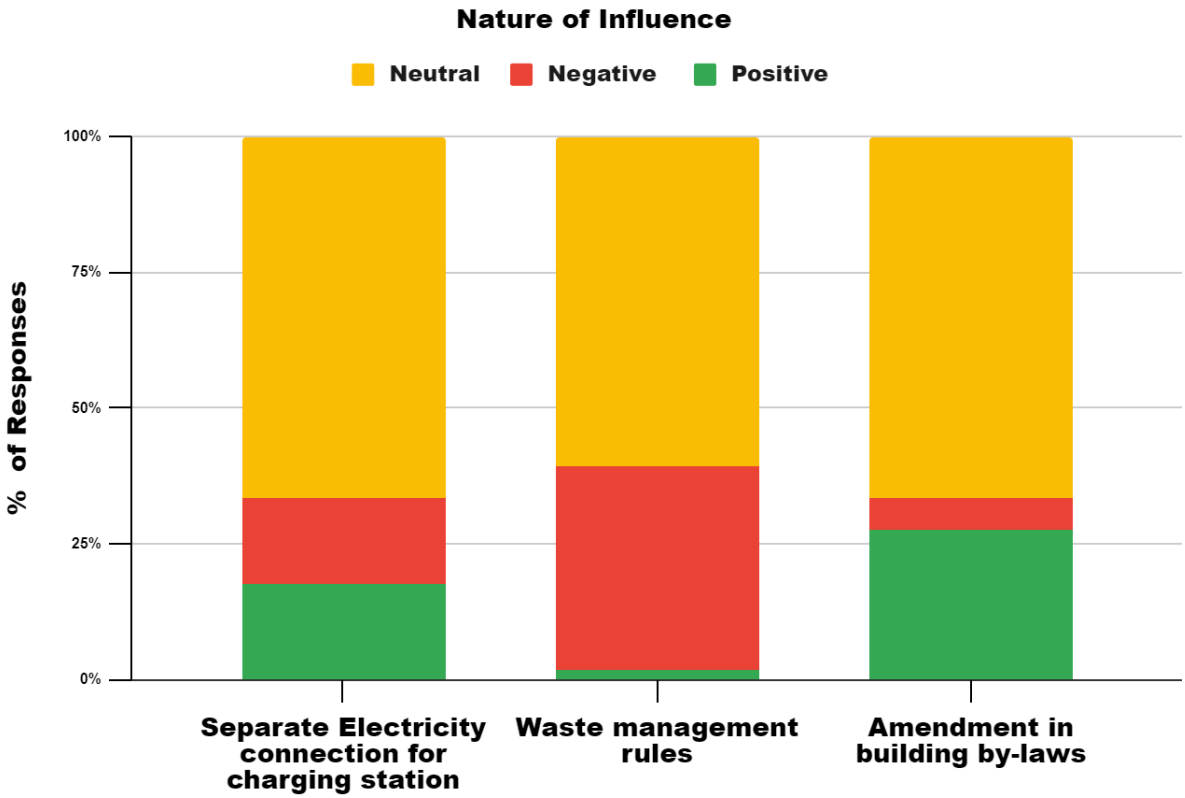
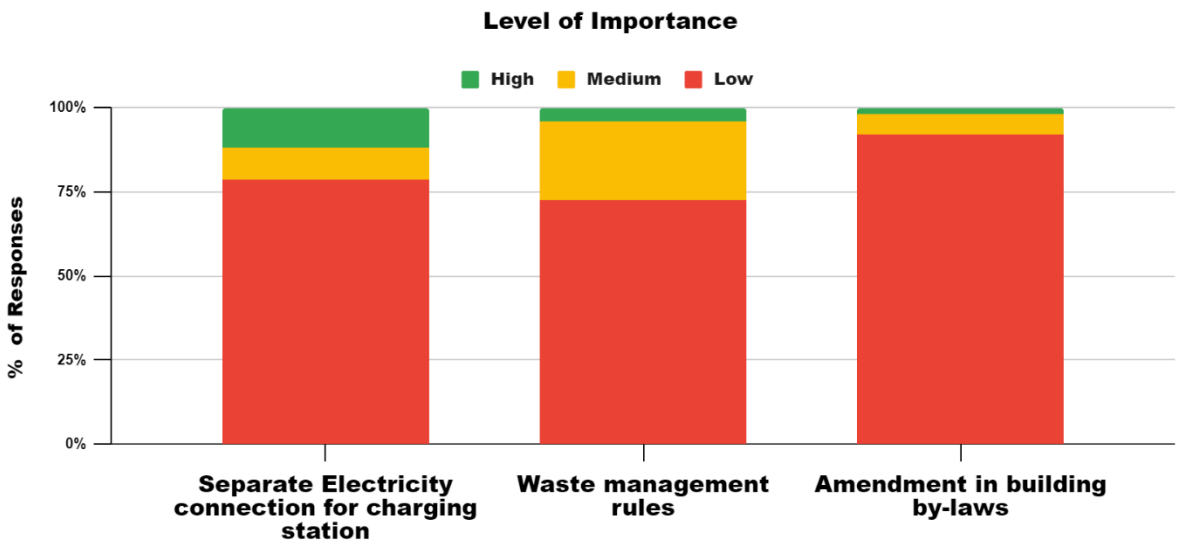


Figure 1.12: Level of importance of various legal factors from supply-side stakeholder survey



1. **Separate electricity connection for charging stations:** The RERC in its Suo-moto draft order, stated that a separate electricity connection, billed at INR6/kWh[33] would be used by the EV charging stations. Unlike refuelling at a petrol pump, EV charging is not a feasible standalone process. Therefore, one property or building can have more than one electrical connection. However, there are regulatory hurdles in getting more than one type of electricity connection at a property due to the theft issues. Since this was not an issue that affected supply-side stakeholders directly, they were mostly indifferent towards it, while a section felt that once EV enters the mainstream market, having multiple chargers at the workplace or in one building would be necessary and hence the regulatory issues around this must be addressed otherwise it could affect the sector negatively (figure 1.11). However, almost all of them agreed that this was not an immediate issue for the EV sector in the state, which is still in its initial stages (figure 1.12).

2. **Waste management rules:** The draft Battery Waste Management Rules, 2020 considers a wide range of batteries, from disposable ones like alkaline and mercury batteries to rechargeable ones such as lithium-ion and nickel-cadmium batteries. The rules propose detailed responsibility of the manufacturer of EV batteries, including setting up battery-waste collection centres and take-back systems and affixing targets for battery-waste collection from 2 to 7 years. However, these rules still have a long way to go before having any effect, which is also reflected in the responses of the supply side stakeholders, who mainly felt the impact of this policy on the EV sector is neutral (figure 1.11) and low (figure 1.12).

[33] https://www.rajras.in/wp-content/uploads/2020/06/Draft-Suo-Moto-Order-EV-eb13b8c.pdf

3. **Amendment in building by-laws:** To make provisions for establishing Public Charging Stations (PCS), the Model Building Bye-laws (2016) were amended to add norms for EV charging Infrastructure in residential buildings and other types of buildings including group housing. These by-laws allow only 20 percent of building premises to be available for EV charging infrastructure.[34] While the majority of stakeholders were unaware of these bye-laws and their response was mainly neutral (figure 1.11) and low (figure 1.12), given the fledgling state of the sector, regulatory moves like these still have a long way to go when it comes to influencing EV demand in the state. However, a section of them welcomed it as most of their customers preferred to charge their EVs at their residences. Having a section of building legally sanctioned for setting up charging stations would definitely help the EV industry grow in the state.

Inferential Analysis of Supply Side Datasets

The scope of carrying out the inferential analysis is to quantify the inputs gathered using the PESTEL framework that will help determine the state of EV adoption in Rajasthan. The data for carrying out the analysis have already been mentioned in the previous chapter. A total of 51 data points for supply side as well as 51 data points for demand side were considered for performing this analysis. A score was assigned to each of the PESTEL factors based on the cumulative impact of both scales to determine their relative importance. As per the analysis, "Low maintenance cost of Electric vehicle" was the most important factor while "Waste management rules (such as producer responsibility laws, e-waste management rules etc.)" came out to be the least important one in the rank analysis.

For supply side, the inputs were obtained on two scales i.e. nature of influence of the factors considered and their level of importance as perceived by the respondents in the cities under consideration. Under the nature of influence scale, respondents were questioned whether a certain factor was positively or negatively affecting the development of the EV ecosystem or whether it was neutral. The respondents were encouraged to provide unbiased answers solely based on their individual experiences with EVs. The factors have already been mentioned in the previous chapter (refer Page 9). The "level of importance" was measured using a 3-point scale. The same respondents were also asked to rate the extent to which they felt that these factors were relevant to the cause of augmenting EV adoption in the state. There were 39 factors grouped into 6 dimensions of PESTEL for supply side while there were 37 factors considered under demand side. The effect of both the scales was combined to get a more holistic view of the factors affecting the EV landscape.

[34] https://archive.pib.gov.in/documents/rlink/2019/feb/p201921501.pdf

Supply Side factors Analysis

Under supply side, Inputs by 51 stakeholders were analyzed. The findings are discussed in the following sections.

The total average scores for each factor were calculated using the following formula:

$$\textbf{Total Average Score for each factor} = \sum_1^m a * x + \sum_1^n b * y \Big/ \sum(m,n)$$

a=1, It denotes positive influence

b=-1, It denotes negative influence

x and y denotes the level of importance of each factor given by the respondent attached to a factor. It can take values 1,2 and 3.

m and n denote the frequency of respondents who answered in positive and negative respectively.

Individual score for providing an overall rank has then been calculated using the formula given below:

$$\textbf{Individual Average Score} = \boldsymbol{Total\ Average\ score\ for\ each\ factor} \Big/ \sum(\boldsymbol{m},\boldsymbol{n})$$

Using the formula the scores for each factor has been shown in table 3 to table 8 below:

Political Factors

Among the political factors, “Rajasthan EV Subsidy” (4) got the highest overall rank by the respondents. This signifies the fact that EV subsidies need to be continued in the initial years as they are instrumental for rapid EV adoption. The subsidy by central government as well as state government has played a pivotal role in bringing down the upfront cost of EVs especially in the two & three wheeler segments. This has resulted in price parity of EVs with their ICE counterparts. The second most important political factor as per the supply side stakeholders is a need for comprehensive EV policy (5) for the state of Rajasthan. The government of Rajasthan is yet to come out with an EV policy. The supply side stakeholders consider it an important factor as it will play a hinge role in bring down the uncertainties and will help secure further investment in the EV ecosystem. Factors such as concession on land for renewable energy based charging station (38), Rajasthan industrial development policies and scheme (30) were among the lesser important factors for stakeholders. This was mainly due to the lack of awareness about these factors or they did not find these factors to be important given the fledgling state of the EV industry in the state.

Table 3: Overall Rankings for Each Political Factor

S. No.	Political Factors	Total Average Score	Individual Average Score	Overall Rank
1	Rajasthan EV subsidy	75.09	1.75	4
2	Concession on land for renewable energy based charging station	-12.6	-1.26	38
3	EV Policy of Rajasthan	43.57	1.56	5
4	Rajasthan industrial development policies and scheme	-2.66	-0.30	30
5	RERC electricity tariff order for EV charging stations	10	0.91	11
6	Subsidy under FAME II Scheme	43.30	0.94	10
7	Allowing subsidy on lead acid battery vehicle in Rajasthan	-6.61	-0.19	28

Economic Factors

The economic dimension captured the top 3 factors of all the factors considered in the analysis. Majority of stakeholders agreed that the low maintenance cost of EVs (1) was the major driving factor for consumers to buy an EV. It has less number of parts as compared to ICE vehicle which means less wear and tear resulting in lower maintenance cost. The second most important factor was related to increase in the demand of EV (2). The demand for EV is subject to increased awareness among the consumers about the benefits. This will in turn boost sales and consequently the supply. Thirdly, stakeholders felt that the newer and innovative business models in the EV arena will play a crucial role in bringing product innovation which can potentially further drive down the upfront as well as operations costs of an EV. Presently the state subsidy offered by Government of Rajasthan is directly transferred in the accounts of beneficiaries once the vehicle is registered in the regional transport office. The processing time for this sometimes take months and therefore is a cause of concern for the stakeholders as the entire hassle of subsidy claim has to shouldered by them which in turn makes them hesitant to invest in an EV. There is a need of service centres as well as is the case with ICE vehicles. This will drive down the anxiety of the consumers regarding this new technology and thus improve adoption. Factors such as Inverted duty structure on EVs (36), import duty on components (33), testing cost (34), cap on LT connection (35), and availability of EV substitutes (37) were relatively less important for the respondents because of lack of awareness or the irrelevance in the present context.

Table 4: Overall Rankings for Each Economic Factor

S. No.	Economic Factors	Total Average Score	Individual Average Score	Overall Rank
1	Ease of processing subsidy for end consumers	48.58	1.21	7
2	Innovative Business Models	8.00	2.00	3
3	Financing options	42.45	0.90	12
4	Electric vehicle demand	88.36	2.01	2
5	Electricity tariff	1.40	0.14	22
6	Inverted Duty Structure on EVs (Difference between GST on EV and that on components)	-35.36	-1.07	36
7	Import duty on components	-16.64	-0.67	33
8	Testing cost	-8.67	-0.72	34
9	Maintenance cost of EVs	89.18	2.03	1
10	Indigenization	26.25	0.66	18
11	Cap on LT connection	-8.40	-0.84	35
12	Availability of charging infrastructure	-5.19	-0.14	26
13	Availability of service centres	46.70	1.09	8
14	Availability of EV substitutes (E.g. CNG) at comparable prices	-27.44	-1.10	37

Social Factors

Under this head, 4 factors were considered for inputs from stakeholders. However, it was the consumer awareness for EVs (9), which according to supply side stakeholders was the main force driving EV sales. Environmental benefits of EVs had a relatively lesser impact on the buying decision. This was in line with the response given by majority of EV users who had explicitly mentioned that savings in term of fuel cost was the primary reason behind their EV purchase. Factors such as workforce readiness as well as employment generation were not much effective in the present context for increasing the numbers of EVs on the roads.

Table 5: Overall Rankings for Each Social Factor

S. No.	Social Factors	Total Average Score	Individual Average Score	Overall Rank
1	Consumer awareness for EVs	47.43	0.97	9
2	Environmental awareness of citizens	-22.76	-0.62	32
3	Workforce readiness	19.00	0.63	19
4	Employment generation	-7.94	-0.23	29

Technological Factors

Successful adoption of a technology requires its constituent elements to be well in place. Since the EV technology is in its nascent phase, many start-ups are trying and testing their ideas in this space. Hence, incubation facilities (17) are a necessity. However, when asked with the respondents about the importance of Incubation facilities, the overall response was not encouraging. Some considered it necessary while majority of them gave a neutral response. When asked about their views on battery technology, suppliers felt that better battery chemistry (13) may result in better range for the consumers in single charge and thus will strengthen the consumer confidence for EV technology. Suppliers also stressed upon the need for battery (15) and connector standardization (16) as this will bring down the range anxiety for the consumers. Surprisingly, battery swapping (24) received a lower rank as it could supposedly be considered the next step after battery and connector standardisation. When asked about the role of AI and IoTs (6) in EVs, suppliers were happy to incorporate these features in the Electric vehicles. According to the suppliers these extra features will differentiate EVs from its counterpart ICE vehicles.

Table 6: Overall Rankings for Each Technological Factor

S. No.	Technological Factors	Total Average Score	Individual Average Score	Overall Rank
1	Incubation facilities	2.75	0.69	17
2	Testing facilities (for component and vehicle)	2.93	0.20	21
3	Battery recycling/repurposing facilities	3.07	0.11	23
4	Advancement in battery chemistry	12.21	0.87	13
5	Inclusion of AI and IoTs	22.35	1.31	6
6	Standardization of batteries	15.71	0.75	15
7	Standardization of charging connector	18.67	0.69	16
8	Battery swapping	0.33	0.01	24
9	Potential of Cyber-Security threats	-1.14	-0.16	27

Environmental Factors

End of life management of electric vehicle and end of life management of batteries were the two factors considered under the environmental factors subject to Electric vehicles. These received a lukewarm response from the suppliers as they did not find it relevant in the present context. According to them, most of the electric vehicles have been sold recently and thus they have not completed even one life cycle. However, between the two factors, end of life management of batteries (20) received a better response when compared to end of life management of vehicle (31).

Table 7: Overall Rankings for Each Environmental Factor

S. No.	Environmental Factors	Total Average Score	Individual Average Score	Overall Rank
1	End of life management of vehicle	-6.64	-0.60	31
2	End of life management of batteries	8.00	0.42	20

Legal Factors

Similar to the environmental factors, factors such as waste management rules (39) and separate electricity connection for charging station (25) were not important in the eyes of suppliers at present. However, they showed a welcoming response to the Amendment in Model building bye- laws, which had charging related provisions for the residential buildings. According to suppliers, this will increase the sales of EV in the near future.

Table 8: Overall Rankings for Each Legal Factor

S. No.	Legal Factors	Total Average Score	Individual Average Score	Overall Rank
1	Separate electricity connection for charging station	-0.06	0.00	25
2	Waste management rules (such as producer responsibility laws, e-waste management rules etc.)	-31.25	-1.56	39
3	Amendment in Model building bye laws	14.12	0.83	14

Demand Influence Surveys

To get a clear demand-side perspective for the EV industry, we divided demand-side stakeholders into two categories - EV users & EV fleet aggregators and potential EV buyers. We then interviewed them using and framed separate questionnaires. This was done to gain a better understanding of their experience with an EV.

In the following section, insights from current and potential EV fleet aggregators, followed by insights from the EV user surveys are portrayed. Users were surveyed on the following questions for the demand-side PESTEL, which were divided under political, economic, social, technological, environmental and legal heads. The table below lists the indicators considered for each of the PESTEL factors.

Table 9: Demand Side Factors

Political Factors	Economic Factors	Social Factors	Technological Factors	Environmental Factors	Legal Factors
EV Subsidies	Upfront Cost	Peer EV Preference	Top Speed	Zero tailpipe emission	Future implementation of regulations related to Green Zones and reserved parking
Registration Fee exemption for EV	Financing Options	Latest Developments (News) in the EV Sector	Absence of gearboxes	Limited Noise while driving	Future provision of separate lanes for EVs
Tax Benefits (SGST refund, Green tax on ICE)	Rate of Interest on EV loans	Resistance from ICE vehicle unions	Smartphone/GPS and other location-enabled technological features		Internet bans
	Operating Cost	Aesthetics	Range		Registration of vehicle
	After Sales Service		Charging Time		
	Maintenance Cost		Replacement and Maintenance of components		
	Resale Value		Safety Features		
	Difference in Battery Life		Risk associated with electrical and electrochemical components		
	Cost of Battery		Vehicle performance in different terrain and temperature conditions		
	Resale value of Li-battery Vs Lead Acid battery		Option of charging at home		

Political Factors	Economic Factors	Social Factors	Technological Factors	Environmental Factors	Legal Factors
	Payload Capacity		Cyber Security Threats		
	Lack of Public Charging Infrastructure				
	Availability of vehicles with alternative fuels (CNG/Petrol) at similar prices				

Political Factors

Figure 2.1: Nature of influence of various political factors from demand influence surveys

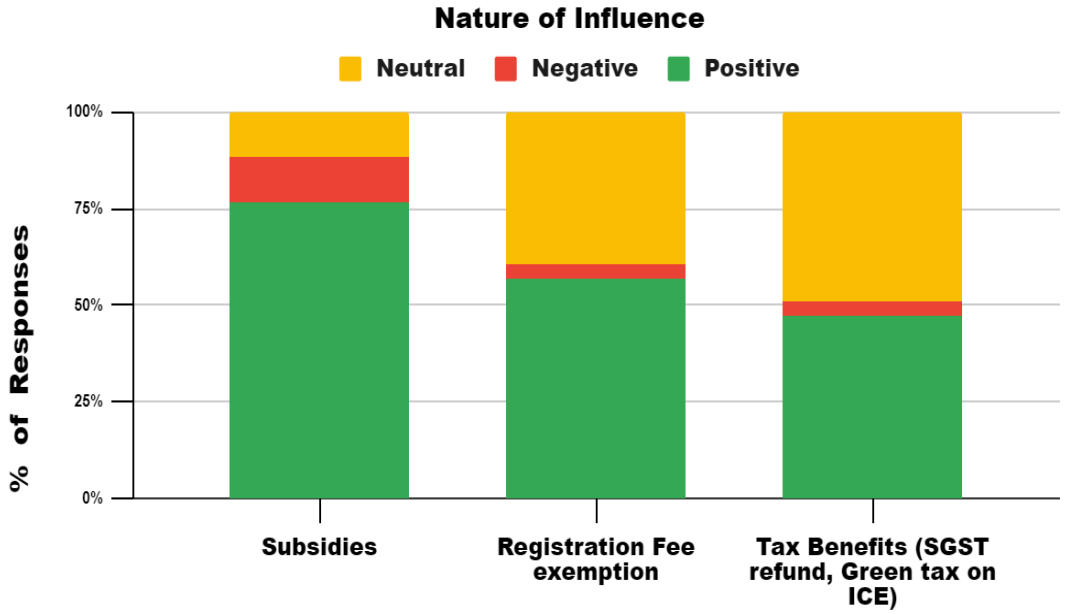
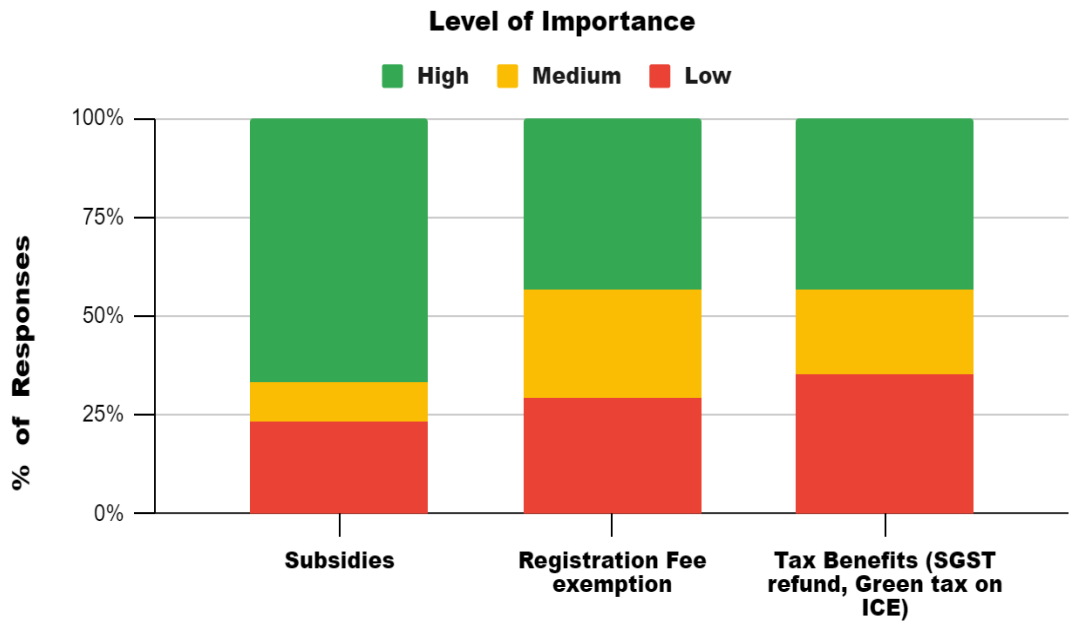


Figure 2.2: Level of importance of various political factors from demand influence surveys



To analyse the impact of policy and regulation on the EV demand; fleet aggregators across all five cities were interviewed on three relevant factors - Subsidies, Registration fee exemption, and Tax benefits. The majority of stakeholders reported that the policy above measures is imperative to push the fledgling EV sector. These incentives play an important role in helping achieve cost parity between EVs and ICE vehicles, and they have a positive impact on demand (figure 2.1). The respondents also reported that subsidies, registration-free exemption, and tax benefits are important (figure 2.2) to address the upfront cost barriers and draw consumer interest in this sector.

Economic Factors

To gauge the economic factors affecting EV demand, we interviewed EV fleet aggregators on 13 aspects- Upfront cost, Financing options, High rate of interest on EV loans, Operating cost, After sales service, Maintenance cost, Resale value, battery life difference between lead acid and li-ion batteries and battery cost.

Figure 2.3: Nature of influence of various economic factors from demand influence surveys

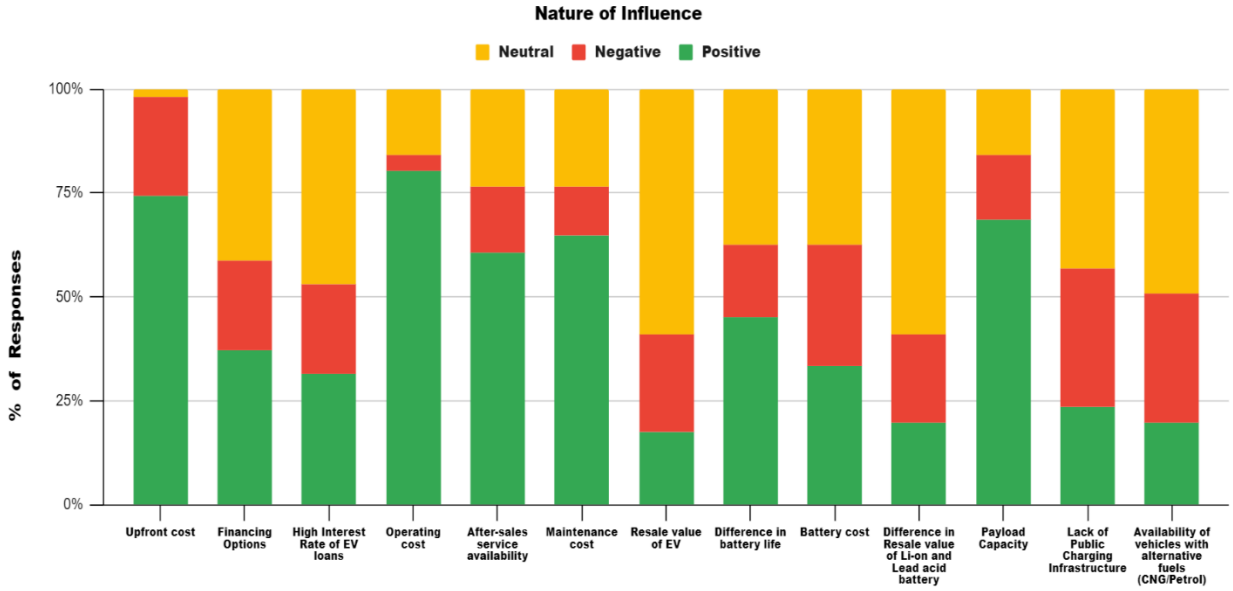
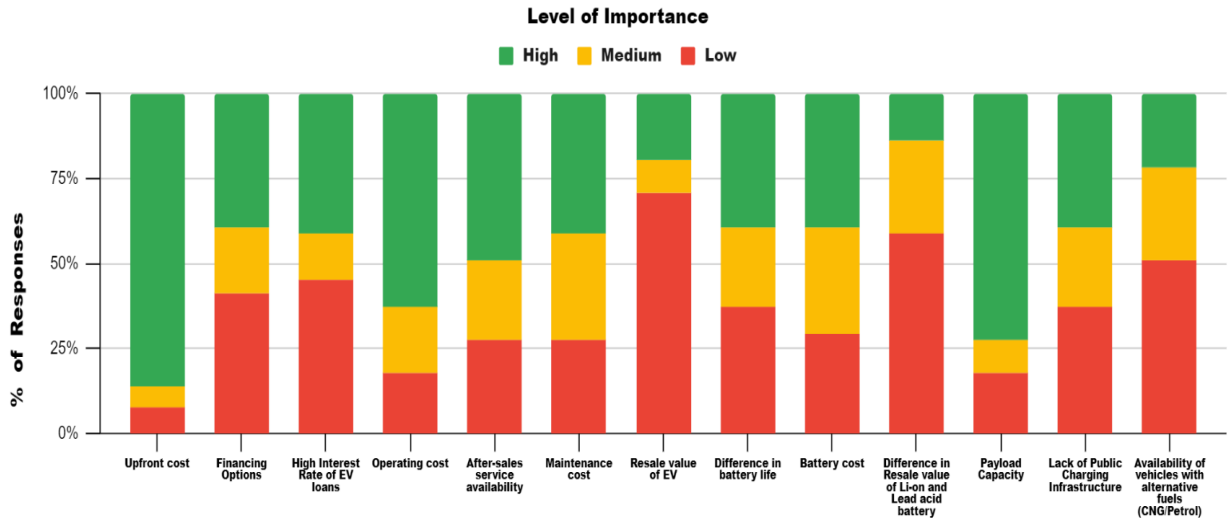


Figure 2.4: Level of importance of various economic factors from demand influence surveys



Upfront cost of EV is a cause of great concern for fleet aggregators owing to the lack of financing options for EV sales. However, subsidies, tax exemptions, and registration fee exemption will help bring down the upfront cost of e-two wheelers and e-three wheelers which are mostly the ones in demand for fleet aggregators. As a result, respondents felt that the upfront cost of EV had a positive (figure 2.3) and high (figure 2.4) impact on EV demand.

However, we received mixed reactions to **financing options** as most EV buyers and aggregators had self-financed it using their savings and hence were indifferent to the

financing options available. Therefore, they responded that the impact of this factor and that of high-**interest rates** was neutral (figure 2.3) and low (figure 2.4) on EV demand.

Again, the majority of the respondents were quite happy with the low **operating and maintenance costs** of an EV, even though a major share of the respondents interviewed were using lead-acid battery powered EVs that did incur some maintenance. However, they agreed that EVs typically required little to no maintenance compared to conventional ICE vehicles. Hence, they felt that these had a positive (figure 2.3) and high (figure 2.4) impact on the EV demand.

On **after sales services**, most dealers were providing repair and maintenance services to their customers and majority of buyers and aggregators were satisfied with their services. Hence, they reported it to have had a positive (figure 2.3) and high (figure 2.4) impact on the EV demand.

The majority of the demand side stakeholders surveyed by us were first time EV buyers and their vehicles had not even completed one life cycle and hence were unable to comment on the **resale value** (figure 2.3) and did not anticipate this factor to have any significant impact (figure 2.4) on EV demand.

In terms of **battery life**, we observed that most of the buyers felt that while a li-ion powered EV had a longer life than its lead-acid variant however, given the lower price of the lead-acid battery vehicle, it was a more cost-effective option compared to its li-ion variant. Hence, when interviewed, they responded that the difference in battery cost had a significant or high influence on their decision to buy an EV (figure 2.4).

Overall, it had a positive impact on EV demand (figure 2.3). However, owing to the nascency of the EV sector in Rajasthan, buyers could not comment on the resale market and **resale value of EV batteries** since their batteries were yet to complete one life cycle in most cases. Thus, supply-side stakeholders could not comment on its impact on EV buyer behaviour (figure 2.3) and felt it had a low impact on EV demand (figure 2.4).

Most fleet aggregators were satisfied with their EVs in terms of **payload capacity**. They felt it had a positive (figure 2.3) and high impact (figure 2.4) when it comes to influencing EV buyer and demand behaviour.

Public charging infrastructure also invited neutral (figure 2.3) responses from respondents, and most of them preferred to charge it at homes and workplaces due to the lack of public charging infrastructure. Another interesting observation was that most people considering buying an EV were doing it to cover short intra-city distances and not long distances. However, almost all of them did acknowledge that a public charging ecosystem was imperative to the growth of the EV sector (figure 2.4).

Finally, in many cities like Jaipur, we observed that in certain segments, the EV sector faced fierce competition from CNG vehicles that were at a more mature stage than the fledgling EV industry. However, EV buyers and fleet aggregators felt that CNG vehicles were not a threat to EVs as there were certain segments that CNG could not replace, such as diesel engines. Hence the majority agreed that the **availability of substitutes** had a neutral (figure 2.3) and low (figure 2.4) impact on EV buyer behaviour.

Social Factors

In order to understand the social facets of EV buyer behaviour and EV demand we interviewed respondents on peer preference of EVs, their knowledge of latest developments in this sector, resistance from ICE vehicle unions and EV aesthetics.

Figure 2.5: Nature of influence of various social factors from demand influence surveys

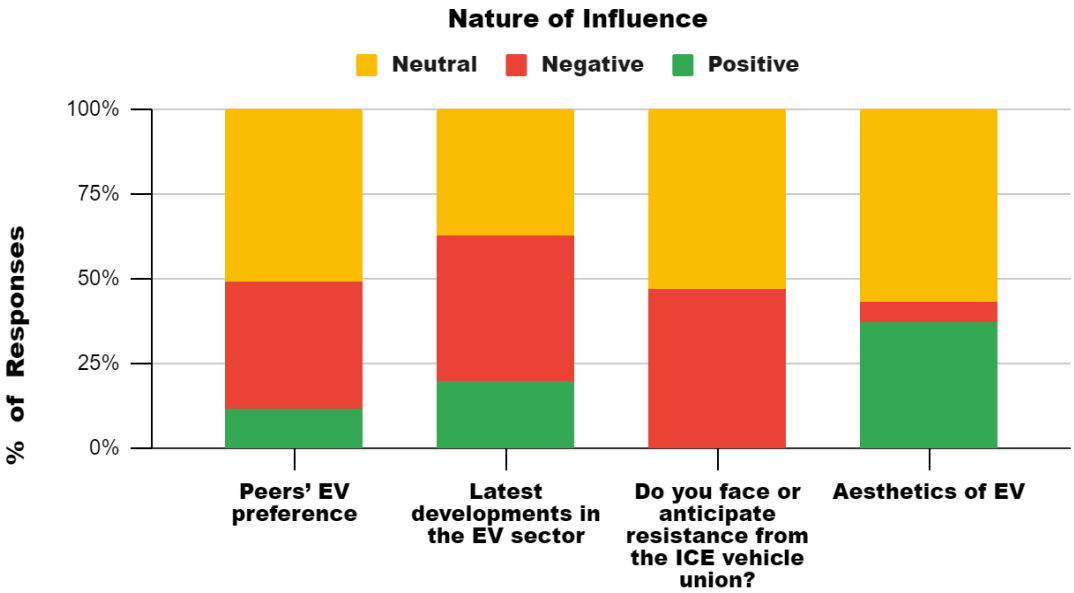
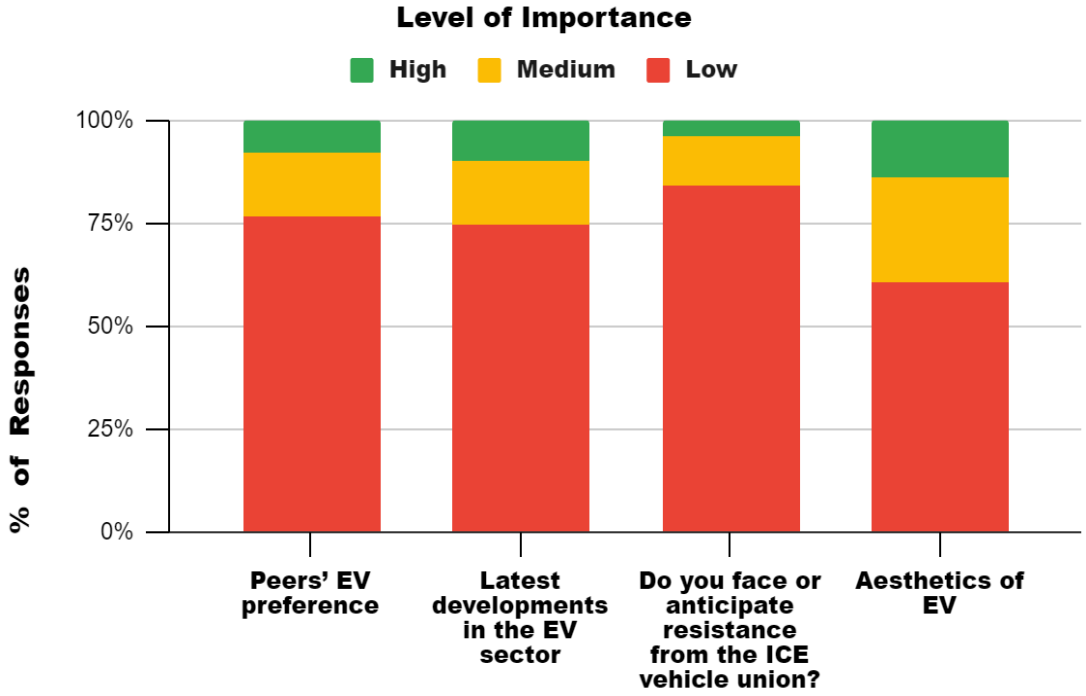


Figure 2.6: Level of importance of various social factors from demand influence surveys



To gauge the social environment surrounding the EV ecosystem in Rajasthan, demand-side stakeholders were asked if **peer preferences** influence their EV purchas**es**. This is especially relevant considering the nascency of the EV sector, wherein much of its popularity depends on positive word of mouth. However, most respondents reported that they were indifferent (figure 2.5) to their peer's choice of automobile technology and were hardly affected by it (figure 2.6).

Also, the majority of the EV buyers and fleet aggregators did not keep up with the **latest developments in the EV industry** (figure 2.5) related to battery chemistry or any technological innovation and it had a low impact on their purchase decisions (figure 2.6). Only a small section of potential buyers reported following EV news regularly and raised concerns regarding the recent safety related incidents across the country.

Another extremely relevant factor in this context is the probability of facing **resistance from the ICE vehicle unions**. Respondents revealed that they do not anticipate any such impedance and reported that its impact is negative to neutral (figure 2.5) and low (figure 2.6) on EV demand.

Finally, regarding the **aesthetics** of an EV, stakeholders reported that as long as the vehicle is functional and sturdy, aesthetics was not a major concern. Hence the impact of EV aesthetics on EV demand is neutral (figure 2.5) and low (figure 2.6). However, a fair share of demand aggregators did find the aesthetics of an EV as a positive influence on purchasing it.

Technological Factors

This section was included to gauge the various technological innovations that could help increase the efficiency of EVs and the reach of this sector. Here buyers and aggregators were surveyed on top speed, gearboxes, smartphone/ GPS applications, range, charging time, replacement and tightening of components, safety features, electrochemical and electrical components, terrain performance, home-charging and cyber-security threats.

Figure 2.7: Nature of influence of various technological factors from demand influence surveys

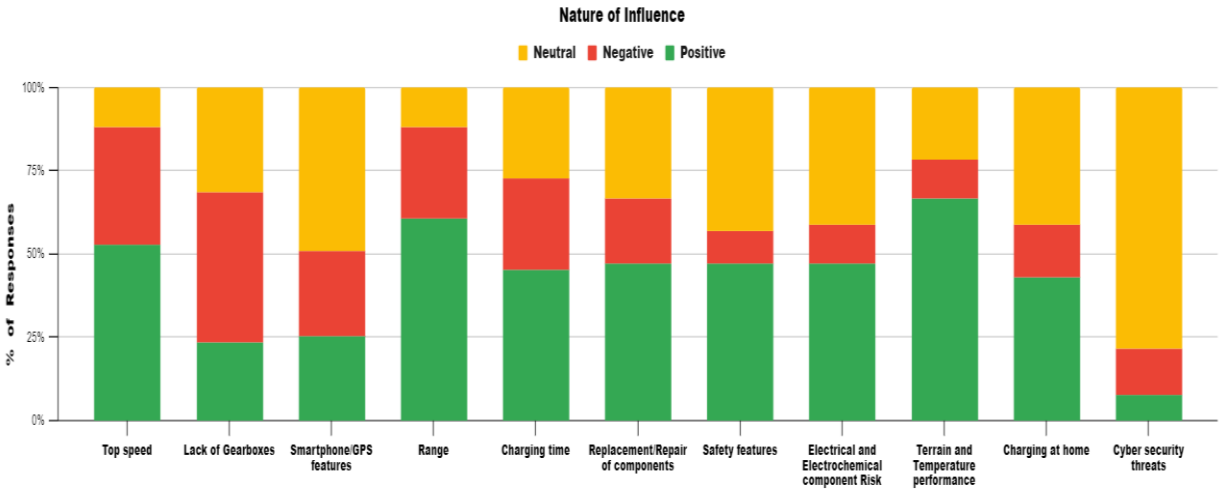
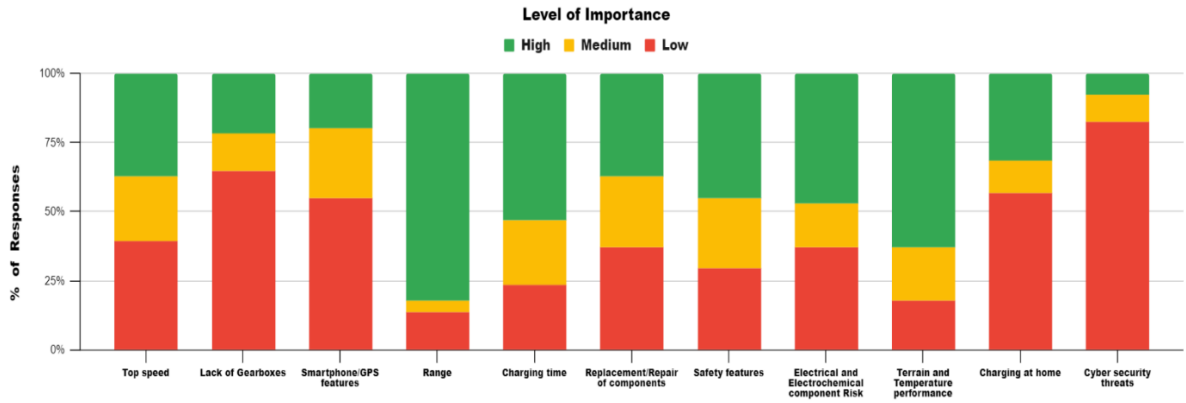


Figure 2.8: Level of importance of various technological factors from demand influence surveys



While **speed** and **range** are the most important factors that drive demand for automobiles, it was observed that for the majority of the respondents who were in the e-two wheeler and e-three wheeler category, they were relatively satisfied with their EVs as compared to e-four wheelers who wanted technological improvements to increase the top speed and range. Thus, these factors positively affect the EV demand (figure 2.7). However, respondents felt that top speed had a low influence between the two, while the range is highly important to EV demand as one could otherwise end up stranded mid-way (figure 2.8).

One of the biggest differences between the EVs compared to conventional vehicles is the **absence of a gear box**. Therefore, EVs are easier to drive than conventional ICE vehicles. However, it was observed that this is not a factor that buyers pay attention to when deciding on buying an EV and hence they responded negatively when questioned about this factor (figure 2.7) which also explains its low impact on EV demand.

As vehicles get technologically upgraded, there is a higher reliance on software, including **smartphone applications**. In the case of EVs it is even more prevalent given the significance of its electronic and software components in vehicle operations. However, these features are unavailable in lower-performance EVs, including low-speed two-wheelers and three-wheelers. Given that these segments are currently on the rise in Rajasthan's EV market, the impact of smartphone applications on consumer demand was found to be neutral and low.

One of the major drawbacks of EVs is that the **time taken to charge** an EV is much higher than the time taken to refuel an ICE vehicle. This factor has a highly (figure 2.8) negative (figure 2.7) impact on EV demand as respondents feel that time is wasted, especially when they run out of charge during work hours. However, compared to this, demand-side stakeholders felt that the **option of charging their vehicles at home** was an added advantage and affected EV demand positively (figure 2.7). Still, it was not a significant factor and had a low impact on EV purchase decisions (figure 2.8).

Now coming to **safety** and **electrical risks**, most respondents responded positively (figure 2.7) as they had never encountered any major issues or been involved in any accidents with their EV. However, a few buyers did speak about the possibility of the motor heating up during the hot summer months in Rajasthan, which could lead to accidents. However, most buyers also agreed that this factor is of high importance (figure 2.8) when deciding on making an EV purchase.

Similarly, in terms of **performance on different terrain and temperature conditions**, respondents felt that it had a high impact on EV demand (figure 2.8) and most felt it affected demand negatively (figure 2.7) because of e-three wheelers and e-two wheelers who complained that their EV did not run smoothly on slopes and hilly terrain.

Finally, coming to **cyber-security**, the respondent pool was not aware of the cyber-risks and hence felt that its impact on EV demand was neutral (figure 2.7) and low (figure 2.8).

Environmental factors

This section was added to see the impact of environmental concerns like the reduction of carbon footprints on EV demand and buyer behaviour. Under this section, we interviewed the demand side stakeholders on two factors- zero tailpipe emissions and limited noise to gauge their understanding of the environmental benefits of an EV.

Figure 2.9: Nature of influence of various technological factors from demand influence surveys

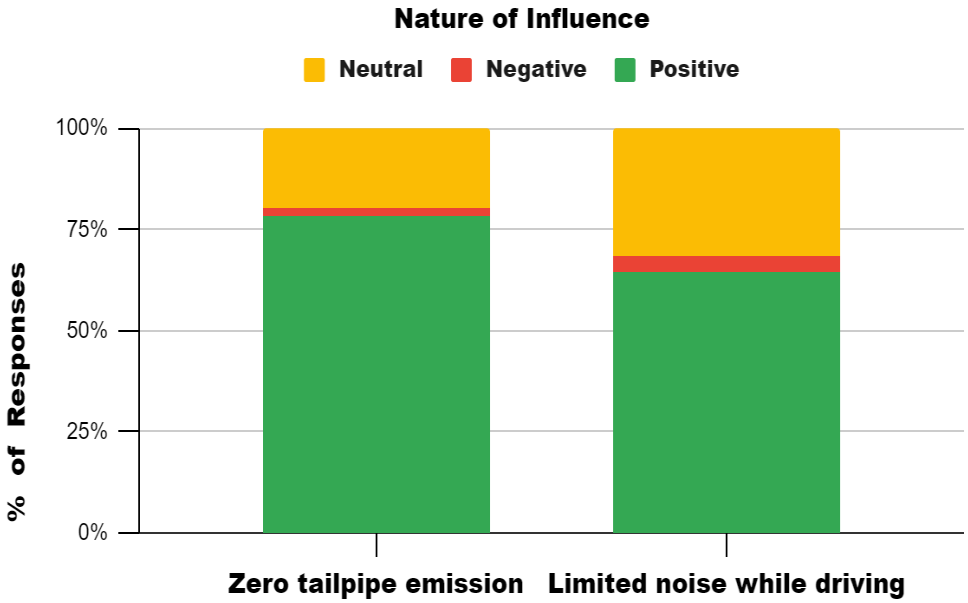
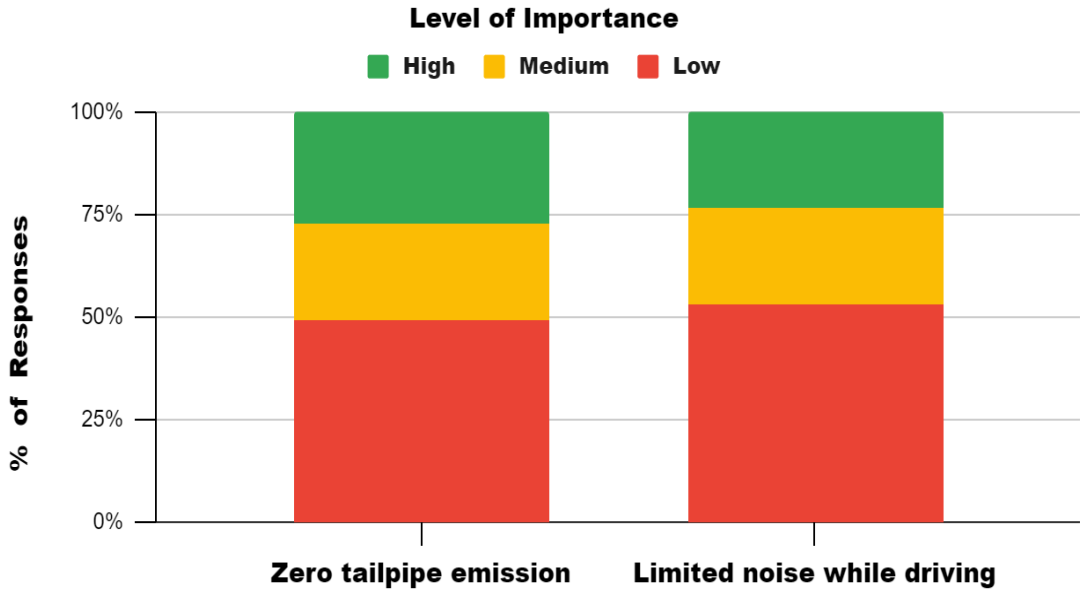


Figure 2.10: Level of importance of various technological factors from demand influence surveys



With the rising global consciousness regarding climate change and its direct link with carbon emissions, almost all countries worldwide are working on decarbonising their transport sector, which is responsible for the maximum number of emissions. Since EV has **zero tailpipe emissions**, respondents reported that this factor does help the EV sector find more takers, affecting EV demand positively (figure 2.9). However, it was an added bonus and had a very low impact on most buyers' purchase decisions (figure 2.10).

Also, EVs function silently and thus do not cause **noise pollution**, which affects the EV industry positively (figure 2.9) by driving up demand. Like the previous factor, it negatively impacts buyers' purchase decisions (figure 2.10).

Legal Factors

This section was added to gauge how legal provisions for the EV industry impact EV demand. Here we surveyed buyers and aggregators on four factors: green zones and reserved parking for EVs, separate lanes for EVs, charging station and internet bans, and finally EV registration.

Figure 2.11: Nature of influence of various legal factors from demand influence surveys

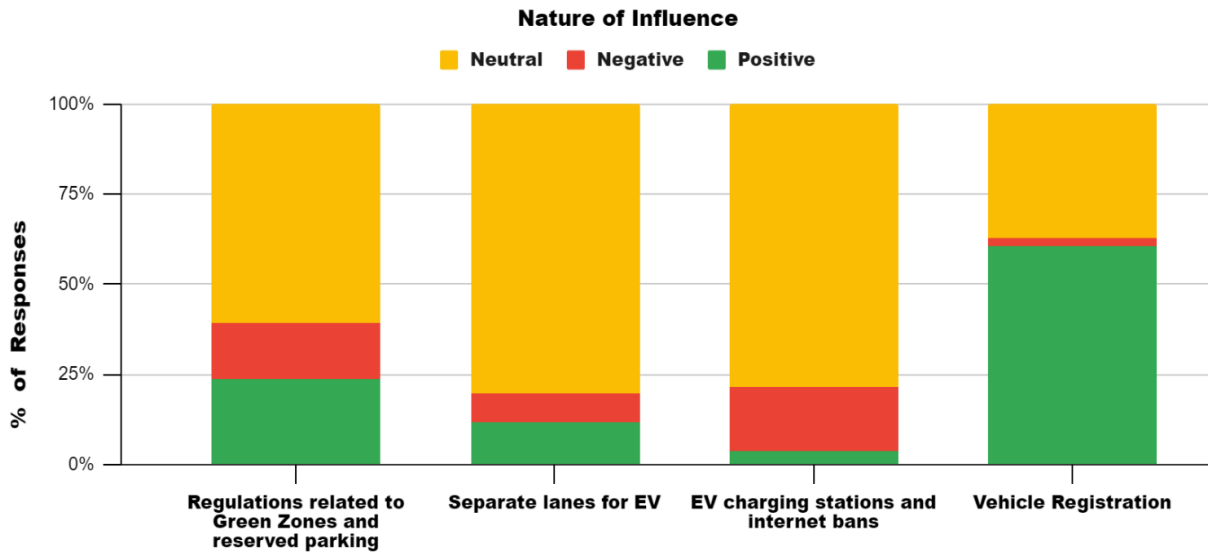
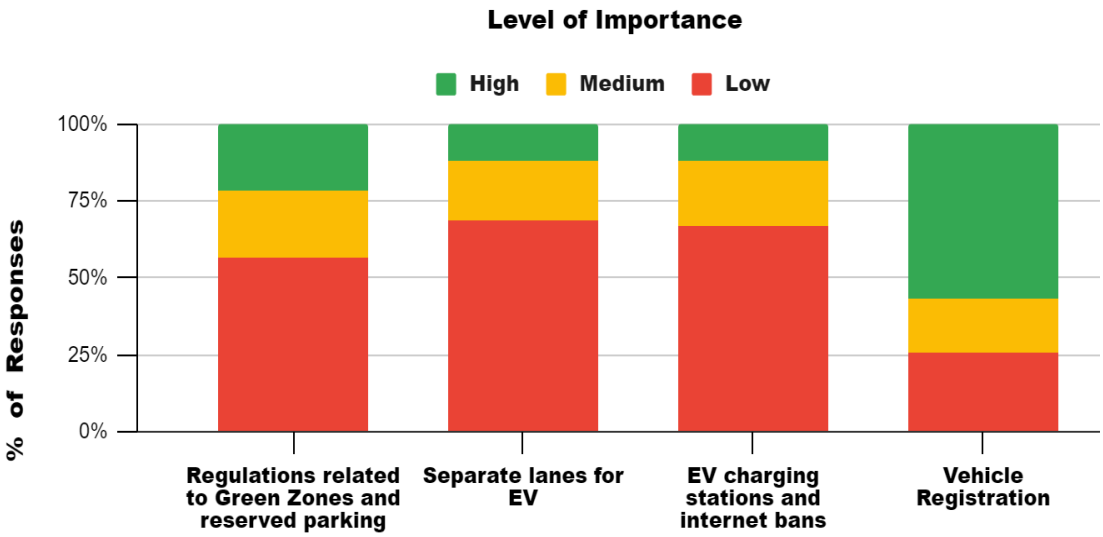


Figure 2.12: Level of importance of various legal factors from demand influence surveys



While interviewing stakeholders on the legal aspects, it was observed that the majority of them were unaware of the regulations in Model Building Bye-laws for EVs and their charging infrastructure, which have provisions for 20 percent reserved parking space for EVs in various buildings types.[35] Also, they were unaware of the state government's plans regarding Green Zones in tourist spots and ecologically-sensitive areas, where only EVs can operate and the provisions for online payment at public charging stations, as all the five surveyed cities lacked adequate EV charging infrastructure. Hence, they felt that these three factors' impact on EV demand was neutral (figure 2.11) and low (figure 2.12).

Finally, coming to **Vehicle registration**, most people agreed that registration was necessary to avail central and state subsidies on EVs along with tax benefits and registration fee exemption, all of which help bring down the upfront cost of EVs. So when surveyed, they felt that registration benefits drive up EV Demand, thus affecting the sector positively (figure 2.11). However, a section of buyers who had purchased low-powered two-wheelers for their children or for commuting short distances had not gotten their EVs registered. Again owing to the benefits that accompany registration, a large section of users felt that it had a high impact on overall demand in the sector (figure 2.12).

Inferential Analysis of Demand Side Factors

Demand Side Analysis

Similar to the supply side analysis, demand side analysis was carried out with 51 demand side stakeholders. The formula used for calculating total average score and Individual Average score for each factor were the same as used in the previous section. Upon analysis,

Political Factors

When it comes to political factors, the incentives provided by the government were rated the most important factors by the respondents surveyed. The incentives available to the consumers are mainly in the form of registration fee exemption (3), Tax benefits (4) and subsidies (6). As a result of these, small businesses are incorporating Electric vehicles as the subsidies offered have brought down the purchasing price of an EV. Again the low operating cost of EV (mentioned in the economic section) is driving down the cost of operations for many businesses. This is resulting in greater potential of adoption of electric vehicles by the small businesses and aggregators.

[35] https://archive.pib.gov.in/documents/rlink/2019/feb/p201921501.pdf

Table 10: Overall Rankings for Each Political Factor

S. No.	Political Factors	Total Average Score	Individual Average Score	Overall Rank
1	Will subsidies impact your buying decision?	91.53	2.03407	6
2	Will Registration Fee exemption for EV affect your buying?	70.90	2.28720	3
3	Will Tax Benefits (SGST refund, Green tax on ICE) be a factor while buying the next vehicle?	36.44	2.27734	4

Economic Factors

A total of 13 sub-factors were considered to gauge the impact of economic factors on EV sales. These comprehensively covered all the financial aspects that a user potentially considers while making an EV purchase. Out of these 13 factors, factors governing cost such as lower operating cost (2) and lesser maintenance cost (12) of electric vehicles were on the top priority while making an EV purchase. Consumers also stressed upon the need for lower upfront cost (5) in order to transition their existing fleet to greener mode of transport. Along with these, better payload capacity (10) for the 3-wheeler segment and greater number of after sales service centres (15) were desired by the consumers to develop user confidence. Financing options (19) were not a cause of concern for this category of users as the businesses preferred buying them using personal savings. Since, a majority of the respondents surveyed operated their business during daytime hence; they did not feel a need of charging infrastructure (33) at present as they could charge these vehicles during the night time. Factors such as resale value of battery (28), resale value of vehicle (30), battery life (20) and cost of battery (27) were not the immediate cause of concern for the respondents and hence they ranked lower among the overall list of factors.

Table 11: Overall Rankings for Each Economic Factor

S. No.	Economic Factors	Total Average Score	Individual Average Score	Overall Rank
1	Will the upfront cost of a vehicle be a concern for you?	113.84	2.27684	5
2	Is financing Options a cause of concern as public banks are not active in EV?	27.97	0.93222	19
3	Will high Rate of Interest on EV loans affect your decision?	20.93	0.77503	21
4	Will low Operating cost of EVs help you buy more EVs in future?	101.84	2.36831	2
5	Will availability of after sales services affect your buying decision?	55.51	1.42341	15
6	Will maintenance cost of EV impact your purchase decision?	61.62	1.57988	12

S. No.	Economic Factors	Total Average Score	Individual Average Score	Overall Rank
7	Will the Resale value of EV impact your buying choices?	-5.43	-0.25850	30
8	Does the difference in battery life matter to you?	27.44	0.85742	20
9	Does the cost of battery impact your purchase decision?	2.25	0.07031	27
10	Resale value of Li battery is more than Lead Acid battery. Will it matter while buying even though the initial cost is higher?	0.57	0.02721	28
11	Will Payload Capacity matter?	76.42	1.77718	10
12	Will the current lack of public charging infrastructure affect your EV purchase decision?	-10.45	-0.36029	33
13	Will the availability of vehicles with alternative fuels (CNG/Petrol) at similar prices impact your purchase decision?	-7.77	-0.29882	32

Social Factors

Social factors tried to capture the behavioural aspects of EV purchase such as word of mouth (35), potential role of the ICE vehicle unions for discouraging EVs (37) or the importance of latest developments and breakthroughs in the EV world (34). Except the aesthetics of the vehicle (14), all factors fared poorly in the eyes of the stakeholders.

Table 12: Overall Rankings for Each Social Factor

S. No.	Social Factors	Total Average Score	Individual Average Score	Overall Rank
1	Would your purchase decision be motivated by your peers' EV preference?	-18.12	-0.72480	35
2	Do you keep up with the latest developments in the EV sector?	-12.31	-0.38477	34
3	Do you face or anticipate resistance from the ICE vehicle union?	-30.00	-1.25000	37
4	Does Aesthetics of EV appeal to you?	32.41	1.47314	14

Technological Factors

Within this group, technical features of an EV were taken into consideration. This ranged from preference of the consumers for speed, range in single charge, and performance of the vehicle in different terrains and safety consideration of the vehicle. Majority of the respondents mentioned that the requirement of their business was not speed (24) but better payload capacity (10). They also demanded better range (17) for the vehicles in order to avoid frequent charging need by these vehicles. Concerns regarding driving in hilly terrain and operations under higher ambient temperature (8) were also prominent among the user category. Further, risks associated with electrical and electrochemical components (13) along with safety considerations (11) were relatively ranked higher while making a purchase.

Table 13: Overall Rankings for Each Technological Factor

S. No.	Technological Factors	Total Average Score	Individual Average Score	Overall Rank
1	Will Top speed matter while buying?	24.80	0.55111	24
2	EVs do not have Gearboxes. Do you want the experience of changing gears in a car?	-6.46	-0.18449	29
3	Would you like Smartphone/GPS and other location-enabled technological features in your EV?	10.00	0.38462	26
4	Does the range of EV impact your purchase decisions?	52.11	1.15802	17
5	Will Charging time impact your buying decision as ICE/CNG have minimal waiting time associated with refuelling?	23.57	0.63696	23
6	Replacement of components & tightening of body parts are two major issues in EV. Will this impact your EV purchase?	31.94	0.93945	18
7	Will the safety features of the vehicles impact your buying decision?	48.07	1.65755	11
8	Will the risk associated with electrical and electrochemical components impact your buying decision?	46.40	1.54667	13
9	Will vehicle performance in different terrain and temperature conditions influence your decision?	72.10	1.80250	8
10	Will the option of Charging at home motivate you to buy an EV?	36.93	1.23111	16
11	Would the possibility of cyber security threats influence your purchase decision?	-3.18	-0.28926	31

Environmental factors

While the savings in term of operating cost was the main driving factor behind the purchase of an EV, consumers did appreciate the environmental benefits of electric vehicles. This was reflected in their response to the questions related to their preference for zero tailpipe emission vehicle (7) and lesser noise vehicle (9).

Table 14: Overall Rankings for Each Environmental Factor

S. No.	Environmental Factors	Total Average Score	Individual Average Score	Overall Rank
1	Will you prefer a vehicle with Zero tailpipe emission?	78.02	1.90303	7
2	Will limited noise while driving be a feature you would consider while purchasing an EV?	63.06	1.80163	9

Legal Factors

One of the prominent effects of subsidies was observed in increase in buying of registered vehicles. With the subsidy announcement by the state government only for registered vehicles, consumers have their preference shifted towards registered EVs. Amenities such as creation of green zones, facilities for reserved parking, and separate lane for EV were not effective as such in driving EV sales in the state of Rajasthan.

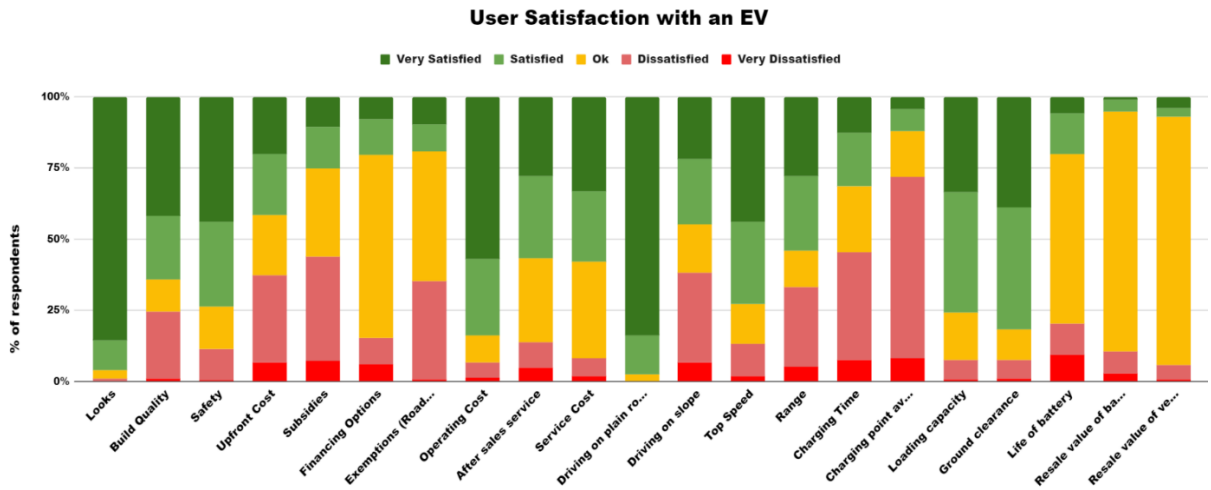
Table 15: Overall Rankings for Each Legal Factor

S. No.	Legal Factors	Total Average Score	Individual Average Score	Overall Rank
1	Would the future implementation of regulations related to Green Zones and reserved parking impact your purchase decision?	13.60	0.68000	22
2	Some states have separate lanes for EV which will save time and traffic. Will the provision for the same in your city in future impact your purchase decision?	4.00	0.40000	25
3	Since EV charging stations require a network to function they may be impacted by internet bans in the city. Will it affect your use?	-11.36	-1.03306	36
4	Is registration of vehicle significant for you?	79.41	2.48145	1

User satisfaction Survey

Apart from the demand aggregators, we also surveyed EV users across various segments (two-wheelers, three-wheelers and four-wheelers) to gauge their level of satisfaction with an EV and get a better understanding of the barriers faced by them on an everyday basis and whether policy changes could address them. The following section contains cumulative insights from our survey in all five cities.

Figure 3.1: User Satisfaction with an EV from all the five cities surveyed



1. **Looks and Build Quality:** Across all the five cities, users were mostly satisfied with the aesthetic appeals or looks of their EV and its build quality. However, users from cities with hilly terrain like Udaipur felt that the build quality could be further improved to make it sturdier and more durable. Besides that, the majority of the body parts for EV are currently imported from China and assembled in India. Hence, this factor did negatively impact user confidence as many users found the quality of these parts questionable.

2. **Safety:** With safety, users were mostly satisfied, but a fraction of users were sceptical about the impact safety of the vehicle. This is especially true in the case of e-three wheelers, who were mostly dissatisfied since it is an open vehicle and not very heavy compared to ICE due to which they question the sturdiness of the vehicle. None of the users in any segment had faced any serious concerns in terms of electrical safety. Still, they were worried about the motor heating up during the high temperatures in summer. E-four wheeler users reported having a good experience with their EVs and have not expressed any safety concerns.

3. **Upfront cost and subsidies:** When it comes to central subsidies, only eighteen OEMs[36] across India are eligible for FAME II subsidies, so only EVs sold by their dealers can avail the FAME subsidy. Again, the Rajasthan EV subsidy has to be claimed through the Regional Transport Offices. While the FAME subsidy is directly applied to EVs and brings down their upfront cost - it is only applicable to certain specific brands and EVs with advanced battery chemistry like li-ion. The Rajasthan EV subsidy is reimbursed to the customer only after submitting and verifying relevant documents.

   Thus, the customer has to pay the full cost and after a long time, they get the subsidy, resulting in consumer dissatisfaction. Therefore, due to the subsidy structures' gray areas, we received mixed responses from users for these factors. Those who could avail both FAME II and Rajasthan EV subsidy were very satisfied with the upfront costs and subsidies, while those who could only avail the Rajasthan EV subsidy felt the upfront cost was not justified especially since the subsidies took a long time to process. Again e-four wheelers fall in the premium category and users complained that they are expensive even after FAME subsidy, SGST reimbursement, and road and registration tax exemption. Furthermore, EV users who did not get their vehicle registered and were not eligible for any subsidy.

   Also, a section of users had gotten their vehicle registered but had not received their state subsidies. These sections were very dissatisfied with both the upfront cost and subsidies.

4. **Financing options**: Currently, e-three wheelers and e-two wheelers are largely financed by private financiers in each of the five cities, while private banks are slowly entering the market. This is because of the nascent stage of the market and the associated lack of trust. Along with that, in the case of e-three wheelers, the economic background of the buyers often poses a challenge for them to avail secured loans. However, for e-four wheelers, public and private financing options are available.

   Thus, a clear lack of awareness or indifference regarding the financing options resulted in a neutral opinion from most users, who have mostly resorted to self-financing. But a section of users had taken out loans from private financiers who typically charge high interest rates (ranging between 12 - 22 percent) and were dissatisfied with the lack of public financing options. Those users who were able to avail public financing options with interest rates ranging around 7 percent - mostly e-four wheeler users- were satisfied with the options available.

[36] https://fame2.heavyindustries.gov.in/content/english/20_1_OEM.aspx

5. **Exemptions:** Users were also indifferent towards Road and Registration tax exemption and the SGST reimbursement as they felt it made little difference to the overall cost of the vehicle. However, users who could register their EVs and claim the subsidies successfully, exemptions and reimbursements were extremely satisfied. In contrast, those who did not register their EVs or had faced trouble claiming these exemptions were dissatisfied with the same.

6. **Operating Cost:** Most users were highly satisfied with the operating costs of EVs, especially those with li-ion batteries, as they hardly had to spend anything. The ones with lead-acid batteries had to check the battery's water levels constantly. Hence, they incurred some maintenance costs, mostly within INR50-100 per day, which was minimal, compared to an ICE vehicle. These results are consistent with our secondary research, where we found that with a running cost of INR1/km, the operational cost of EVs is one-tenth of that of ICE vehicles, which have a running cost of about INR9/km.[37] However, few users incurred a daily operational charge greater than INR200, due to which they were dissatisfied.

7. **After Sales Service & Service Cost:** This received mixed responses. Most users were servicing their EVs at their dealers. In contrast, others complained about the lack of service centres and the service costs because EVs need mechanics who are adept at handling the electrical components of the vehicle and such mechanics are few and mostly based in Jaipur. So, when users in other cities need repairs, they have to pay the mechanic for his services and pay for his transportation, which drives up the servicing cost. Also, a section of buyers could not comment on these two factors as their EVs were new and hence they had not encountered any such issues with it and hence did not have to avail after-sales service.

8. **Performance (Terrain, Top Speed and Range):** In case of performance on plain road and slope, top speed and range - the majority of users in the e-three wheeler category reported that while they were satisfied with the smooth performance of their EVs on the plain road, however, they were dissatisfied with its performance on slopes and uneven roads. They felt that their EVs were not sturdy enough to withstand the jerks experienced while driving on uneven roads, which again related to the build quality and impact safety. This was especially prominent in Udaipur, which has a hilly terrain. Also, most users were satisfied with the top speed of their EVs as well as the range. Still, e-four-wheelers reported range anxiety which prevented them from making long distance trips and they were restricted to intra-city trips rather than inter-city trips.

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[37] https://auto.economictimes.indiatimes.com/news/oil-and-lubes/as-petrol-nears-rs-100/litre-evs-running-at-one-tenth-cost/81029317#:~:text=Consequently%2C%20the%20running%20cost%20of,cost%20of%20running%20an%20EV.

9. **Charging time and Infrastructure:** The majority of the users across all segments complained about the lack of public charging stations and how that contributes to range anxiety which again hampers user confidence. This also corresponds with the information provided by the Tata Motors EV Charging station locator[38] , as per which only Jaipur had 31 public EV charging points, Udaipur had 7, and Jodhpur had 1, while Kota and Alwar had zero public charging stations.

   Also, according to a significant section of dissatisfied respondents, the time taken for charging was too long. This is mostly true for the e-three-wheelers with lead-acid batteries, as most users reported that they took 8-12 hours for one full charge, which was a problem for their users as most of them were daily wage earners. So, if their batteries got discharged at any point during their work hours, they would lose their earnings for hours spent on charging. Also, e-four-wheeler users complained that owing to the lack of charging infrastructure on highways and major connecting roads, their movements were restricted to their cities as they could not travel from one city to another in their EVs.

   It was also observed that all the e-four-wheeler users that owned some form of an ICE vehicle, either a four-wheeler or a two-wheeler, intended to use it whenever they had to cover long distances or in case of emergencies.

10. **Ground Clearance:** During the initial scoping visits and consultations, it was found that the conditions of the roads in all the selected five cities were far from ideal and hence we included this factor to capture the user's experience of driving an EV on these uneven roads. We also wanted to see if users were satisfied with the ground clearance of their EVs or the space between the road and the lowest part of the vehicle body. Users in the e-four wheeler category were very satisfied with ground clearance and e-two wheelers, but a section of e-three wheelers was dissatisfied with the relatively high ground clearance, which made them anxious about the stability of their EV.

11. **Loading Capacity of EVs:** Most respondents reported a loading capacity of 150-200 kgs for the e-two-wheeler while that for the e-three-wheeler category was 500-700 kgs. While e-two wheeler and e-four wheeler owners were mostly satisfied with their vehicles' loading capacity, e-three-wheelers owners largely used their EVs as rickshaws to ferry passengers or to load goods. They were dissatisfied with their EVs since they were constantly scared that they were not stable or sturdy enough, which again related to building quality.

[38] https://nexonev.tatamotors.com/charging-locator/

12. **Life of battery:** Again, most users, especially those with li-ion batteries, could not comment on the battery life as their batteries were yet to complete one life cycle. However, they reported that li-ion batteries mostly came with a warranty period of 4-5 years and most users were satisfied with that. Still, since their EVs were new, they could not verify and comment on whether the battery life matched with the manufacturer claims. However, in the case of lead-acid batteries, mixed reactions were captured as some users were satisfied with it while some were dissatisfied.

    The satisfied ones reported that their batteries had outlived the manufacturer's warranty of one year, while those who were dissatisfied were the ones whose battery gave up within the warranty period. They had to go through the tedious process of warranty claim and after the warranty period, they had to frequently change the battery due to its short lifespan, which proved to be expensive for them.

13. **Resale Value of Vehicle and battery:** Since most of the users we surveyed were first-time EV users and one life of the vehicle had not been complete, they could not comment on these two factors. Also, while a market for used e-three wheelers is developing and being refurbished and resold, no such market is present for e-two wheelers and e-four wheelers. Among the ones who were satisfied with the resale value of the vehicle and battery were those who managed to recover some fraction of the upfront cost of the EV while those who were dissatisfied were the ones who sold their EV or batteries at a loss.

Inferential Analysis of User Surveys

A total of 311 EV users from five different cities (Jaipur, Jodhpur, Udaipur, Kota, and Alwar) were surveyed during the field survey under the EV Raj project. In the field survey questionnaires, 21 different topics were considered to understand the user experience with electric vehicles. In Rajasthan, electric vehicle adoption and electric vehicle related infrastructure were different in different cities. Based on the infrastructure availability and acceptance ratios in different cities, respondents were given feedback about their vehicles accordingly.

Looks: There are lots of private players in the market associated with manufacturing and model up-gradation, especially in the 2&3 wheeler segments. So, most buyers have chosen their vehicle according to their preference. Vehicle aesthetics are an important factors to attract buyers. During the time of the field survey, approximately 95 percent of respondents were either satisfied or very satisfied with their vehicle's looks. This highlights that users are mostly influenced by the vehicle's looks.

Build quality: Most manufacturers are use lightweight materials for their products to achieve maximum range. For this reason, sometimes manufacturers do not meet the expectations of the user and in no way can compromise the build quality of the vehicle. However, some manufacturers are very concerned about the quality of their products and maintain their reputation by providing better quality products. In this regard, when the respondents were asked about the build quality of their vehicle construction, about 70 percent of the respondents were satisfied or very satisfied with the quality of construction of their vehicle.

Safety: Based on user preference, most users have shown their concern about the safety of their EVs. At the time of the field survey, more than 70 percent of respondents were satisfied with the vehicle's safety.

Upfront cost: Upfront costs of EVs are the most crucial factor driving buyer behavior. In this respect, approximately 36 percent of respondents were either dissatisfied or very dissatisfied with the upfront cost. This response highlights that the buyers found the upfront cost of EVs quite high.

Subsidies: Both the Central, as well as State subsidies, help drive down some of the initial upfront costs of Evs promoting their faster adoption. But, state subsidies are often not applicable for 4 wheelers. Our survey found that approximately 42 percent of respondents were dissatisfied with the amount of subsidy provided by the government. Also, the delay in subsidy claims influenced respondents' responses.

Financing options: Presently, only the private banking sectors are interested in funding loans for EVs albeit with higher interest rates. Thus with limited options, buyers were forced to take out loans from private banks and had to pay more money to buy an electric vehicle. Hence, almost 64 percent of respondents were indifferent to the financing options.

Exemptions (Road tax/Registration): There are two different categories of EVs available in the market- registered vehicles and non-registered vehicles. Along with this, government also provide some exemptions in road tax, registration fees, etc. for the other vehicle segments. When respondents were asked exemptions on road tax, registration, etc. related questions almost 45 percent of respondents were satisfied with it.

Operating cost, after-sale service and service cost: With the advancement of technology and regular new inventions in the field of electric vehicles, manufacturing units lower the additional operating cost of the vehicles for the users. Approximately 84 percent of respondents were either satisfied or very satisfied with the vehicle operating cost. Similarly, when respondents were asked about the after-sales services and service cost of vehicles, more than 50 percent of respondents were satisfied or very satisfied and 30 percent were satisfied with the amount they had to pay at the time of servicing of the vehicle.

Driving performance: In the case of a battery operated vehicle users always have anxiety about the driving performance of the vehicle. When respondents were asked about their experience after driving an electric vehicle on flat roads, more than 85 percent of respondents were satisfied or very satisfied with their experience. But, when asked about their driving experience on slopes, about 38 percent of respondents were dissatisfied or very dissatisfied with their experience.

Top Speed: Among the variety of users' preferences, vehicle speed is one of the crucial factors for buyers. But, available quite large options in the market provide better opportunities for buyers to choose according to their preferences. In this regard, approximately 72 percent of respondents were either satisfied or very satisfied with their vehicle's top speed.

Range: Range anxiety is an important factor that influences buyer behaviour. But, with advanced digital meters and charging indicators in the vehicles, somehow users manage by planning their trips smartly. Overall, the issue of range is yet to be solved for long-distance travelers. When respondents were asked about the vehicle range related questions, almost 32 percent of respondents revealed their dissatisfaction with the vehicle range.

Charging ecosystem: Presently, the charging ecosystem in Rajasthan, as well as the country, is at a nascent stage, which results in range anxiety in buyers. Almost all users we interviewed were charging their EVs at home and 70 percent of them were either dissatisfied or very dissatisfied with the charge point availability in their city. Additionally 45 percent of respondents were dissatisfied with the time taken by their vehicles for a full charge.

Loading capacity: Manufacturers uses low-weight materials which compromises the vehicle loading capacity. But, as per our survey, almost 75 percent of respondents were either satisfied or very satisfied with their vehicle loading capacity.

Ground clearance: In the city outskirts roads are uneven. Hence proper ground clearance becomes necessary as it decreases the chances of accidents. As per our survey, 82 percent of respondents were satisfied or very satisfied with their vehicle's ground clearance.

Life of Battery: In an EV, the battery is the most important component. The battery capacity is associated with vehicle pricing. So, maximum users were concerned about the battery life. There are different kinds of batteries available in the market and their prices also vary according to their working efficiency and longevity. When respondents were asked about battery life span, approximately 60 percent of respondents responded neutrally.

The resale value of battery and vehicle: Electric vehicles are in the market for the past few years and most consumers have bought their vehicles recently or a few years back. So, the majority of them did not have any knowledge about their vehicle or battery resale value.

Hence when asked about their vehicle or battery resale values, almost 85 percent of the respondents responded neutrally.

Citywise Inferential Analysis of User Satisfaction Dataset

To gauge the satisfaction level of existing Electric vehicle users, EV user satisfaction survey was carried out in the five cities i.e. Alwar, Kota, Jaipur, Jodhpur and Udaipur. The sample size for each city was determined with 95 percent confidence interval representing the users in each segment i.e. 2,3 and 4 wheelers. The table showing the sample size for each city has been given below. The inputs of these users were obtained on 5 point likert scale for 21 parameters representing a comprehensive list of factors that can govern the buying as well as word of mouth publicity for electric vehicles. The City wise data analysis have been provided for each city in the following sections.

Table 16: Category wise User Surveys carried out in Each City

Cities	Total Sample Size for User Survey	Two-Wheeler	Three-Wheeler (Commercial and Passenger)	Four-Wheeler (Passenger)
Jaipur	99	49	46	4
Kota	62	31	29	2
Jodhpur	49	24	23	2
Udaipur	34	17	16	1
Alwar	67	33	31	3
Total	311	154	145	12

Jaipur

A total of 99 user surveys were done in Jaipur with representation from each segment of vehicle.

Looks, Build Quality and Safety: Approximately 95 percent of the respondents were either satisfied or highly satisfied with the looks. Electric vehicle in the markets are available in different design which are a point of attraction for many consumers. At the same time, when build quality of electric vehicle is considered the percentage of satisfied customers drop down to nearly 60 percent. This highlights the fact that the build quality of the EVs are not at satisfactory levels. Since, the entire survey was carried out before the battery safety concerns incidences emerged, the safety rating for EV as given by users were of the order of 75 percent.

Performance Parameters: When inputs across performance parameters were considered, almost all users were satisfied or highly satisfied with the driving on plain roads. However, the percentage drops to almost 42 percent when driving on slopes was considered. Nearly 70 percent of the consumers said that they were happy with the top speed of the vehicle.

Charging Ecosystem: Users showed their dissatisfaction in terms of charging point unavailability (76 percent dissatisfied consumers) and higher charging time (43 percent dissatisfied users).

Post Purchase Service: When the consumer were asked about the after sales service and service cost, more than 60 percent of the users expressed their satisfaction in terms of lower service cost and lesser number of services needed for the vehicle.

Financial considerations: Inputs on financial parameters such as upfront cost, operating cost and financing were also taken. The subsidies by both central and state governments have resulted in bringing price parity in terms of 2&3 wheelers. This has resulted in 60 percent of the users being satisfied with the upfront cost. The price parity has not been achieved for four wheeler segment as the subsidies have not been offered for this category of users. About 80 percent of the consumers were satisfied with the lower operating cost of vehicle as compared to an ICE vehicle.

Life and Resale value: When asked about the life of battery, majority of users (more than 70 percent) said the life was adequate enough as per the claims offered by the manufacturers. They showed a neutral response when asked about the resale value of battery as well as vehicle as they did not have the knowledge about these and the ecosystem associated with the second life of battery.

The responses of the users for 21 parameters have been mentioned in the form of star rating given below:

Table 17: Jaipur EV user feedback star ratings

Product Quality	Weighted Mean	Star Rating				
Looks	4.8	★	★	★	★	½
Build Quality	3.7	★	★	★	½	
Safety	4.1	★	★	★	★	½
Upfront Cost	3.1	★	★	★	½	
Subsidies	2.9	★	★	½		
Financing Options	3.2	★	★	★	½	
Exemptions (Road tax/Registration	2.8	★	★	½		
Operating Cost	4.2	★	★	★	★	½
After sales service	3.8	★	★	★	½	
Service Cost	3.9	★	★	★		
Driving on plain road	4.9	★	★	★	★	
Driving on slope	3.2	★	★	★	½	

Top Speed	3.9	★	★	★	☆	
Range	3.5	★	★	★	☆	
Charging Time	2.9	★	★	☆		
Charging point availability	2.4	★	★	☆		
Loading capacity	3.9	★	★	★	☆	
Ground clearance	4.2	★	★	★	★	
Life of battery	2.9	★	★	☆		
Resale value of battery	3	★	★	★		
Resale value of vehicle	3	★	★	★		

Alwar

In Alwar, 67 users participated in the survey for giving feedback related to Electric Vehicle driving experience.

Looks, Build Quality and Safety: As far as looks of the vehicles were concerned, 97 percent of the person surveyed liked the appearance of EVs. However, similar to Jaipur the percentage of people satisfied with build quality dropped to 61 percent. In terms of safety, about 80 percent of the people rated the vehicle to be safe.

Performance Parameters: 98 percent of the people surveyed said that the driving experience on plain roads was satisfactory while 43 percent said that the driving experience was not at par with ICE vehicles when driving on slopes were considered. 82 percent of the respondents gave the speed rating to be satisfactory or highly satisfactory.

Charging Ecosystem: 77 percent of the people felt the need for a charging station in circles, petrol pumps and other areas while, almost half of the users complained about the longer charging time of the electric vehicles.

Post purchase service: Majority of the users' response to after sales service and service cost were on a fine or satisfactory level. The services offered were found to be almost the same level as ICE vehicle. Electric vehicles are associated to have lower maintenance or service cost owing to lower number of parts in the vehicles. This was reflected in their response where 45 percent respondents found it to be on a satisfactory or highly satisfactory note.

Financial Considerations: 37 percent of the respondents think that the upfront cost of the EVs are on a higher side and it should be brought down through subsidy by the government. This was reflected in the response, where 66 percent of the people think that there should be more subsidies on electric vehicle. About three fourth of the respondents showed an indifferent attitude towards financing option as majority of them bought the vehicle through

cash only. A whopping 90 percent of the respondents showed their higher satisfaction level with lower operating cost of electric vehicle.

Life and resale value: When asked whether the battery life lived up to the manufacturer's claims, more than 68 percent of customers indicated that they were fine with the battery life while almost a quarter of people were satisfied or highly satisfied with it. They responded neutrally when asked about the resale value of a battery or a car since they were ignorant about the subject and the ecosystem surrounding a battery's second life.

Table 18: Alwar EV user feedback star ratings

Product Quality	Weighted Mean	Star Rating				
Looks	4.9	★	★	★	★	½
Build Quality	3.7	★	★	★	½	
Safety	4.3	★	★	★	★	½
Upfront Cost	3	★	★	★		
Subsidies	2.5	★	★	½		
Financing Options	3.1	★	★	★	½	
Exemptions (Road tax/Registration	2.4	★	★	½		
Operating Cost	4.5	★	★	★	★	½
After sales service	3.6	★	★	★	½	
Service Cost	3.7	★	★	★	½	
Driving on plain road	4.9	★	★	★	★	½
Driving on slope	3.4	★	★	★	½	
Top Speed	4.4	★	★	★	★	
Range	3.9	★	★	★	½	
Charging Time	3	★	★	★		
Charging point availability	2.3	★	★	½		
Loading capacity	4	★	★	★	★	
Ground clearance	4.1	★	★	★	★	½
Life of battery	3.2	★	★	★	½	
Resale value of battery	3	★	★	★		
Resale value of vehicle	3	★	★	★		

Udaipur

There were 34 users in Udaipur who participated in this survey and provided their responses on Electric vehicles and their experience.

Looks, Build Quality and Safety: Almost 99 percent of the users responded positively to the looks of the EVs which refer to the fact that people were not that much concerned regarding EVs' looks and other factors were much more important to them. Satisfaction level for build quality was higher in Udaipur as compared to other cities though it can be attributed to the fact that two wheelers here outnumber three wheelers and most of the users were quite satisfied with their vehicles' build quality. Also, people were very satisfied with the safety issues since none of the incidents of fire in EVs had happened at the time of survey.

Performance Parameters: In line with the responses in other cities, users were quite satisfied with driving experience of EVs' on plain road while being dissatisfied with it on slopes. Since Udaipur has a hilly terrain throughout the city, the dissatisfaction level here was on the higher side and can be considered as one of the primary reasons for lower adoption of e-three wheelers in the city. Almost 90 percent of the people found the speed of the EVs to be satisfactory.

Charging Ecosystem: More than half of the users were satisfied with charging time which is quite opposite to the views given by users in other cities. This is due to the fact that majority of two wheeler users responded positively when enquired. Since Udaipur has only 1 charging station, almost 65 percent of the people were dissatisfied with state of charging infrastructure in the city.

Post Purchase Service: Majority of the users were satisfied with after sales services and service cost since the EVs needed a very less maintenance and this amounted to a very low number of servicing of the parts which was available in ample amounts in city.

Financial considerations: A significant number of users were dissatisfied with the upfront cost. Almost 80 percent of the people were satisfied with the operating cost since it costs almost negligible amount of money to run an EV as compared to an ICE vehicle. Most of them were satisfied with the financing options as most of the two wheelers were self-financed while the three wheelers were mostly operated by hotels or local companies which didn't go for loans to buy an EV. Almost 60 percent of the users were satisfied with subsidies on EVs though many of them expected more subsidies while also wanting for a better delivery system for subsidies.

Life and Resale value: 80 percent of the people were satisfied with the life of the battery since majority of the people after calculating the cost were finding it profitable to have a battery life of 3-4 years. Almost 85 percent of the people were satisfied with the resale value

of battery and vehicle since the market for these isn't established yet and most of the vehicles were 2-3 years old.

Table 19: Udaipur EV user feedback star ratings

Product Quality	Weighted mean	Star Rating				
Looks	4.9	★	★	★	★	½
Build Quality	4.1	★	★	★	★	½
Safety	4.1	★	★	★	★	½
Upfront Cost	3.2	★	★	★	½	
Subsidies	3.2	★	★	★	½	
Financing Options	2.9	★	★	½		
Exemptions (Road tax/Registration	3.4	★	★	★	½	
Operating Cost	3.4	★	★	★	½	
After sales service	3.8	★	★	★	½	
Service Cost	4	★	★	★	★	
Driving on plain road	4.9	★	★	★	★	½
Driving on slope	3.1	★	★	★	½	
Top Speed	4.1	★	★	★	½	
Range	3	★	★	★		
Charging Time	2.8	★	★	½		
Charging point availability	2.5	★	★	½		
Loading capacity	4	★	★	★	★	
Ground clearance	4.1	★	★	★	★	½
Life of battery	3	★	★	★		
Resale value of battery	2.8	★	★	½		
Resale value of vehicle	3.2	★	★	★	½	

Jodhpur

In Jodhpur, a total of 49 users participated in the surveys and provided their inputs on EV experience.

Looks, Build Quality and Safety: Users were quite satisfied with looks as almost 98 percent people responded positively when asked enquired. Also the satisfaction level for build quality was quite high compared to users from other cities. As far as safety is concerned, users overwhelmingly found EVs to be quite safe though it can also be attributed to the fact that surveys were done before the safety concerns emerged though some people raised concern over battery safety in summer season when the days remain quite hot throughout Jodhpur.

Performance Parameters: Users were quite satisfied with vehicles' performances on plane road with almost 80 percent of the satisfactory response. While users were dissatisfied with its performance on slopes, the number was low as compared to people from other cities. Users also find EVs' speed as one of the positive reasons to buy it with most of the two hweeler users finding it satisfactory.

Charging Ecosystem: Users were dissatisfied with both charging time and infrastructure as there was no charging infrastructure in the city. The charging time was also too high for many users with most of the three wheeler users complaining over it.

Post Purchase Service: Since the EVs require extremely low maintenance and translating to a very low number of servicing of the parts, which were available in plentiful amounts in city, the majority of consumers were satisfied with after sales services and service cost.

Financial considerations: Financial inputs on factors including up-front costs, on-going expenses, and financing were also gathered. The central and state governments' subsidies have brought about price parity in terms of 2&3 wheelers. As a result, 83 percent of users were satisfied with the up-front fee. Due to the lack of subsidies for this group of consumers, price parity has not been reached for the four wheeler segment. The decreased running costs of the car compared to an ICE vehicle were satisfactory to about 90 percent of the consumers.

Life and Resale value: More than 80 percent of customers said that the battery life was satisfactory when asked about it in relation to the manufacturer's claims. When questioned about the resale value of a battery or a vehicle, they gave a neutral reaction since they lacked awareness of these topics and the ecosystem surrounding the second life of a battery.

Table 20: Jodhpur EV user feedback star ratings

Product Quality	Weighted Mean	Star Rating				
Looks	4.8	★	★	★	★	½
Build Quality	4.2	★	★	★	★	½
Safety	3.8	★	★	★	½	
Upfront Cost	3.9	★	★	★	½	
Subsidies	3	★	★	★		
Financing Options	3.2	★	★	★	½	
Exemptions (Road tax/Registration	3.1	★	★	★	½	
Operating Cost	4.5	★	★	★	★	½
After sales service	3.4	★	★	★		
Service Cost	3.5	★	★	★		
Driving on plain road	4.8	★	★	★	★	½
Driving on slope	3.1	★	★	★	½	
Top Speed	3.9	★	★	★	½	
Range	3.4	★	★	★	½	
Charging Time	3.3	★	★	★	½	
Charging point availability	2.4	★	★	½		
Loading capacity	4.4	★	★	★	★	½
Ground clearance	4.4	★	★	★	★	½
Life of battery	3.1	★	★	★	½	
Resale value of battery	3.1	★	★	★	½	
Resale value of vehicle	3	★	★	★		

Kota

A total of 62 electric vehicle user survey were done in Kota, Rajasthan with representation from each segment i.e. 2,3&4 wheelers.

Looks, Build quality and Safety: The look of the vehicle is one of the most important factors to attract customers for purchasing an electric vehicle. Approximately 90-95 percent of respondents were either satisfied or highly satisfied with the looks. There are plenty of electric vehicle manufacturing companies that come up with new designs and technologies that provide more options for users. When it comes to build quality related questions, the positive response drops to about 50 percent respondents either satisfied or highly satisfied. This type of response highlights that the build quality of electric vehicles is not satisfactory

for users. According to responsible vehicle user's point of views, the vehicle safety is the most important factor at the time of purchasing an electric vehicle. The safety rating for EV as given by users were of the order of 67 percent.

Post Purchase Services: Approximately 75 percent of the electric vehicle users were either satisfied or very satisfied with low operating cost of their vehicles. Similarly, in case of the after sales services and vehicle servicing cost related queries, respondents were almost 60 percent satisfied or very satisfied with the electric vehicle.

Performance Parameters: When the respondents were asked about the driving performance on plain roads, almost all the users were satisfied or highly satisfied with it. But, when asked about driving performance on slopes, the respondent's feedbacks drops down to approximately 45 percent due to low performance. There are different variants of same vehicles available on the market, which provide different options for the customers to buy according to their preferences. In the case of vehicles' speed, almost 65 percent of respondents were satisfied or very satisfied with vehicle's top speed. When the consumers were asked about the loading capacity of their vehicles, more than 70 percent of users were satisfied or very satisfied with the loading capacity. Similarly, almost 60 percent users were satisfied or very satisfied with the vehicle's ground clearance.

Charging Ecosystem: Charging points availability and charging time requirements is the factor, which highly influence the consumers at the time of purchasing electric vehicles. In this case, respondents were expressed dissatisfaction in terms of charging point unavailability (67 percent dissatisfied or very dissatisfied consumers) and higher charging time (53 percent dissatisfied or very dissatisfied users).

Financial Considerations: On the subsidies provided for 2&3 wheelers, approximately 40 percent respondents were satisfied with it. But, in the four wheeler segment the subsidies are not offered which influence the buyer's decision. Currently only the private banking sector offers financing options for customers to purchase registered electric vehicles with high interest rates. The limited financing options with higher interest rates influence the customers highly. But, almost 58 percent respondents were satisfied with the financing options. When respondents were asked for electric vehicles road tax and registration cost related questions, almost 58 percent users responses were satisfied. The upfront cost of electric vehicles is a major factor for influencing the buyers at the time of vehicle purchasing. Almost 48 percent users were dissatisfied or very dissatisfied with the high upfront cost of the vehicles. The electric vehicle range is an anxiety factor for the consumers. Almost 39 percent respondents were either dissatisfied or very dissatisfied with the vehicle range.

Battery Life and Resale value: When asked about the life of battery, many users (more than 40 percent) said the life was adequate enough as per the claims offered by the manufacturers. They showed a neutral response when asked about the resale value of battery as well as

vehicle as they did not have the knowledge about these and the ecosystem associated with the second life of battery.

The responses of the users for 21 parameters have been mentioned in the form of star rating given below:

Table 21: Kota EV user feedback star ratings

Product Quality	Weighted Mean	Star Ratings				
Looks	4.6	★	★	★	★	☆
Build Quality	4.6	★	★	★	★	☆
Safety	3.9	★	★	★	☆	
Upfront Cost	2.9	★	★	☆		
Subsidies	2.8	★	★	☆		
Financing Options	2.8	★	★	☆		
Exemptions (Road tax/Registration	3.3	★	★	★	☆	
Operating Cost	4.2	★	★	★	★	☆
After sales service	3.6	★	★	★	☆	
Service Cost	3.9	★	★	★	☆	
Driving on plain road	4.6	★	★	★	★	☆
Driving on slope	3.2	★	★	★	☆	
Top Speed	3.8	★	★	★		
Range	3	★	★	★		
Charging Time	2.6	★	★	☆	☆	
Charging point availability	2.4	★	★	☆		
Loading capacity	3.9	★	★	★	☆	
Ground clearance	3.8	★	★	★	☆	
Life of battery	2.6	★	★	☆		
Resale value of battery	2.7	★	★	☆		
Resale value of vehicle	3	★	★	★		

5

Learning from other States

This section will look at other leading Indian states with a robust EV policy to promote electric vehicles across various categories for both private and commercial use. It will help one to understand the salient aspects of an enabling EV ecosystem that can also be replicated, with some state specific modifications, in Rajasthan.

While promoting Electric Vehicle usage, government generally allocates funds in two ways – in the form of supply side incentives for manufacturers of EV and/or EV components and in terms of demand side incentives targeting the consumers. The weightage however differs from state to state depending on various parameters. The Policies of the select states namely Maharashtra and Tamil Nadu offer fiscal and nonfiscal incentives to fast-track the adoption, promotion and manufacturing of EVs in these states. On one hand, incentives have been designed to realise better penetration of battery electric vehicles into the traditional city mobility plan through creation of demand for the purchase as well as use of EVs in the state.

On the other hand, a set of supply-side initiatives aiming at attracting investment and manufacturers to establish EV manufacturing units have been taken up. In both these states, a collaboration between the public and private players has been the key to successful promotion of electric vehicles. Also, the academia is playing a crucial role in facilitating the R&D works in the EV space.

Maharashtra

The Government of Maharashtra, through its EV policy 2021[39], offered a basket of incentive for two wheelers, three wheelers as well as four wheelers electric cars. The demand incentive offered by the state entitled the consumers to receive an early bird discount of INR5000/kWh of the vehicle battery capacity till 31st of March 2022. All electric vehicles in the state are eligible for road tax exemption as well as an exemption from registration charges as announced by the state EV policy. There are specific provisions for vehicles sold without batteries and distribution of the incentives between stakeholders takes place in such scenario.

To give a fillip to the EV adoption in Maharashtra, the policy has included a provision which states that all EV and associated industries are to be granted equivalent benefits of 'D' class category of 'mega projects' irrespective of the location of manufacturing plant. The state EV policy has a provision to grant incentives for developing different categories such as slow,

[39] https://evreporter.com/wp-content/uploads/2021/07/MH-EV-Policy-2021.pdf

moderate and fast public charging stations or even a semi-public charging station. To promote EV charging infrastructure further, the state also encourages reservation of land for EV related infrastructure within City Development Plans, conferring a 'critical amenity status' to charging infrastructure. There is also an emphasis on creating manufacturing hub in the under-developed zones of the state in order to ensure a balanced economic growth across Maharashtra.

Keeping in mind the need for scrapping old ICE vehicles, the state provides scrapping incentive upon submission of evidence. The state of Maharashtra, in a very unique endeavour, provides 'Assured Buy Back' incentive to the OEMs and three wheelers along with a minimum of 5 years battery warranty. The government of Maharashtra recently facilitated the collaboration between Tata Power and National Real Estate Development Council (NAREDCO) in order to fast-track the expansion of EV charging infrastructure across the state. This pro-industry step by the Government will definitely contribute to the national aim of a speedy transition to environment friendly city mobility.

Table 22: Maharashtra EV Policy

Policy Interventions	Innovative Regulatory Mechanisms	Non-Legislative Steps	Collaborative Efforts
Demand side incentives Fiscal incentives linked to vehicle type are provided to the OEMs by the Maharashtra Govt. in addition to the Fame II incentives, owing to which the end user does not have to go through the process of subsidy claim.	**Supply side incentives** The Government of Maharashtra aims to attract investments to develop a robust EV manufacturing and R&D ecosystem in the state. Hence, it **provides all benefits under 'D+' category of mega projects/other categories to these industries** irrespective of location of the manufacturing unit in the state	Urban local bodies shall be encouraged to provide **lane and parking preferences to EVs**	The government of Maharashtra recently **facilitated the collaboration between Tata Power and National Real Estate Development Council (NAREDCO)** in order to fast-track the expansion of EV charging infrastructure across the state.
All the EVs sold in the state are **exempted from road tax and registration fees** under this policy. Also, **no permits required for e-autos** as per Ministry of Road Transport and Highways' notification dated 18th October, 2018[40]	**Incentives on extended battery warranty and buyback agreement** To address concerns about battery life, Maharashtra Govt. provides OEMs additional incentives (to be transferred to the customers within 30 days) for offering a minimum 5- year warranty for batteries through	All institutional and commercial complexes shall **convert at least 25 percent of their total parking spaces to be EV ready** by 2023.	**Government of Maharashtra, in partnership with relevant/interested OEMs and service providers, is developing skill enhancement centres** for delivering vocational courses on

40 https://morth.nic.in/sites/default/files/notifications_document/Notification_no_S_O_5333E_dated_18_10_2018_regarding_exemption_to_Battery_Operated_Transport_Vehicles_and_Transport_0.pdf

Policy Interventions	Innovative Regulatory Mechanisms	Non-Legislative Steps	Collaborative Efforts
	the 'Assured Buy Back' incentive		the EV ecosystem. These centres will help train ICE mechanics in repairing and servicing of EVs and charging stations.
EVs eligible for demand incentives under this policy are also eligible for the **scrappage incentive** which is reimbursed by the Maharashtra Govt. This incentive ranges from INR7,000- 25,000 depending on vehicle type.	Maharashtra Govt. **encourages fleet aggregators to include electric vehicles in their fleet,** as per the Motor Vehicle Aggregator Guideline 2020[41] issued by Ministry of Road Transport and Highways.		
Public and semi-public charging stations are eligible for demand incentives of up to INR10,000 for slow and up to INR5 lakh for fast charging stations			
Property tax rebates to residential owners for installing private charging infrastructure within their premises.			

Tamil Nadu

Leveraging its existing locational advantages of being the automobile manufacturing hub for a long time, Tamil Nadu government has incorporated a number of unique and lucrative incentives to make the state as the preferred destination for all EV manufacturing facilities. Along with offering 100 percent state GST reimbursement (to be given for sales by manufacturers till 2030), there are other provisions 100 percent electricity tax exemption and 100 percent stamp duty exemption etc..

For those cases where total reimbursement of SGST is not applicable, the state government has made a provision for 15 percent capital subsidy on eligible investment made till a certain date over a period of 10 years. Similarly, 20 percent capital subsidy is available for EV battery manufacturing units in the state. There are also special provisions for the MSME units

41 https://morth.nic.in/sites/default/files/notifications_document/Motor%20Vehicle%20Aggregators27112020150046.pdf

engaged in the EV space including an increased interest subvention at 6 percent on loans taken from the Tamil Nadu Industrial Investment Corporation (TIIC).

In a bid to generate livelihood options in the EV sector, the government announced reimbursement of employer's contribution to the EPF for all new jobs created in this space. Additionally, there are 'one-time re-skilling allowance' given for the existing automobile manufacturing firms for each employee working in the production line. A provision for 15 percent subsidy while obtaining land from state government agencies like State Industries Promotion Corporation of Tamil Nadu (SIPCOT) or Small Industries Development Corporation Limited (SIDCO) on the total cost of the land has been included in the policy. To ensure a balanced growth across different districts of the state, a 50 percent subsidy on any investment in the EV sector in the southern districts of Tamil Nadu has been offered by the policy.

In order to implement a long-term e-mobility plan, Tamil Nadu is also putting emphasis on developing a robust charging infrastructure across the state. To counter the challenges pertaining to charging infrastructure, its EV policy has incorporated provisions for deploying charging stations at various public sites. Also, government departments like the Greater Chennai Municipality Corporation have started using electric vehicles for the departmental activities such as for collecting solid wastes from houses across the city and dedicated charging stations have been established with the help of private players for facilitating such steps.

The Tamil Nadu Government through its EV policy also decided to introduce an Open Permit System for the approved E-autos. Owing to the political buy in and good investment climate, the Tamil Nadu government could get a number of investment commitments in 2021 from the leading brands like Ola Electric, TVS Electric, Ather Energy, Srivaru Motors etc. The automobile manufacturing hub at Hosur has been able to efficiently leverage its proximity to the IT hub in Bangalore where extensive research and development activities take place. Going a step forward, the Tamil Nadu government has also announced various additional incentives for making the EV sector thrive in the coming days. These interventions include but are not restricted to - replacing certain percentage of public buses by E-buses, providing a Single-Window Clearance facility, amending building and construction laws as per the requirements, earmarking parking space in the commercial buildings for EVs etc..

Table 23: Tamil Nadu EV Policy

Policy Interventions	Innovative Regulatory Mechanisms	Non-Legislative Steps	Collaborative Efforts
All the EVs sold in the state are **exempted from road tax and registration fees** under this policy up to 30.12.2022. Also, **permits for EVs are also waived** up to 30.12.2022.	EV related and charging infrastructure manufacturing industries in the state that obtain land from SIPCOT, SIDCO and other governmental agencies are given a **15 percent subsidy on cost of land and 50 percent subsidy if investment is in southern districts** up to 31.12.2022.	To attract investments by OEMs, the govt **encourages creation of EV parks** in major auto-manufacturing hubs.	The Tamil Nadu Govt. **in partnership with Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) will invest in setting up charging stations**.
100 percent SGST reimbursement on all EVs manufactured, sold and registered for use in the state. For intermediate products used in EV manufacturing and charging infrastructure, where SGST reimbursement is not possible, **a capital subsidy of 15 percent** will be given on eligible investments over 10 years.	EV related and charging infrastructure manufacturing units are given an employment incentive in the form of **reimbursement of employer's contribution to EPF** for all new jobs created up to 31.12.2025.	**EV Venture Capital Fund** to be created by Tamil Nadu Govt. to offer financial support to EV start ups	The Tamil Nadu govt. is in talks with the Higher education department to redesign the curriculum in Engineering and Polytechnic colleges to **update mechanical and automobile courses to include the EV industry**. Apart from this, short term courses will be introduced in select technical institutes which will be designed in consultation with EV OEMs.
EV related and charging infrastructure manufacturing industries in the state are given **100 percent exemption on electricity tax bill** up to 31.12.2025	MSME units engaged in the EV space are given an **increased interest subvention of 6 percent on loans** taken from the Tamil Nadu Industrial Investment Corporation (TIIC)		
At least **10 percent of parking space is reserved for EVs in commercial buildings** like hotels, shopping malls, cinema etc.			

6

Impact Assessment

This project started with the objective of identifying current supply and demand side gaps as well as various policy level interventions that could be enforced by the state-level authorities to ease the transition to (EVs) in the state of Rajasthan. This section aims to assess the impact generated by this project on the overall EV ecosystem of the state, trace the policy changes envisaged and track the outcomes achieved.

1. Impact of the project in the overall EV ecosystem

To measure the impact of the project, stakeholders were grouped into two broad categories:

1.1 Existing EV users

A positive word of mouth is an effective way for encouraging EV adoption amongst the general population. Consumers usually provide positive feedback when they are satisfied with any product and in some ways this feedback influences others and helps build a positive public opinion. In order to capture these satisfaction and dissatisfaction levels, 311 user surveys were carried out and their responses were recorded across selected attributes of EVs. These responses formed the basis of our awareness generation campaigns as it helped us to get a better understanding of the existing EV scenario in Rajasthan.

1.2 Supply Side and Demand side Stakeholders

A total of 102 stakeholder consultations were carried out with varied set of stakeholders (supply side and demand side) across 05 major cities in Rajasthan. These stakeholders ranged from manufacturers (about 39 percent of total supply side stakeholders interviewed), dealers (about 27 percent of total supply side stakeholders interviewed) who were also providing repair and after sales service to their customers, a few EV-financiers and charging station operators, fleet aggregators (about 21 percent of total demand side stakeholders interviewed). The inputs from these stakeholders were captured under 39 factors on the supply side and for 37 factors on the demand side within the PESTEL framework to measure the relative importance of each factor for each of these stakeholders. An exhaustive inferential analysis was then performed to categorise the factors into 03 broad classes: a) factors requiring immediate attention, b) factors requiring a tactical approach and c) factors requiring a timely and strategic approach in order to accelerate the adoption of EVs in Rajasthan. In order to address the factors requiring immediate attention, an awareness generation activity was

designed to highlight the benefits of EVs and personal level consultations were carried out to address the misinformation/ myths.

1.3 Awareness Generation

The awareness generation campaign was designed based on the issues highlighted by the 311 user interviews as well as 102 consultations conducted with supply and demand side stakeholders.

On analysing the data, it was observed that lower operating costs of EVs was main selling point of EVs while, lack of charging stations and range anxiety were the main barriers to large scale adoption of EVs in Rajasthan. These two factors were the main themes for our awareness generation campaign wherein we tried to dispel concerns regarding these two factors and more by directly engaging with people during leaflet distribution.

1.3.1 Physical Awareness Campaign

In order to address the immediate issues emerging from data analysis and propagate the benefits of EVs, a campaign consisting of two electric rickshaw was arranged on which we covered almost all major junctions in the city. Suggestions from locals were also welcomed to ensure maximum visibility and engagement in our campaign. The route covered important and commonly frequented public places such as bus stops, parks, malls, major markets etc. within the city.

The following table provides a detailed set of activities carried out in our awareness campaign in all five cities of Rajasthan.

Table 24: City wise Details of Physical Awareness Campaign

S. No.	City	Banners for campaign	Wall posters	Leaflets distribution/ personal consultations	Stickers
1	**Jodhpur**	6	200	400	30
2	**Udaipur**	6	200	400	30
3	**Kota**	6	200	600	30
4	**Jaipur**	6	200	450	30
5	**Alwar**	6	200	400	30

1.3.2 Digital Awareness Campaign:

In order to supplement the physical campaign and ensure its sustainability, a digital campaign was organised in parallel. The two campaigns were linked using a mascot named “Buddhi GV” representing the modern Rajasthani demography which is upholding traditional culture all the while embracing modern culture and technology. Additionally, a website was created for the digital campaign wherein all useful information related to EVs - such as availability of

charging stations, EV-subsidies and schemes announced by the state and central governments, digital stories containing snippets from our interactions with different stakeholders were listed for easy reference. The posters, leaflets and banners used in the physical campaign carried QR codes that linked them to the digital campaign. This two-pronged strategy, also helped us disseminate our digital stories to potential EV buyers which we believed would certainly influence EV demand.

The following table shows the number of views garnered for each of our city specific digital stories-

Table 25: City wise Details of Digital Awareness Campaign

S. No.	City	Youtube links	Views as of 16.07. 2022.
1	Jodhpur	EV-olution in Rajasthan - Episode 1 (Jodhpur) - YouTube	597
2	Udaipur	EV-olution in Rajasthan - Episode 2 (Udaipur) - YouTube	374
3	Kota	EV-olution in Rajasthan - Episode 3 (Kota) - YouTube	226
4	Jaipur	EV-olution in Rajasthan - Episode 4 (Jaipur) - YouTube	442
5	Alwar	EV-olution in Rajasthan - Episode 5 (Alwar) - YouTube	623

2. Change in Policy Landscape:

CUTS has been actively engaged in the electric mobility sector for the past few years. The policy recommendations made by CUTS have been accounted for and successfully incorporated in the draft EV policy of Rajasthan.

As a follow up, the organisation will continue with its advocacy for better policy outcomes through research and awareness generation programmes with necessary participation from relevant stakeholders, partnering with other civil society organisations that are active in EV-space.

3. Tracking Project Outcomes:

The following outcomes are envisaged as a result of this project:

a. **Government Stakeholders:** Better informed and sensitized state-level authorities regarding the need for a well-designed EV policy and their key roles and responsibilities in facilitating an E-mobility transition in the state.

b. **Supply-Side Stakeholders:** Increased traction amongst industry and corporate stakeholders at the state level, regarding policy practices that can potentially generate better penetration of electric vehicles and better utilization of these policy practices.

c. **Demand-Side Stakeholders:** Increased awareness amongst different categories of EV users at the state level, for enhanced adoption and effective policy.

The project has developed and enhanced the level of awareness on EVs among the demand side stakeholders through a well-designed awareness generation strategy which involved a tactical and long-term approach.

The project has been successful in bringing ground level insights by organising consultations with dealerships, which acts as an interface between the consumers and the manufacturers. To bring traction among the supply side stakeholders at the state level, a dedicated webpage has also been created as part of the project where information related to EVs such as policies, and incentives has been listed in Hindi for ease of understanding.

To develop the EV ecosystem in Rajasthan, the state has indicated responsibilities for various departments such as department of transport will be the nodal agency for the policy related aspects. Similarly, department of industries will be responsible for arranging funds for providing incentives to the electric business setup. Department of energy will facilitate setting up charging infrastructure across Rajasthan. Further, department of finance will be responsible for convergence of cross departmental funds and department of urban development will undertake suitable amendments to the building bylaws and facilitate development of charging infrastructure. Representative from these departments were invited for a round table conference in October 2021 to gather information related to developments within these departments. In addition to this, engagements with government officials were made on a continuous basis during stakeholder consultation in the five cities. The engagement will further continue on a regular basis as and when needed.

7

Way Forward

Greenhouse gases are the major contributor to climate change and their reduction is necessary for mitigating climate change. CO2 is a primary GHG and human activities are accelerating its emission. Transport sector is third highest carbon emitting sector after power and industrial sector. It is responsible for 13.5 percent of the country's energy-related CO2 emissions, with road transport accounting for 90 percent.

Electric vehicles have the potential to transform the transport sector not only in India but also around the world, by drastically reducing carbon emissions and clearing the way for significant climate progress. Electric mobility comes with zero or ultra-low tailpipe emissions of local air pollutants and much lower noise thus contributing to environmental sustainability. When coupled with the decarbonisation of the power sector, electric vehicles would also provide major contributions to keep the world on track to meet its shared climate goals.

The Electric Vehicle industry in India is lagging behind, with less than 1 percent of the total vehicle sales as compared to other economies. By being one of the most innovative clusters for the automotive sector, it has the potential to provide a major boost to the economic and industrial competitiveness of the country which in turn can attract investments. Currently, Indian roads are dominated by conventional vehicles running on petrol and diesel and have approximately 0.4 million electric two-wheelers and a few thousand electric cars only. The Indian EV industry is facing various barriers due to challenges posed by cost, infrastructure, lack of standardisation, etc. The government of India has undertaken several initiatives to promote the manufacturing and adoption of EVs in India, and with their support Electric vehicles have started penetrating markets in India.

Rajasthan has introduced an incentive package of INR40 crore for EVs for 2022-23. The budgetary support will be utilised to reimburse goods & service tax applicable on EVs with a bracket of INR5,000-10,000 for two wheelers and INR10,000-30,000 for four wheelers. The state has a growing EV ecosystem which is in need of a holistic and comprehensive policy to accelerate manufacturing and adoption. The scope of Rajasthan's EV market growth rests on availability of capital for original equipment manufacturers, battery manufacturers, charging point operators as well as improvements to infrastructure and diversified options for consumers.

On the basis of the survey of stakeholders which comprised of respondents from supply side (Dealers, EV manufacturers, battery manufacturers etc.), demand side (Fleet Aggregators, owner of small businesses) and users (Driving for personal use) and analysis carried out afterwards, some key insights were obtained, acting upon which, can contribute towards rapid EV adoption in Rajasthan. These have been further categorised into separate timeframes depending on the urgency with which they have to be addressed i.e. short term, mid-term and long term focus.

The research report based on the exhaustive analysis of PESTEL parameters highlights the immediate concerns impeding the growth of EVs in the state. The findings from this report will be showcased to policymakers and stakeholders through events, round table conference, meetings etc. to create a compelling environment for comprehensive policy formulation which addresses the major factors responsible for EV adoption among consumers and development of an effective manufacturing and aftersales ecosystem.

The digital stories created to spread awareness and impact of the campaign in the five cities will be evaluated based on increase in sales over a period of time. Similarly, the web page created under this project can be a guiding tool for consumers in buying EVs by providing information on subsidy available, new policy level interventions and dealership enquiries. For industries, this report can help as evidence to push for an efficient policy and regulatory framework that can attract capital investment in this sector.

Table 26: Actionable Insights from various Stakeholders Surveyed

Timeframe Stakeholder Type	Short Term Focus (0-1 Year)	Mid-Term Focus (1-2 years)	Long Term Focus (2 Year onwards)
Supply Side Stakeholder	**Focus on easing the process of subsidy delivery:** As found out from survey of supply side stakeholders as well as users, subsidy matters a lot in the purchase of electric vehicles. However, there is a delay associated with processing of subsidy offered by the Government of Rajasthan. In order to remove the customer dissatisfaction, this should be given a top priority which will lead to quick	**Standardization of battery connector and battery:** NITI Aayog has come up with a draft battery swapping policy in April 2022 with an objective to facilitate battery swapping for 2W and 3W vehicle category. The prerequisites for effective implementation of this will mean standardisation of battery as well as connector. Government should try to bring all the manufacturers on the same	**Focus on Indigenization:** The government of Rajasthan should prepare a roadmap for indigenising the electric vehicle by building an infrastructure enabling its development. Currently, China has a monopoly on lithium and cobalt reserves globally leaving a limited supply options for

Timeframe Stakeholder Type	Short Term Focus (0-1 Year)	Mid-Term Focus (1-2 years)	Long Term Focus (2 Year onwards)
	subsidy processing. **Need for a Comprehensive EV Policy:** Government of Rajasthan should speed up the process of releasing a comprehensive EV policy document, which will guide the supply side stakeholders in carrying out future investments in EV ecosystem. This will also remove the uncertainties in the minds of these stakeholders. **Focus on awareness generation:** Recent incidents of fire as well as concerns related to vehicle performance in the extreme temperatures of Rajasthan is making the consumers doubtful on whether to buy an EV or not. A focused awareness drive addressing these issues should be organized on a greater scale which will increase feel good factor about Electric vehicle.	page for standardizing these and facilitating mass scale adoption of electric vehicles. **Effective implementation of model building bylaws:** A sizeable population of the city lives in apartment buildings. They have a concern regarding charging stations. In order to overcome the issue related to charging, provisions related to amendment in model building bye-laws should strictly be enforced so that people living in apartments and other building types can have an electric vehicle.	India. Proper end of life management of batteries will reduce the need of raw material for batteries thus contributing to indigenisation of supply chain. **Scope of renewable based charging stations:** Presently, charging stations are less in number. Again, cost economics and lesser utilization of charging stations will not favour setting up of renewable power based charging stations. Government should plan their phased implementation in the long term horizon.
Demand Side Stakeholders and users driving for personal use	**Focus on Incentives:** Based on the survey conducted for the demand side stakeholders, incentives provided by the governments played a pivotal role in bringing down the cost of electric vehicles. Currently, electric vehicle constitutes 0.45 percent of the total vehicle	**Focus on Payload capacity:** Increasing payload capacity has a lot to do with improvement in battery technology. Investment in Research and development by the manufacturers as well as government institutions will bring better battery technology in the	**End of life management of Batteries and Vehicle:** Although majority of vehicles running on the roads have not completed their useful life, planning and proper management of

Timeframe Stakeholder Type	Short Term Focus (0-1 Year)	Mid-Term Focus (1-2 years)	Long Term Focus (2 Year onwards)
	sold as of 05.07.2022. In order to accelerate the EV adoption, government should continue giving incentives to the customers so that it reaches at least a sizeable number (say, 2-3 percent of total vehicle sold). **Focus on Build quality:** Electric vehicle technology is still at initial development stage. In order to win the users' confidence, focus should be on improving the build quality. This will improve the user experience, which in turn will create a positive impact on other potential buyers. The immediate area of focus should be on performance in different terrain and temperature condition. **Focus on Safety:** While rapid adoption of electric vehicle is an imperative, it should not be at the cost of compromising the safety of the users. As observed during the awareness campaign phase of this project held during the month of June, there were a lot of negative sentiments related to EV due to the fire incidences happening all across India. Government should come up with stringent regulations related to quality so that these	market which will increase the payload capacity for vehicles used for commercial purposes. **Focus on EV Finance:** The need for financing is not an immediate cause of concern for these business houses. They preferred to buy the vehicle on cash. However, governments should focus on encouraging the public sector banks as well as private sector banks to provide financing at cheaper rates. **Focus on After sales service:** Currently, major players in the EV domain have usually one service centre that is mainly located in their dealerships due to economic reasons. However, as the number of electric vehicle will increase on the roads, users will demand more number of service centres in their localities. This will give a good experience to the consumers. **Focus on Public charging Infrastructure:** Most of the businesses surveyed are operating in the daytime. Again the distance covered for performing their business tasks are taken care of with the single charge of the battery. This gives them	electric vehicle and battery is a necessary step. Building a recycling infrastructure around the batteries will help in better utilization of batteries.

Timeframe Stakeholder Type	Short Term Focus (0-1 Year)	Mid-Term Focus (1-2 years)	Long Term Focus (2 Year onwards)
	types of incidences can be reduced or even eliminate from EV sector.	ample time to charge their electric vehicle during the night time. This was probably the reason that they did not felt the immediate need for charging station. However, since the scope of adoption is huge, public as well private players should have a mid-term focus in installing charging stations.	

Annexure

Explanation of Factors involved in the PESTEL framework
Electric Vehicle Demand Influence Survey Form

Political Factors

Sl. No.	Factors	Explanation
1	Rajasthan EV Subsidy	The state government has offered up toINR10,000 for E2W and up to INR20,000 for E3W for vehicles registered from April 1, 2021, until March 31, 2022. Moreover, SGST will be refunded to all EV buyers during this period.
2	Registration Fee Exemption	Ministry of Road Transport and Highway notified in March 2021 to waive off registration charges for EVs under Central Motor Vehicles Rules, 1989. In October 2020, Delhi Motor Vehicles Rules, 2020, an amendment was made regarding the waiver of the registration fee applicable on Battery Operated Vehicles as defined in Central Motor Vehicles Rules, 1989. In Rajasthan, as per interaction with the District Transport Officers in Alwar and Udaipur, a registration fee of INR300 to INR1000 is applicable as per the electric vehicle segment (2W, 3W or 4W). In addition, there is a charge of INR200 for a smart card.
3	Tax Benefits	The GST levied on EVs is at the lowest slab of 5 per 0cent versus 28 percent for ICE-powered vehicles. In July 2021, Rajasthan Government announced EV subsidies under which there will be reimbursement of SGST for vehicles purchased between April 01, 2021, to March 31, 2022. When paying off an EV loan, a total tax exemption of up to INR 150,000 is available under section 80EEB of the Income Tax Act, 1961-2021. In addition to this, there is a waiver of road tax, green tax, toll taxes, and permit fees for all segments of electric vehicles.

Economic Factors

Sl. No.	Factors	Explanation
1	Upfront Cost of Vehicle	The initial cost of a vehicle is one of the major factors influencing the demand for EVs. After incorporation in central and state EV subsidies, the 2W and 3W segments of EVs has almost achieved price parity with their respective petrol vehicle variant. The initial cost of e-cars is still very high (around 43 percent) compared to its equivalent petrol variant.
2	Availability of Financing Options	There are private financing options for EVs by HDB financial services, IDFC, and Urban Living Finance Pvt. Ltd, and Bajaj Finserv. In December 2021, Hero Electric tied up with HDB Financial Services to offer easy financing options to purchase electric scooters. The collaboration will enable customers to avail hassle-free loans with minimum documentation on their desired electric scooter. Furthermore, HDB will offer eligible customers the benefits like attractive interest rates, flexible tenure options, and affordable EMIs.
3	Rate of Interest	Financing options for EVs are limited as of now. In the case of two-wheelers and 4 wheelers, loans can be availed from the private and public banks depending on the customer profile. The rate of interest for these banks ranges between 7-12 percent. For 3 W, banks are reluctant to provide financing because of the perception of being risky customers. Therefore, e-rickshaws are being financed by private financiers. The interest rates lie beyond 12 percent for these types of customers.
4	Operating Cost of Vehicles	The operating cost of ICE vehicles is around 6 times that of EVs (here petrol price is taken as INR110/L, and electricity cost is INR10/unit)
5	Availability of after sales services	There is a combined business of sale, service and spare parts with most of the dealers in Rajasthan like Ather, Warivo and Hero Electric. Some new entrants are planning to organise service camps in the neighbouring cities once in the six months when more than ten vehicles will be there in that city. Currently, the EV users of neighbouring cities have to bear additional charges for the conveyance of the mechanic. Some old EV dealers who have been in the market for four to five years now have already started to train the Personal Garage Owners (PGOs) of ICE vehicles for the primary service of electric vehicles. They have trained 20-30 mechanics so far in Bhiwadi & Alwar.

Sl. No.	Factors	Explanation
		Therefore, there is a chicken-egg dilemma in case of service centres. The expansion of service network depends on the number of EVs in a city.
6	Maintenance Cost	There are fewer parts in an EV than in an ICE, thus EVs require lesser repair and maintenance. In case of any damage or fault, the component of EVs is required to be replaced. The main EV components, such as motor, controller, battery and portable charger come with a warranty of one to three years. The OEMs focuses on increasing the warranty of these components which will assure low maintenance cost for longer time period.
7	Resale value of vehicle	The secondary market for electric cars and 3-wheelers is in nascent stage. Therefore, there is uncertainty regarding the resale value of these vehicles. In the electric 2-wheeler segment, some OEMs like Ather Energy have come up with a facility of buyback that assures the resale of vehicle to the dealer within three years at around 60 percent of purchase price.
8	Life of Battery	EV battery is a crucial component of an electric vehicle. The life expectancy of Li-ion battery is around six to eight years, and of lead acid battery is two to three years. The dealers provide a warranty of three years for Li-ion batteries and six to twelve months on lead acid battery.
9	Cost of Battery	Battery holds around 40 percent of the initial cost of vehicle. The price of 1 kWh lithium-ion battery pack is somewhere between INR15,000 to INR20,000. An e-rickshaw with lead acid battery is INR30,000 to INR50,000 cheaper than that the vehicle with Lithium ion battery of equivalent capacity.
10	Resale Value of Battery	The scrap value of lead acid battery is INR80 per kg. An e-rickshaw holds the weight of around 32-35 kg of battery pack. Scrap value of lithium ion battery is higher of around INR1000 to INR1200 per kg. The Li-ion batteries weigh one-third less and provide 50 percent more energy than the lead acid batteries
11	Payload Capacity	Payload capacity is the weight a vehicle can safely carry in addition to its empty weight. It includes driver's weight plus the weight of passenger or goods.

Sl. No.	Factors	Explanation
		It is one of the major deciding factors for the commercial vehicles as it directly impact the profit earned through the vehicle.
12	Availability of charging stations	There is chicken-egg dilemma for installation of charging infrastructure. On one hand the adoption of EVs is less due to less number of charging stations in a city. On the other hand the revenue generation for setting up charging station with the current number of EVs in the market is the major concern of charging station operators. Though 80 percent of the time charging is done at home or workplace, but to tackle the issues of range anxiety and charging point anxiety the visibility of public charging points is important. Hero Electric in this regard has put-up their 15A charging board at the retail shops, restaurants, shopping complexes etc.
13	Availability of Substitutes	While, both CNG and EVs have comparable upfront and running costs - CNG vehicles have been around longer than EVs. Hence, there are more refuelling stations and service stations for CNG due to which EVs face a lot of competition from CNG vehicles which also have lower emissions compared to ICE vehicles.

Social Factors

S. No.	Factors	Explanation
1	Peers' Influence	This includes the perception of people for any new technology. Some are excited to try out new things while some are afraid due to uncertainty of new technology. The peer influence and word of mouth for a new technology plays a vital role in acceptance for a new technology.
2	Knowledge and Awareness of EVs	The perception and knowledge of consumers for EVs is important factor in EV adoption. With advancement in battery chemistry from lead acid to lithium ion, the range, capacity and charging time has improved. Still, there is negative perception of people for EVs due to the factors like the long charging time, short range of vehicle and performance of the vehicle on slope. To increase the awareness of people, the OEMs have come up with an idea of an experience centre in place of conventional vehicle showroom, like in case of Ather Energy. At the experience centre the sales person understands the commuting need of customer as per his/her daily travel pattern and then suggests the EV model accordingly. The internal body parts like chassis, motor and battery are also displayed at these centres to make the potential consumers learn about the EV parts and how it differs from the conventional vehicle.
3	Resistance by current ICE vehicle users	In the case of the passenger 3W segment, the passengers prefer EV due to their low fares as compared to ICE vehicles. This adversely impacts the income of existing conventional auto owners. Therefore, these auto unions tend to resist anyone opting for EVs.
4	Aesthetic Appeal	The aesthetic of vehicle is an important decision making factor for the potential vehicle buyers. OEMs are trying new things with EVs in context of their looks in terms of their size. Despite its low height, the acceptance of micro-mobility options like yulu e-bike is high. On contrary the Monster model of Joy -bike is a repellent for potential EV users due to its low height.

Technological Factors

Sl. No.	Factors	Explanation
1	Top Speed	In two wheeler segment, there is 1) Battery operated two wheeler with speed less than 25 kmph, commonly known as low speed vehicles which are quite common in EVs as it does not require registration and licence; 2) L1 category vehicles with maximum speed up to 45 kmph; and 3) L2 category vehicles with speed above 45 kmph. In the three-wheeler segment there is 1) E-rickshaw and e-cart with maximum speed up to 25 kmph; and 2) L5 category vehicles with maximum speed above 25 kmph. The 2Ws and 3Ws with top speed up to 25 kmph are new in EVs and therefore there is a myth that EVs have lower top speed than ICE vehicles. EVs have a higher starting torque than ICE counterparts and accelerate faster. As far as speed is concerned, EVs available in the Indian market have top speeds depending upon the model/category selected.
2	Gearboxes	One of the biggest differences between the EVs compared to conventional vehicles is the absence of a gear box. Therefore, EVs are easier to drive than the conventional vehicles. But those who like driving cars with a manual gearbox, are likely to miss the feeling of the car working its way up or down through the gearbox.
3	Smart phone applications	The EVs are coming with better smartphone applications than ICE vehicles, especially the 2W and 4W segments. One can now unlock their EVs, check battery status, navigate and many more things with the help of their mobile phones. Some people are excited about these features, while some are worried about whether they will be able to keep up with the smart features or not due to lack of knowledge.
4	Range	The range of EV is continuously improving. Still, it is one of the chief pain points for customers deciding between conventional and electric vehicles.
5	Charging Time	Acceptance of EVs requires a huge behavioural change in consumers as people are so used to the benefits of conventional ICE vehicles. One of the main differences for users is the long charging period in EVs, compared to the few minutes required to fuel up a conventional car at the

Sl. No.	Factors	Explanation
		gas or petrol station. Even fast charging takes about an hour to reach a full charge, while slow/moderate charging takes one to six hours to charge from 0-80 percent. Fast chargers are mainly used to charge electric 4-wheeler, and the charging rate is also dependent upon Cell Chemistry.
6	Build- Quality	The build quality is how well all parts of a vehicle are put together. In EVs, apart from replacing damaged components, the major service required is tightening body parts that frequently get loose due to poor road conditions. Therefore, the perspective of potential EV users on the build quality of the vehicle is an important factor, as the better the quality, the lesser the requirement of repair and maintenance.
7	Vehicle Safety	It indicates the safety of people in the vehicles involved in the crash. The certification agencies, Automotive Research Association of India (ARAI), and the International Centre for Automotive Technology (ICAT) do rigorous vehicles' front side and rear crash test.
8	Electrical Safety	The incidents e of fire and explosion risk in batteries have raised safety concerns while opting for EVs. Most EV manufacturers address the issue with their efficient and intelligent Battery Management Systems (BMS), which perform the task of cooling, heating, insulation & ventilation of Batteries, etc. Also, the certification agencies, Automotive Research Association of India (ARAI), the International Centre for Automotive Technology (ICAT) does rigorous testing for overcharge, short circuit and vibration.
9	Performance in different terrain and temperature condition	People perceive that EVs are slower, have a short range, and have lower payload capacity than conventional vehicles. All these concerns heighten when thinking about the performance of EVs on a slope
10	Charging Facility at Home	With EVs one has the convenience of charging the vehicle at home. The problem of waiting at busy fuel station to and from workplace can be easily overcome with electric vehicles. One just needs to plug in her/his vehicle at home charger for 4-5 hours before she/he plans to go.
11	Cyber security threats	Cyber security becomes more relevant in the automotive context, since systems and sub-systems related to the safety of vehicle users against unauthorized access, and malfunction shall be affected. Nowadays, cars are connected to several IT devices like mobile phones, computers, WI-FI routers etc. Hence there is a possibility of a hacker interfering with vehicle safety systems or stealing sensitive information

Environmental Factors

S. No.	Factors	Explanation
1	Zero Tail Pipe Emission	Driving an electric vehicle can help to reduce carbon footprint because there will be zero tailpipe emissions. One can reduce the environmental impact of charging her/his vehicle further by choosing renewable energy options for home electricity.
2	Limited Noise While Driving	EVs are quiet, so they reduce the noise pollution that traditional vehicles contribute to.

Legal Factors

Sl. No.	Factors	Explanation
1	Reserved Parking Space & Green Zones	In February 2019, amendments have been made in the Model Building Bye-Laws, 2016, including the EV charging infrastructure provisions. The current plan is to reserve 20 percent parking space in the premises of various building types for electric vehicles. The bye-laws also specify the requirement of the charging infrastructure at these premises as per the type of building (residential, commercial etc.) and the segment of an electric vehicle. Various state governments are planning to develop the green zones at selected locations of tourism, heritage, ecologically sensitive areas such as National Parks, Forest & Wildlife Reserves. Only green number plate vehicles, i.e., EVs will be allowed at these green zones. Rajasthan government allocated 60 Acres of land in Karoli to deploy EV zone. There is a plan to develop the country's first EVs only area at the Kevadia district of Gujarat.
2	Reserved Lane	It means dedicated lane only for EVs, like there is a separate lane for Bus Rapid Transport System (BRTS) in Ahmedabad. This might attract “time is money” segment of people to purchase EVs, and will also increase the range of vehicle by minimizing the loss of charge in the traffic congestion. An upcoming Delhi-Mumbai Expressway is an example of this where the government in planning to construct a dedicated four lanes for electric vehicles.

Sl. No.	Factors	Explanation
3	Internet Ban	The charging stations at public places are mostly automatic with online payment system. During the cases of internet ban in the state due to the exams, riots, elections etc. the stations become non-functional.
4	Registration of EV	There are two -types of electric two-wheelers. High-powered ones and low powered ones. The low powered electric scooters and motorcycles that are equipped with a 250 watt motor and limited to a top speed of not more than 25 kmph, can be rode without a driving license, vehicle registration and insurance as well.

Electric Vehicle Supply Side Stakeholders Survey

Political Factors

Sl. No.	Factors	Explanation
1	Rajasthan EV subsidy	Subsidies up to INR10,000 for E2W and up to INR20,000 for E3W have been offered by the state government for vehicles registered from April 01, 2021, until March 31, 2022. Moreover, SGST will be refunded to all EV buyers during this period.
2	Concession on land for renewable energy based charging station	On September 28, 2021, the state government had passed order to allot the government land at 50 percent concession for the first 500 renewable energy-based EV charging stations. The provision to allot land is made under Rajasthan Solar Energy policy, 2019 and Rajasthan Wind and Hybrid Energy Policy, 2019.
3	EV Policy of Rajasthan	In the Roundtable conference held on October 01, 2021 by CUTS International on "Accelerating Electric Vehicle Adoption in Rajasthan", it was claimed that the EV policy of Rajasthan would be out soon. Under the policy, there are plans for cluster-based development of the e-mobility sector in the state that include provisions for auto-component manufacturing, battery manufacturing and swapping, electronic component manufacturing and relevant skill training facilities being set up in close proximity.
4	Rajasthan industrial development policies and scheme	Auto & auto components are one of the thrust sectors of Rajasthan industrial development policy. In the Roundtable conference held on October 01, 2021, by CUTS International on "Accelerating Electric Vehicle Adoption in Rajasthan", the Executive Director mentioned extending the benefits of the Rajasthan Investment Promotion Scheme (RIPS), 2019 for EV manufacturing. The focus will be on sectoral development by making EV Zones, emphasising the EoDB, facilitating charging stations and swapping infrastructure in the RIICO Industrial area, additional interest subsidy, and capital subsidy.
5	RERC electricity tariff order for EV charging stations	In the draft Sue-Motu order by RERC for EV charging tariff, for LT connection, the charges are INR6 per unit plus fixed charges of INR40 per hp per month, and for HT connection, the charges are INR6 per unit plus fixed charges of INR130 per KVA per month. Beyond this, there is a ‘time of day (ToD)’ rebate of 15 percent on power charges for recharging EVs at night from 11:00 pm to 6:00 am.
6	FAME II Scheme	FAME II was launched with a budget outlay of Rs 10,000 crore in April 2019 to support 7,000 e-buses, 500,000 e-three-wheelers,

		55,000 e-passenger vehicles and a million e-two-wheelers Under this scheme, 191 charging station has been sanctioned for Rajasthan in Kota, Ajmer, Jaipur, Udaipur and Jodhpur.
7	Allowing subsidy on lead-acid battery vehicle in Rajasthan	The incentives for EVs with lead-acid batteries have been withdrawn under the FAME II scheme, and the central subsidies are available now only for EVs with advanced battery chemistry. On the other hand, the EV subsidy released in Rajasthan is also applicable on lead acid battery. Therefore, there is a non-alignment between the Central and state policies for EV adoption.

Economic Factors

Sl. No.	Factors	Explanation
1	Ease of availing subsidy for end consumers	The central subsidies on EVs are already applied when it reaches the end consumer. In contrast, for the state subsidy, the benefit is reimbursed to the consumers once the registration on the vehicle is done. The registration process for claiming state subsidy is carried by the dealer, which includes submitting the documents and bank details of the consumer to the Regional Transport Office. The process of claiming the subsidies sum claimed by dealers for initiating the process and the time of receiving the benefit is a concern here.
2	Innovative Business Models	To drive up the adoption and manufacturing of EVs, the entire automotive value chain will need to continue making substantial investments in R&D, setting up production capacities and developing an ecosystem that solves the issue related to range anxiety and charging infrastructure. Innovative business models would be necessary, especially for the players like the charging station providers, who have to wait longer to start making returns. In the Roundtable conference organized on October 01, 2021, by CUTS International on "Accelerating Electric Vehicle Adoption in Rajasthan", it was suggested to adopt the business model to allotting the land on revenue sharing basis for charging stations. Revenue sharing implies sharing profit and loss and capital cost equally or within the predefined context among partners.

Sl. No.	Factors	Explanation
3	Financing options	The ease of buying an EV through affordable and accessible financing options is the demand of every potential EV buyer. There is limited availability of financing instruments in the Indian EV market. Therefore, the buyers are forced to choose loans with high-interest rates, low Loan-to-Value (LTV) ratios and shorter repayment periods. Interest rates for EV loans tend to be even higher than those for internal combustion engine (ICE) vehicles. The charge is up to 14-15 percent interest for a commercially operated electric car, compared to 12 percent for a diesel car. The difference is more significant for electric two-wheelers, as the interest rates can be even higher than 20 percent. This adds to the ownership costs for vehicle owners. Apart from these financing concerns related to the procurement of the vehicle, EV owners pay higher insurance than owners of conventional models. Since a vehicle's insurance cost is based on its capital expenditure, the higher the upfront cost, the higher the insurance premiums. Also, the financing and insurance mechanisms for batteries are missing, though it holds about 40-50 percent cost of the EV. There is a need for a financing mechanism for batteries where one can purchase a battery individually and get asset security against any losses.
4	Electric vehicle demand	The supply of EVs in a city is dependent on the demand for EVs. This decides the whole economy of scale that could be achieved by investing in any sector.
5	Electricity tariff	RERC has set up an electricity tariff of INR8/kWh for manufacturing industries. For setting up a new facility or expanding the existing facility, the electricity tariff is one of the major economic deciding factors for the OEMs. Manufacturing industries have to opt for separate connections and tariff also varies, but this step of flat tariff will raise the OEM's interest. Also, the Rajasthan government, in its draft EV policy, specified a flat tariff of Rs.6/kWh for charging stations.
6	Inverted Duty Structure on EVs	The current GST on EVs is 5 percent, while that on batteries is 18 percent and that on components is 28 percent. The state govt has declared the reimbursement of SGST amount to all EV users from April 1, 2021, until March 31, 2022.

Sl. No.	Factors	Explanation
7	Import duty on components	Under the Phased Manner Programme of FAME II, from April 2021 onwards, the import duty on EV components is from 10 percent to 30 percent. The duty is higher for Semi Knock Down (SKD) Units and lower for Completely Knock Down (CKD) units.
8	Testing cost	The testing is required during the R&D phase and the certification. For component testing, the manufacturer has to bear the cost of all specifications of components and the certification is done as per the requirement of the OEM. The testing is sometimes neglected to avoid the testing cost.
9	Maintenance cost of EVs	The maintenance in EVs includes mainly replacing the powertrain components and the tightening of body parts. The frequency of the maintenance required is less as compared to ICE vehicles due to lesser parts in EVs. This impact the business of service centres. On the other hand, there is an additional conveyance charge for the mechanic due to the limited network of service centres.
10	Indigenization	FAME II subsidy emphasises indigenisation of EV components in a phased manner. But due to the low economy of scale, the pace of indigenization is slow.
11	Cap on LT connection	The state has an LT connection limited of up to 50 KW, and beyond this limit, the HT tariff applies to EV charging stations.
12	Availability of charging points	There is a chicken-egg dilemma for the installation of charging infrastructure. The adoption of EVs is highly dependent on the availability of charging stations. The revenue generation from setting up a charging station with the current number of EVs is the major concern of charging station operators.
13	Availability of service centres	There is a chicken-egg dilemma also in the case of service centres. In the case of EVs, the service centres are available at the dealers' showroom only. The expansion of the service network depends on the number of EVs in a city.
14	Availability of EV substitutes (E.g. CNG) at comparable prices	While both CNG and EVs have comparable upfront and running costs - CNG vehicles have been around longer than EVs. Hence there are more refuelling stations and service stations for CNG, due to which EVs face a lot of competition from CNG vehicles which also have lower emissions compared to ICE vehicles

Social Factors

Sl. No.	Factors	Explanation
1	Consumer awareness for EVs	The perception of consumers for EVs is an important factor in EV adoption. With the announcement of EV subsidy in Rajasthan, consumer awareness has increased. Still, people have concerns regarding the high upfront cost of vehicles, long charging time, vehicle range, the vehicle's performance on a slope, and its built quality.
2	Environmental awareness of citizens	Rising environmental concerns have demanded from the transport sector globally to move to cleaner mobility options like EVs. The environmental awareness of citizens is a key enabler for any transition to minimise the impact on the planet's health.
3	Workforce readiness	Electrification in the automotive sector is the biggest technological revolution in decades, and the transition from ICE to EV has demanded a parallel skill transformation of the automotive workforce. The adoption of EVs depends on the readiness of the drivers of this revolution, i.e., how prepared OEMs and their dealer outlets are to sell EVs, the readiness of decision makers in developing an enabling ecosystem for e-mobility multi-stakeholder integration that could lead to collaborative development.
4	Employment generation	Like any change, the transition of the transportation sector from ICE vehicles to EVs will have winners and losers. With an increase in the adoption of EVs, there will be a loss of jobs in the conventional fuel industry of oil and gas. Since EVs have fewer parts and require far less maintenance than conventional ICE vehicles, there will also be a loss of jobs in the auto component manufacturing and the maintenance and mechanics industry. On the other hand, the transition will lead to direct jobs in the auto industry in manufacturing, research and development, and battery manufacturing. Indirect jobs will be created from the installation and maintenance of electric vehicle supply equipment (EVSE).

Technological Factors

Sl. No.	Factors	Explanation
1	Incubation facilities	There are many incubation centres in Rajasthan like the Atal incubation centre, incubations of MNIT, and Manipal. Students are doing innovative research and developing new concept models in EV technology. There are challenges in fabricating these models because innovation is not coming out of labs.
2	Testing facilities (for component and vehicle)	The testing is required during the R&D phase and during the certification. For certification of EVs, there are two agencies in India, ARAI in Pune and ICAT in Manesar, Haryana. The regional testing labs for R&D are an important part of product development.
3	Battery recycling/repurposing facilities	Battery holds 40 percent cost of an EV. Achieving a circular economy by repurposing and then recycling could bring down the cost of batteries. The current recycling and repurposing facilities in the state are currently focusing on the lead-acid batteries in the state. The adoption of EVs with lithium-ion batteries is very low, and the ones that are there have not reached their end of life yet.
4	Advancement in battery chemistry	Advancement in the battery chemistry is aiming for batteries which have lower cost and higher capacity. Advance chemistry cell batteries like Li-ion, NMC, LFP etc. are currently deployed in EVs and the costa associated are rapidly decreasing and expected to be drop to less than US$100 by 2025. In India, FAME II was launched in 2019, stating that ACC batteries would get this subsidy. All the major OEMs started to shift, and this battery chemistry started to take market throughout India and Rajasthan. In addition, the focus is on shifting to materials available in India or with the allies of India. With the advancement of technology in vehicles EVs, mostly E2W, are now coming with a feature of parental control. This feature enables one to track the vehicle's location and can even stop it.
5	Inclusion of AI and IoTs	With the transition from ICE to EV, there is advancement in technology in the automobile sector to make the vehicle more smart, safe, and connected by including Artificial Intelligence and the Internet of Things.
6	Standardisation of batteries	The battery holds 40 percent cost of the vehicle and holds a major portion of an EV. Due to this, standardisation of battery is a challenge for OEMs as it restricts the major portion of them from being unique. On the other hand, standardisation could pave the way for achieving economies of scale, reducing vehicle prices as a whole.

Sl. No.	Factors	Explanation
7	Standardization of charging connector	One of the major hurdles in expanding the network of public charging stations is the lack of standardisation of connector types. Ather, in this regard, has opened the proprietorship of its connector type for other OEMs. This has led to collaboration in the EV sector, as Hero MotoCorp has adopted the Ather's connector type. Economies of scale for EV charger manufacturers and revenue generation for charging point operators are associated with the standardisation.
8	Battery swapping	Battery swapping technology allows one to replace their discharged battery with the charged battery, and the process takes lesser time than that required in the refuelling of ICE vehicles. One company provides battery swapping service in Rajasthan, i.e., HOP Electric Mobility. The company has established two swapping stations for their vehicle in Jaipur city and plans to expand its network to Jaipur-Delhi Highway.
9	Cyber-Security threats	Cyber security becomes more relevant in the automotive context, since systems and sub-systems related to the safety of vehicle users against unauthorised access and malfunction shall be affected. Nowadays, cars are connected to several IT devices like mobile phones, computers, WI-FI routers etc. Hence there is a possibility of a hacker interfering with vehicle safety systems or stealing sensitive information

Environmental Factors

Sl. No.	Factors	Explanation
1	End of life management of vehicle	With every EV entering the market, the end-of-life management of ICE vehicles is currently important. Nitin Gadkari, Minister of Road Transport & Highways, on August 17th, 2021, emphasised the scrappage policy and has requested manufacturers to give a 5 percent discount on new vehicles bought against scrapping old vehicles. The government is taking approvals from state governments for implementing it on a country basis.
2	End of life management of batteries	The dominating lead-acid market in the state has a well-established circle of the end-of-life management of batteries. Due to the advancement of battery chemistry, the market for other batteries like lithium-ion is in a nascent stage.

Legal Factors

Sl. No.	Factors	Explanation
1	Separate electricity connection for charging station	There is a separate category of electricity connection for EV charging. In its draft policy, the Rajasthan government stated the separate electricity connection, billed at INR6/kWh for the charging station. Unlike refuelling at a petrol pump, EV charging is not a feasible standalone process. Therefore, more than one electricity connection has to be at the premises. There are regulatory hurdles in getting more than one type of electricity connection at the property due to theft issues.
2	Waste management rules (such as batteries, components, O&M etc.)	It includes the management of waste generated during the EV and its component manufacturing process and after its end of life. In India EoL management of vehicles and their batteries is a major concern, as the assembly of components is done here rather than manufacturing. As per the scrappage policy of India, end of life age of vehicles is 15 years, whereas in other countries like the UK, Italy, and Germany typical lifespan of the old vehicle was fixed at around 9-10 years, after which it qualifies for scrappage benefits. The Ministry of Environment, Forest and Climate Change drafted rules for managing used electric vehicle (EV) batteries by directing manufacturers and dealers to record and collect the used batteries while placing the new ones.
3	Amendment in Model building by laws	Provision 10.4 has been added in the Model Building Bye-laws 2016, which deals with electric vehicle charging Infrastructure in residential buildings and other buildings, including Group housing.

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