INDUSLAW
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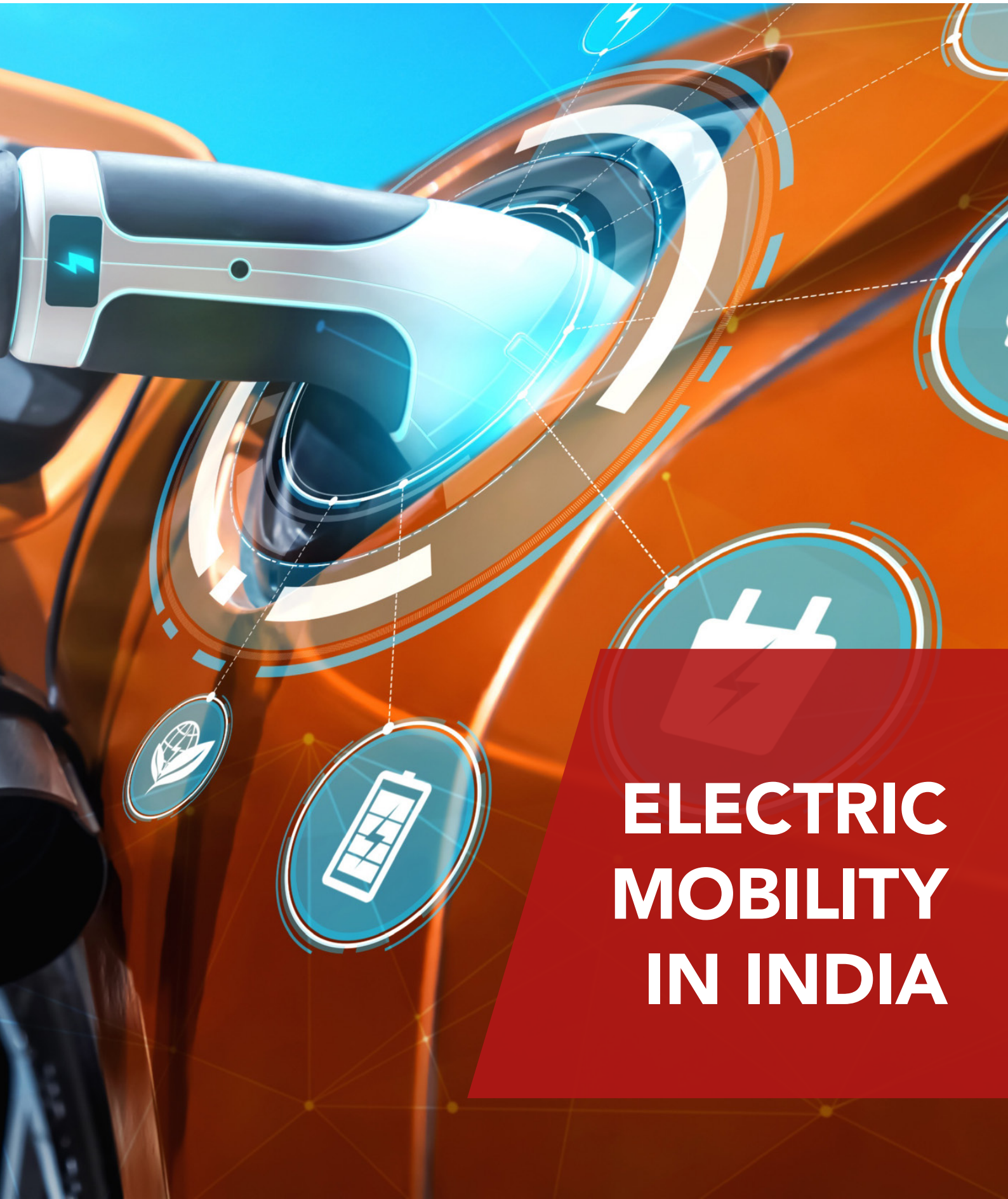
Confederation of Indian Industry



ELECTRIC MOBILITY IN INDIA

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Kartik Ganapathy
Founding Partner
INDUSLAW

FOREWORD

The fight to protect the planet from the effects of climate change would not be impactful without the transition of the automotive industry to green electric vehicles. The Indian Government's focus on decarbonizing its automobile sector has been at the core of the growth of electric vehicle industry. The past few years have been an exciting time in the Indian electric vehicle industry. Market analysis shows that in the year 2022 alone the electric vehicle market in India grew by almost 223% with the addition of approximately 48,000 new electric vehicles. With favourable policies and incentives this figure is expected to grow further in the coming years.

The Indian Government's support to the EV 30@30 campaign could be the much-needed catalyst to the EV industry. In addition to new electric vehicle manufacturing companies, we also see traditional vehicle manufacturers foray into the electric vehicle space, thereby increasing the competition in the market to offer technologically superior options to customers at more compelling prices. The Indian customer also has begun to focus on being more environmentally conscious and are looking for alternates to traditional combustion engine vehicles in newer technologies like electric vehicles, hybrid vehicles and green hydrogen vehicles.

Coupled with this growth in electric vehicles, the development of charging infrastructure is the need of the hour. The efficient implementation of electric vehicle charging infrastructure is crucial to meet the demands occasioned by the growth of electric vehicles. There is also a need to customize the policies and incentives of the government to the unique requirements of the Indian urban and rural markets, so as to further enable a rise in the adoption of electric vehicles across various markets in India.

We expect, with continued efforts on the part of the Government at both union and state levels and all the stakeholders in the e-mobility industry, penetration of electric vehicles will be at par with, and eventually replace, internal combustion engines on the Indian roads. In time, this will also help India realise its goal to reach net zero carbon emission by 2070.

We thank the Confederation of Indian Industry for their support in preparation of this report. We thank all our readers for supporting our attempt to summarize the nuances of the electric vehicle industry through this report.

MESSAGE FROM CII CHAIRMAN

Electric vehicles are the epitome of innovation and sustainability. They represent a paradigm shift in the automotive industry thus, offering a sustainable and efficient alternative to traditional internal combustion engines, reducing emissions, and promoting a cleaner environment. With advanced technology and sophisticated design, electric vehicles provide a seamless driving experience while demonstrating a commitment to a greener future.

Delhi's leadership in the electric vehicle (EV) sector is a shining example of India's commitment to sustainable and green transportation. With the Delhi EV Policy and other initiatives, the city has established itself as a leader in the EV industry, promoting clean transportation and driving the developmental change needed to realise a sustainable future.

Delhi is indeed, the first state in the country to come up with a step-by-step guide to help employers adopt workplace charging of EVs. The Delhi policy aims to improve air quality and establish a comprehensive EV ecosystem in the city. Moreover, Delhi has also become the first state in India to incentivize e-cycles, further promoting clean transportation.

The Confederation of Indian Industry (CII) in Delhi is at the forefront of driving the electric vehicle (EV) revolution in India. Working closely with the Delhi Government, CII Delhi has provided crucial policy recommendations for the adoption of EVs. CII Delhi is also actively generating awareness on the benefits of EVs, hosting insightful workshops, conferences and conducting surveys. With a steadfast commitment to the EV industry, CII Delhi is driving the developmental change serving as a catalyst for the EV industry's success in India. As the EV revolution continues to grow in India, Delhi's efforts will serve as a catalyst for other states to follow, creating a comprehensive and sustainable ecosystem for EVs across the country.

With the continued support of the government, industry, and society, India can realise its vision of a green and sustainable future powered by electric vehicles.

Puneet Kaura

Chairman - CII Delhi State &

Managing Director & CEO

Samtel Avionics Ltd.

ELECTRIC MOBILITY IN INDIA

1. INTRODUCTION

India is heavily reliant on various forms of fossil fuels to operate its industries, power plants and vehicles.[1] In addition to the pollution caused by the use of fossil fuels, these non-renewable energy sources are being continuously depleted with the increase in population and rapid industrialisation. Given the challenges and consequences of such depletion and the growing concerns of climate change, India is aggressively looking at adoption of other eco-friendly alternatives for energy.

Transportation is a significant contributor to total emissions, and therefore the poor air quality of various cities and states in India.[2] There has been a rapid increase in the production and use of automobiles every year. For emerging economies like India, where accelerating economic expansion is driving the need for transportation, the urgency to discover viable sustainable mobility alternatives is also amplified.

To reduce the dependability on non-renewable fuels, Electric Vehicles ("**EVs**") are currently seen as the future of sustainability as well as the harbinger of green and clean mobility.

India's e-mobility initiatives for pollution-free commercial and private transportation have prompted many established vehicle manufacturers and new entrants to begin manufacturing of EVs in the last mile connectivity and bulk short/long distance transportation space, especially in the 2-wheeler ("**E2W**") and 3-wheeler ("**E3W**") segments. It is estimated that the total number of EVs registered in 2022 was 10,00,000 (ten lakh i.e., one million) units, whereas the number stood at 3,20,000 (three lakh twenty thousand i.e., three hundred and twenty thousand) units in 2021 which is approximately a 300% (three hundred percent) jump in just a year.

As per the statistics published by the International Energy Agency, a Paris-based autonomous intergovernmental organization, while the Covid-19 pandemic witnessed a drop in global car sales by 16% (sixteen percent), the registration of EVs grew by almost 41% (forty one percent) in 2020.[3] A report published by the Indian Energy Storage Alliance, a leading industry alliance focused on the development of advanced energy storage, green hydrogen, and e-mobility technologies in India, projects that the Indian EV market will grow at a compound annual growth rate ("**CAGR**") of 36% (thirty six percent) till 2026. The EV battery market is also projected to grow at a CAGR of 30% (thirty percent) during the same period.[4]

The consistent and ongoing efforts of the Government of India ("**Union Government**") to incentivize both the demand and supply side for EVs and familiarize citizens with the merits of adopting EVs has been a major contributor to the growth and popularity of EVs in India. To

[1] 57.4% of India's power comes from fossil fuel. Data as available at Ministry of Power, Government of India "*Power sector at a glance*", March 2023 (accessed from https://powermin.gov.in/en/content/power-sector-glance-all-india).
[2] International Council on Clean Transportation, "*Decarbonizing India's Road Transport: A Meta-Analysis of Road Transport Emissions Models*", May 2022 (accessed from https://theicct.org/wp-content/uploads/2022/05/Meta-study-India-transport_final.pdf).
[3] International Energy Agency, "*How global electric cars sales defied Covid-19 in 2020*", January 2021 (accessed from https://www.iea.org/commentaries/how-global-electric-car-sales-defied-covid-19-in-2020).
[4] India Energy Storage Alliance, "*India's EV market to grow at CAGR of 36% till 2026*", December 2019 (accessed from https://indiaesa.info/images/pdf/press_release/Press_release-_India_EV_report_2019._758346379.pdf).

illustrate, the Union Government has encouraged the use of EVs by providing tax exemptions and consumer subsidies as well as funding the construction of charging infrastructure.

Along with the Union Government's efforts, technological developments, advancements in battery technology and the developing charging infrastructure have further boosted the penetration of EV in the automobile consumer industry. In this Report, we will discuss the EV landscape of India. On the governance side, we aim to summarize the steps taken by the Union Government to ensure the widespread use of EVs and their adoption. The Report also deals with the specific spheres of charging infrastructure and battery ecosystem, which serve as an important aspect of the e-mobility domain in India. We will also compare and analyse the disparities between the Indian EV market with other competitive Asian markets, to draw inspiration for the developing EV sector in India. Lastly, the Report aims to analyse the potential hurdles in India's attempt to adopt EVs, and other emerging trends and updates in this industry.

2. EV LANDSCAPE IN INDIA

In this Report, we have divided the Indian EV sector into two landscapes – vertical and horizontal. In the vertical landscape we will address the governance framework for the EV sector in India, primarily dealing with the key governing and regulating agencies and the executing or implementation agencies as well as the applicable legislations, rules, regulations, standards and specifications laid down by these bodies. In the horizontal landscape, we will address the demand and supply side of the EV market, and elaborate on various developing business models, i.e., mobility, infrastructure and energy that we see emerging in India.

2.1. VERTICAL LANDSCAPE

2.1.1. *EV Governance Framework*

The Constitution of India ("**Constitution**") provides that the Union Government as well as the governments for respective States of India ("**State Governments**") have the power to make laws with respect to the subject matters enumerated in the 'Concurrent List' of the Constitution.[5] The subject matters of '*mechanically propelled vehicles*' (which includes EVs)[6] and '*electricity*' (as relevant for regulating supply of electricity for charging infrastructure),[7] fall under the concurrent list, and are therefore regulated by both Union Government as well as the State Governments. Further, the Constitution stipulates that the Union Government and State Governments must direct their policies towards securing the ownership and control of the community's material resources in order to preserve natural resources, safeguard the environment, and advance the general welfare.[8]

Accordingly, several governmental bodies at the Union (i.e., federal) and State levels are responsible for governance of the EV industry. The roles played by these bodies can be categorized as policy-making and regulatory functions, and executive or implementation functions. We have described the vertical landscape of the EV sector below.

(a) Regulatory Agencies

Central level agencies / bodies: As discussed above, in exercise of its powers under the

[5] Article 246 read with Seventh Schedule of the Constitution.
[6] Entry 35 of List III of Seventh Schedule of the Constitution.
[7] Entry 38 of List III of Seventh Schedule of the Constitution.
[8] Article 39 read with Article 48A under Part 4 (Directive Principles of State Policy) of the Constitution.

Constitution, the Union Government (through its ministries and departments as indicated in the snapshot below) has enacted a number of legislations, rules, policies, schemes, guidelines and regulations to: (i) regulate and govern the EV sector (including but not limited to investment, manufacture of EVs, EV batteries, charging infrastructure, etc.); (ii) protect and safeguard the environment; and (iii) ensure wellbeing of the labourers who are employed in this sector. All such legislations, rules and regulations, are hereinafter referred to as the "**Applicable Laws**". A summary of the key Applicable Laws has been provided in Section 2.1.2 of this Report.

- Central policies: In addition to the Applicable Laws, the Union Government has also rolled out a number of policies and schemes to encourage the demand of EVs and has also issued various incentive programs for manufacturers and consumers to provide an impetus to the demand and supply side of EVs. Further, the National Institute for Transforming India, Government of India ("**Niti Aayog**"), a policy think-tank/ advisory body which supports the Union Government and State Governments in recommending policy and regulatory changes, has been actively supporting the electric mobility mission of India. Niti Aayog has released the draft Battery Swapping Policy and developed the e-Amrit portal,[9] a one-stop destination which provides all the relevant information with respect to EVs including subsidies, purchase incentives and investment opportunities to all the stakeholders and raise awareness and sensitize users towards switching to EVs.

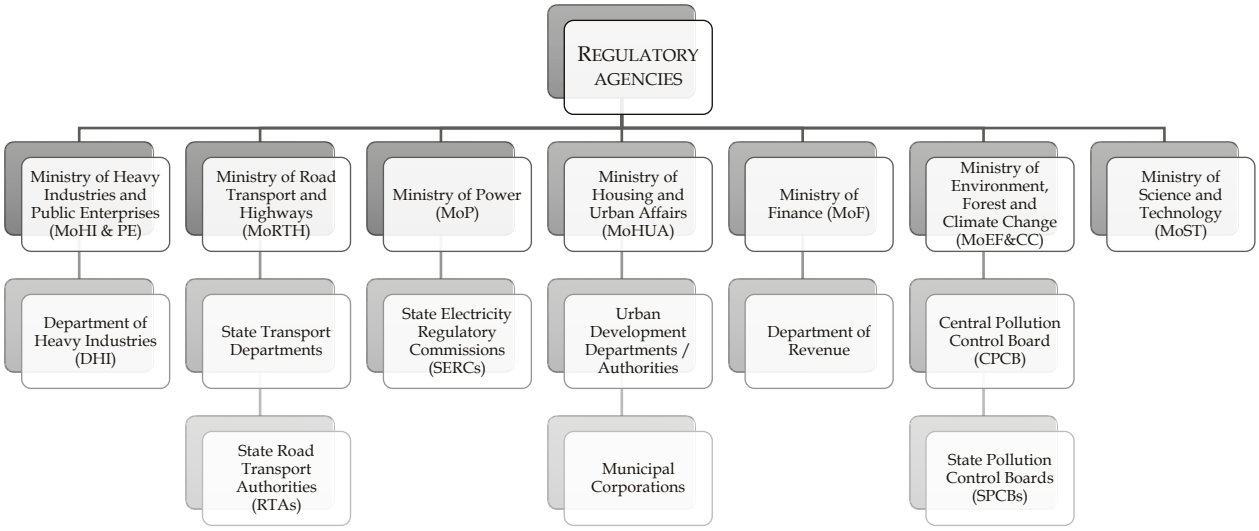
- Central schemes: The Union Government has also undertaken various initiatives to ensure adoption of EVs, such as the Automotive Mission Plans, the National Mission on Electric Mobility, the National Electric Mobility Mission Plan, the Scheme of Faster Adoption and Manufacturing of Electric Vehicles in India ("**FAME Scheme**"), Vehicle Scrappage Policy, etc., which have been broadly analysed and discussed in Section 3.1 below. Typically, the concessions offered to consumers under these policies include financial subsidies on purchase, exemption from road tax and registration charges, and low interest rates on loans for EV purchase. Similarly, some of the incentives offered to manufacturers include capital subsidies across the EV supply chain, concessions on taxes, tariffs and duties, interest free loans and reimbursement towards employee provident fund contribution, amongst others.

State level agencies / bodies: In addition to the Union Government, as discussed above, several states have also finalized or are in the process of finalizing EV policies that support and complement the national electric mobility policies. These policies offer incentives such as capital interest subsidies, stamp duty reimbursements, tax exemptions and interest free loans. Presently, about 25 (twenty five) State Governments in India have issued and notified policies for promotion of EVs and 3 (three) State Governments have published draft policies.[10] Most of the EV policies issued by the State Governments provide for incentives either on the supply side or demand side or both. The demand side/consumer incentives (such as registration fee and tax exemptions) are the cornerstone of many policies, including those in Delhi, Gujarat, and Maharashtra, while other states particularly the states of Tamil Nadu, Karnataka, Andhra Pradesh, Telangana and Uttar Pradesh (which are more focused on manufacturing activities) are among those that have a strong focus on

[9] Please refer https://www.niti.gov.in/e-amrit
[10] Please refer https://evyatra.beeindia.gov.in/state-ev-policies/

supply-side / manufacturing-related incentives (such as capital subsidies and production related incentives).[11] Supply-side incentives are often implemented with the broader strategic objective of creating a localized supply chain, and such incentives ideally also contribute to economies of scale that translate into lower production costs. We have provided a summary of the nature of subsidies and incentives proposed under various state-level policies to promote EV manufacturing and consumption in certain states in Section 3.2 read with Annexures 1A and 1B.

Further, we have represented below the key ministries and departments of the Union and State Governments that play an important role in policy-making and regulating the EV industry in India.



(b) Implementation or Executive Agencies

Government bodies with executive roles are responsible for the day-to-day governance of the EV sector, which includes functions of planning, permitting, and supporting implementation of EV and battery manufacturing, power distribution, charging infrastructure, pollution control, etc. The implementing agencies are also responsible for setting standards and specifications requirements, licensing, and certification processes amongst other functions.

We have highlighted the key implementing / executive agencies in the following categories:

Planning and Recommendation:

- National Council for Electric Mobility ("**NCEM**"): is the apex body for making any recommendations to the Union Government in respect of e-mobility and India's target to achieve 30% (thirty percent) EV sales penetration by 2030;[12]

[11] Climate Trends, "*Analysis of state electric vehicle policies and their impact*", February 2023 (accessed from https://climatetrends.in/wp-content/uploads/2023/02/full-report-digital-with-spreads.pdf).
[12] The Hindu, "*EV penetration : India's transition to electric mobility will be faster, says experts*", December 2022 (accessed from https://www.thehindubusinessline.com/economy/indias-transition-to-electric-mobility-will-be-faster-say-experts/article66277520.ece).

comprises of ministers of key central ministries and departments, eminent representatives from industry and academia and is chaired by the MOHI&PE;

- National Board for Electric Mobility ("**NBEM**"): is set up by the Department of Heavy Industry ("**DHI**") to assist the NCEM at secretary level; constituted with secretaries of the stakeholder central departments and ministries along with representatives from the academia and industry;
- National Automotive Board ("**NAB**"): acts as technical advisor and secretariat for both the NCEM and NBEM; and is comprised of a panel of experts in the field to assist NBEM and act as the main operating agency to implement FAME Schemes (discussed in detail in Section 3.1.2 below).

Standards, specifications and certifications:

- Automotive Research Association of India ("**ARAI**"): is a premier automotive research, development and certification institute that aims to support the automotive industry in the development, evaluation and certification of EV; develops standards for manufacturing of EVs and its components; and provides approval certificates for all automobiles including battery operated vehicles and EV charging systems as per the technical standards specified by it;
- Bureau of Indian Standards ("**BIS**"): is the national standards body of India; responsible for formulating the standards for EV charging as well as batteries used in EVs;
- Central Electricity Authority ("**CEA**"): is responsible for defining technical standards and regulations for EV charging.

Electricity distribution and charging infrastructure:

- State and Regional Transport Authorities (RTAs): are amongst the foremost stakeholders in planning for public charging infrastructure, as they have information on EV penetration trends in the city or region through vehicle registration data;
- State Electricity Distribution Companies ("**DISCOMs**"): act as state nodal agencies to govern the implementation of public charging; select agencies to install, operate and maintain public charging stations and battery swapping/charging facilities in the state; are responsible for providing electricity connections for EV charging, implementing the EV tariff established by State Electricity Regulatory Commissions, ensuring that EV charging infrastructure is connected and operating properly, preventing improper use of EV connections, managing the distribution network, and undertaking grid upgrades based on growth in load including from EV charging;

- Urban local bodies ("**ULBs**"): work alongside DISCOMs and are responsible for facilitating permissions, approvals, and certifications needed for EV charging infrastructure; ULBs include municipal corporations, municipal councils and other statutory governing bodies at the city level.

It is imperative that these implementing / executing authorities at all levels of the governance framework, work closely together and support the regulatory authorities to promote and enable faster adoption of EVs and develop a seamless charging infrastructure across the country.

2.1.2. ***Applicable Laws***

(a) Acquisition of land

At the outset, every manufacturer, that intends to set up an EV/its components/battery manufacturing unit, will be required to determine the geographical location where such manufacturing unit is proposed to be established. Determination of the appropriate geographical location of any manufacturing unit plays a key role in contributing towards the future sustainability of the business. Further, as discussed above, both the Union Government and the State Governments have the power to frame laws with respect to 'mechanically propelled vehicles'. Therefore, an important consideration, while setting up a manufacturing unit, would be to first decide the State in which such manufacturing unit may be set up.

Factors for determining location:

Prior to taking the decision regarding the geographical location for the unit, it is pertinent to consider multiple factors such as availability of raw materials, connectivity through roadways/railways/ports for logistics, availability of labour (whether skilled or unskilled) to manufacture the EVs and/or its components, feasibility for construction of the required infrastructure, implications of the manufacturing policy of the concerned States as well as the production-related incentives provided by the Union Government. Various States' EV policies provide for procurement of land for setting up manufacturing facilities in the concerned States at subsidized rates. Most States have also proposed setting up of manufacturing hubs and industrial parks for EV manufacturers. We have discussed these in greater detail in Section 3.2 below. Therefore, it is imperative for the companies intending to set up such facilities to assess the State EV policies to determine the best set of incentives and subsidies to make an informed decision for land acquisition.

Modes for procuring land:

Generally, a manufacturer may procure the land for setting-up its manufacturing unit by way of: (i) purchase / acquisition of land from private owners; (ii) purchase / acquisition of land in an industrial park (set up by Union Government and State Governments) through government agencies; and (iii) leasing of land in an industrial park through government agencies.

- Acquisition of land from private owners for setting up the manufacturing unit:

  The primary concerns here include ensuring that the title investigation is carried out and all approvals required to setup a manufacturing unit are obtained from the relevant authorities. The manufacturer would, therefore, be required to undertake a comprehensive land title diligence and verify the ownership of the land to ensure that such land is free from any encumbrance, charges and security and other legal disputes. Further, it is important to note that agricultural land cannot be used for setting up a factory unless the same is converted to industrial use. Thus, in the event the desirable area is an agricultural land, such land must be first converted into industrial use if the same is being considered for a manufacturing plant. Acquisition of private land also would require addressing issues such as land fragmentation and compliance with local land ceiling laws.

- Acquisition of land from Government agencies:

To promote ease of doing business, the Union Government and State Governments have established industrial parks which consist of land parcels that are ready for industrial use and are equipped with basic amenities like power, water, internal roads, etc. As stated above, land may also be procured in such industrial parks, either by acquiring ownership rights by way of purchasing the land parcel or by way of negotiating lease arrangements. State Governments usually set up such industrial parks through state owned industrial development corporations. These industrial development corporations procure land from the State Government, develop industrial parks with basic facilities and later sell the land (as in the case of State Industries Promotion Corporation of Tamil Nadu) or provide the land on long-term leases (as in the case of Rajasthan State Industrial Development and Investment Corporation) to potential investors (e.g., companies wanting to set-up a manufacturing unit in an industrial park). It is pertinent to note that lease agreements entered with State owned industrial development corporations may have conditionalities like restricted usage of the leased land, prior consent requirement in case of change in control of the lessee (where lessees are corporates), requirement to hire local labour, etc. Such restrictions may need to be carefully analysed especially in situations where companies engage with new strategic partners or desire to expand their operations.

Long term leases, and indeed agreements for the purchase of land would have to be duly stamped and registered. Such land can be leased or acquired only by Indian incorporated or registered entities. A duly stamped and registered agreement is essential to protect the interest of the purchaser or the lessee in the event of any disputes with respect to the use and occupation of the land.

(b) Foreign investment

Equity and other non-debt investments:

Foreign investment through non-debt instruments (such as equity shares, compulsorily convertible preference shares and debentures, warrants, convertible notes) in India is governed primarily by the Foreign Exchange Management Act, 1999, the Foreign Exchange Management (Non-debt Instruments) Rules, 2019 (the "**Non-debt Rules**"), and the Consolidated Foreign Direct Investment Policy, 2020 (the "**FDI Policy**") published by the Department for Promotion of Industry and Internal Trade ("**DPIIT**"). The Non-debt Rules and the FDI Policy are supplemented by press notes issued by the DPIIT from time to time, and other policy statements issued by the Union Government (together with the Non-debt Rules and the FDI Policy, the "**FEMA Regime**").

- Investment routes and sectoral cap: The FEMA Regime specifies the relevant investment routes (automatic route and government approval route), permissible investment limits (sectoral caps) and the investment conditionalities, depending on the sector in which the Indian investee entity operates, and the extent of investment being made.
- Investment modes: Foreign investment under the FEMA Regime includes all types of foreign investments, whether direct or indirect, such as foreign direct investment, foreign portfolio investment, foreign venture capital investment, indirect foreign investment, etc. Accordingly, the sectoral caps for permitted foreign investment under FEMA Regime would include all the investment

modes through which foreign investment could be brought into India.

- Other general investment conditions: In addition to the requirements mentioned above, any foreign investment in an Indian entity, irrespective of the sector that it operates in, is required to comply with certain general investment conditions such as adherence to valuation and pricing guidelines and reporting requirements.

The FEMA Regime permits foreign investment up to 100% (hundred percent) through the automatic route, that is, without the requirement of seeking any governmental approval, for manufacturing of automotive and auto components (which includes EVs).[13]

Debt investments:

In addition to bringing foreign investment in India through non-debt instruments, investments can also be brought through instruments of debt. The framework for debt instruments is governed under Foreign Exchange Management (Debt Instruments) Regulations, 2019 ("**Debt Rules**"), which deals with investments through debt instruments such as non-convertible debentures, dated Government securities, treasury bills, bonds and commercial paper issued by an Indian company, units of domestic mutual funds or exchange-traded funds (ETFs) by foreign portfolio investors, non-resident Indians, overseas citizens of India, etc.

External commercial borrowings:

Foreign investors also have the option to invest in entities through loans, bonds, debentures, trade credits, partially/optionally convertible, or non-convertible debt, etc., which are treated as external commercial borrowings ("**ECBs**").[14] Under the ECB framework, funds can be raised either via foreign currency denominated ECBs or through Indian Rupee denominated ECBs. These borrowings can be raised under either the automatic or the government route. The proceeds from ECBs cannot be utilised for certain activities, which include real estate activities, equity investment, investment in capital market, etc.[15] Even though ECBs are essentially considered as debt instruments, in certain cases they may come with convertible options and can be converted into equity shares after a minimum average maturity period.[16] The conversion of ECBs into equity is subject to conditions such as pricing guidelines, reporting requirements, lender's consent, and applicable sectoral norms.[17]

Recent investments in EV sector:

It is evident that the Union Government has recognised the opportunities that the EV sector promises to offer in India and has, therefore, increased its focus on adopting EVs to take advantage of such opportunities. Several Indian startups have also identified the merits of EVs and its related services. Ola Electric, for instance, has received funding of over USD 860 million till date, from investors such as

[13] Paragraph 5.2.5 of the FDI Policy read with Entry 5 of the table mentioned in Schedule I of the Non-debt Rules.
[14] Entry 2.1 (ii) of Master Direction - External Commercial Borrowings, Trade Credits and Structured Obligations, March 2019 (accessed from https://rbi.org.in/Scripts/BS_ViewMasDirections.aspx?id=11510#65).
[15] Entry 2.1 (viii) of Master Direction - External Commercial Borrowings, Trade Credits and Structured Obligations, March 2019 (accessed from https://rbi.org.in/Scripts/BS_ViewMasDirections.aspx?id=11510#65).
[16] Entry 7.4 of Master Direction - External Commercial Borrowings, Trade Credits and Structured Obligations, March 2019 (accessed from https://rbi.org.in/Scripts/BS_ViewMasDirections.aspx?id=11510#65).
[17] Entry 7.4 of Master Direction - External Commercial Borrowings, Trade Credits and Structured Obligations, March 2019 (accessed from https://rbi.org.in/Scripts/BS_ViewMasDirections.aspx?id=11510#65).

Softbank, Tekne Private Ventures, Edelweiss, Alpine Opportunity Fund, etc., and is planning to raise USD 250-300 million in growth equity to expand its E2W operations and fund its planned battery facility.[18] Similarly, Ather Energy is seeking a primary infusion of approximately USD 250 million and has raised funding of approximately USD 170-180 million from investors such as National Infrastructure Investment Fund, Caladium Investment and Hero MotoCorp[19]

Further, as per reports, Hyundai Motor India has planned to invest about INR 4,000 crore (approximately USD 485 million) for research and development as it looks to roll out 6 (six) new electric vehicles in India by 2028,[20] and auto parts manufacturer, Uno Minda, intends to invest around INR 300 crore (approximately USD 36.5 million) to expand its manufacturing capacity of four-wheeler ("**4W**") alloy wheels and 4W automotive switches to meet rising demand.[21]

(c) Manufacturing of EVs and its components

The Union Government and the State Governments have prioritized adoption of EVs in the country, not only by way of enactment of legislations and statutes but also by rolling out various policies and schemes with the aim of incentivizing manufacturers to drive the demand for EVs in India.

Specific policies to promote manufacturing:

- FAME Scheme: One of the key policies introduced by the Union Government in this respect is the FAME Scheme, which was implemented in 2 (two) phases with the goal to support the development of both hybrid vehicles and EV markets as well as that of their manufacturing ecosystems. The FAME Scheme provides upfront incentives for EV purchases and offers subsidies to both manufacturers as well as consumers. It is pertinent to note that in order to access the incentives under the FAME Scheme, a range of eligibility criteria for EVs including price, range and speed and usage of local supply chains for manufacturing have been specified.

- Phased Manufacturing Program: Under the FAME Scheme, the Union Government rolled out certain additional initiatives, such as the Phased Manufacturing Program (launched in 2019) to promote indigenous manufacturing of EVs, its assemblies / sub-assemblies and parts / sub-parts / inputs of sub-assemblies.

[18] The Economic Times, "*Ola Electric kicks off $250-300 million fundraise plan*", March 2023 (accessed from https://economictimes.indiatimes.com/tech/funding/ola-electric-kicks-off-250-300-million-fundraise-plan/articleshow/98878940.cms).
[19] Outlook Start-Up, "*Ather energy seeks unicorn funding at USD 1.3 billion valuation" February 2023,* , February 2023 (accessed from https://startup.outlookindia.com/investors/ather-energy-seeks-unicorn-funding-at-1-3-billion-valuation-news-7534).
[20] Mint, "*Hyundai India plans to invest ₹4,000 crore to rev up EV biz*", December 2021 (accessed from https://www.livemint.com/auto-news/hyundai-india-plans-to-invest-4-000-cr-to-rev-up-ev-biz-11638901814438.html).
[21] Mint, "*Uno Minda to invest ₹300 crore to expand manufacturing capacity in Haryana*", August 2022 (accessed from https://www.livemint.com/news/india/uno-minda-to-invest-rs-300-crore-to-expand-manufacturing-capacity-in-haryana-11661426781909.html).

- Production Linked Incentive schemes: The Union Government has launched the Production Linked Incentive schemes in various sectors (including manufacturing of automobiles and auto-components as well as advanced chemistry cell and battery storage) to encourage local manufacture and increase in employment levels under its 'Make in India' initiative. One of the key objectives of the scheme was also to attract foreign investments in the manufacturing sector and to create a large-scale manufacturing ecosystem in the country.

Owing to the success of these policy initiatives, we note that there were about 380 (three hundred eighty) EV manufacturers in India till July 31, 2021.[22] The growth of the EV sector in India naturally means an increase in the requirement for manufacturing of its batteries as well. It has also been witnessed that Original Equipment Manufacturers ("**OEMs**") have started shifting towards lithium-ion batteries in part, to meet the Union Government's criteria of an advanced battery to access incentives under the FAME-II Scheme. It is currently not predictable whether the Union Government will float the third phase of FAME Scheme (FAME-III) in the coming financial year, extend the existing FAME-II or discontinue the same. We have dealt with the eligibility requirements as well as the salient features of these policy initiatives in detail in Section 3.

Laws relating to manufacturing:

- Motor Vehicles Act, 1988 ("**MV Act**"):

MV Act and the rules framed thereunder play an important role in governing the specifications for manufacturing of motor vehicles, and other aspects for their use, including registration, licensing, inspection of vehicles, responsibilities of drivers and other road users. It is also important to highlight that as of date, there is no specific central legislation in India to solely govern the EV space. However, since the definition of a 'motor vehicle' under the MV Act and the underlying rules is broad in its ambit and covers 'battery operated vehicles', EVs are also governed by the provisions of the MV Act and the rules framed thereunder.

The Union Government has been empowered under the MV Act to notify the standards required to be complied with by a manufacturer of motor vehicles and to make rules regulating various aspects of motor vehicles including the construction and maintenance of motor vehicles. Such notifications may cover aspects with respect to, *inter alia*, width, height, length and overhang of vehicles and of the loads carried; size, nature and condition of tyres; brakes and steering gear; signalling appliances, lamps and reflectors; speed governors; standards of the components used in the vehicle as inbuilt safety devices; etc.[23] Further, the State Governments have been given the power under the MV Act to make rules with respect to matters which are not regulated by the Union Government, such as, *inter alia*, periodical testing and inspection of vehicles by prescribed authorities and fees to be charged for such tests.[24]

[22] Please refer https://e-amrit.niti.gov.in/Manufacturers
[23] Please see Sections 109 and 110 of the Motor Vehicles Act, 1988.
[24] Please see Section 111 of the Motor Vehicles Act, 1988.

- Central Motor Vehicles Rules, 1989 ("**CMVR**"):

  The Union Government has also enacted the CMVR in terms of the provisions of Section 110 of the MV Act. The CMVR provides for specifications and standards for the construction and maintenance of motor vehicles, including but not limited to overall dimension of the vehicle, braking requirements, steering gears, and safety standards.[25] We note that Rule 124 of the CMVR was amended effective from 01 October 2022, pursuant to which an additional requirement has been mandated to the existing standards for conformity of production for traction batteries used in electric power train vehicles.[26] Under the above-mentioned rule, the Union Government is authorized to specify the relevant standards prescribed by the BIS with regards to any component or assembly to be used for manufacturing of a vehicle including EVs.

  In addition to the standards and specifications, the CMVR also identifies certain agencies for testing of the manufactured motor vehicles and for issuing the type approval certificates, which, *inter alia,* include the ARAI, Vehicle Research and Development Establishment of the Ministry of Defence of the Union Government, Central Institute of Road Transport, International Centre for Automotive Technology, etc.[27] The CMVR additionally states that each manufacturer of motor vehicles and their parts, components, and assemblies must submit a prototype of the vehicle or the part, component, or assembly, as applicable, to obtain authorization by any of the aforementioned organizations.[28]

Laws relating to standards and specifications:

- Process of testing and certification for EVs:

  In the context of the broad framework of the standards and specifications provided under the MV Act and CMVR, it is critical to understand the homologation procedure for approvals. Homologation process refers to the process for granting approvals needed for the vehicles before they can be marketed and/or sold. This is undertaken to ensure that the vehicles adhere to the technical requirements and standards set by the relevant regulatory organizations. Such technical guidelines are imperative as they ensure that all 'Electric Vehicle Supply Equipment' ("**EVSE**") are compatible and interoperable with all EVs. Such a process for evaluating and certifying compliance with technical standards is known as 'type approval'. This process of obtaining type approval is similar for all types of EVs whether E2Ws, E3Ws, 4Ws, whether commercial fleets or private passenger vehicles. For automotive vehicles, including EVs, homologation is a multi-step process:[29]

  (i) *Component approval*: whereby the components of automobiles such as lights, mirrors, tyres as well as parts attached to the automobile such as electric/electronic sub-assemblies, car audio systems are evaluated in

[25] Please see Chapter V of the Central Motor Vehicles Rules, 1989.
[26] Please see Central Motor Vehicles (Twenty fifth) Amendment) Rules, 2022.
[27] Please see Rule 126 of the Central Motor Vehicles Rules, 1989.
[28] Please see Rule 124 and 126 of the Central Motor Vehicles Rules, 1989.
[29] EV Reporter, "*Guide to Homologation of electric 2W and 3W in India*", March 2020 (accessed from https://evreporter.com/guide-to-homologation-of-electric-vehicles).

accordance with the standards and are subject to approval;

(ii) *System approval*: whereby, *inter alia*, the braking system and exhaust emissions from the vehicle are assessed for approval; and

(iii) *Whole vehicle type approval/vehicle certification test*: whereby it is determined whether the automobiles destined for consumer sale comply with the appropriate environmental, safety, and security criteria.

These approvals are based on test reports prepared by officially recognized testing agencies / organizations. The relevant regulatory body grants approval for each of the aforementioned processes in accordance with the applicable rules under the CMVR based on the test reports. For each vehicle prototype, the concerned authorized agency issues "Type Approval Certificate (TAC)" and/or "Conformity of Production Certificate (COP)" according to the applicable rules. This certificate is recognized in all countries as mentioned in the test report.

- Process of testing and certification for EV batteries*:*

Much like the testing and certification system for EVs, EV battery manufacturers are also required to adhere to strict standards and go through several testing procedures before their batteries may be allowed for use in EVs. These tests certify that the batteries meet all statutory, commercial, and manufacturing criteria. Ordinarily EV batteries undergo:

(i) *physical testing:* for assessing the dimensions and other constructional requirements like electrolyte level indicator, terminal posts, connectors, nuts and bolts, etc. The battery is also tested for any marking (such as source of manufacturer, year of manufacture, country of origin, etc.); and

(ii) *mechanical testing*: for assessing the insulation, wiring, assembly of cells into batteries, impact of continuous charging, vibration testing, temperature cycling, mechanical shock, thermal abuse, overcharge protection, forced discharge, fire resistance, hydrogen emission, amongst others. Batteries also have to undergo tests such as life cycle test, capacity test, etc.

In light of the recent incidents of EVs catching fire, the Union Government along with the relevant ministry and department has put in place stringent tests and safety parameters for batteries used in EVs. Additional safety requirements related to battery cells, battery management systems, on-board charger, design of battery pack, thermal propagation due to internal cell short circuit have been announced to avoid fire incidents. We have discussed recent changes to the battery standards and safety norms in detail in Section 5.1.

- Certifying agencies and applicable standards:

As mentioned above, there are certain implementing / executive bodies which lay down the technical standards and specifications for both ICE vehicles and EVs. In this Report we have discussed the role of ARAI, BIS and CEA in the process of manufacturing EVs, its components, batteries and charging infrastructure, in brief:

(i) *ARAI* is a premier automotive research, development and certification institute that aims to support automotive industry in the development,

evaluation and certification of EVs.[30] The ARAI develops standards for manufacturing of EVs and its components. In India, for every vehicle irrespective of its type, ARAI testing is mandatory. The ARAI provides approval certificates for all automobiles including battery operated vehicles and EV charging systems as per the technical standards specified by it. Some of the approvals include (i) CMVR type approval for battery operated vehicles (as per AIS 049 and Amd. 1 and 2); (ii) CMVR type approval for hybrid electric vehicles (as per AIS 102); (iii) technical specifications for battery operated vehicles (as per AIS 007 (Rev. 5) Table 13); and (iv) requirements for the constructional and functional safety for battery operated vehicles (as per AIS 038), etc.

(ii) *BIS* is a member of the International Electrotechnical Commission (IEC), a global organization that develops reference standards to guarantee interoperability and reduce trade barriers for EVs and their components.[31] Some of the applicable standards approved by the BIS include the (i) Indian standards for AC charging (as per IS 17017 Parts 1, 2, 21 and 22); (ii) Indian standards for DC charging (as per IS 17017 Part 23, 24 and 25); and (iii) the combined charging system standard for both AC and DC charging (as per IS 15118 series). It is highlighted that the Indian standards for EV charging are compliant with global standards; however, local climate considerations and the difference in vehicle types available in India necessitate modifications that are specifically applicable to India.[32]

(iii) *CEA* makes technical standards and regulations for the power sector in India and is primarily responsible for the standards related to safety of power grid, which serves as an important aspect for the EV charging infrastructure of the country. The CEA has issued the CEA (Measures relating to Safety and Electric Supply) Regulations, 2010 dealing with general safety, fire safety as well as testing and regular inspection of the charging stations.[33]

The detailed aspects pertaining to the standards and specifications issued by the relevant bodies with respect to the battery manufacturing and charging infrastructure are dealt with in detail in Sections 5.1 and 4 respectively.

(d) Environment protection and climate change

*Environmental (Protection) Act, 1986 ("**EPA**") and the underlying rules and regulations*

In India, the EPA was passed as a broad legislative act with the purpose of limiting, preventing, and controlling environmental pollution. Through a number of laws and notifications, it establishes the requirements for the discharge of environmental pollutants, with a focus on managing chemical and hazardous waste, limiting noise pollution, among other things. The EPA has prescribed standards for emitting or discharging any environmental pollutant and any person carrying on any industry, operation or process must adhere to such standards.

[30] Please refer https://www.araiindia.com/pages/about-us
[31] Please refer https://www.bis.gov.in/
[32] Please refer https://e-amrit.niti.gov.in/bis-standard
[33] Please refer https://cea.nic.in/ev-charging-standards/?lang=en

Even though there is no pollution associated with the usage of EVs, the installation and operation of charging stations (which eventually rely on thermal power plants) and the recycling and disposal of used EV batteries are likely to contribute to environmental damage. The majority of used batteries typically end up in backyard smelters, which extract metals through highly polluting mechanisms. Therefore, the EPA works to allay these worries by regulating or controlling industry pollution emissions, e-waste disposal, water contamination, etc. under a strict regime. The EPA and the rules and regulations formulated under it demand strict adherence to its provisions, and any violation or non-compliance with any provision under the EPA or its underlying regulations may attract penal liability and monetary fines.

In addition to the penal provisions provided under the EPA, courts in India also have broad powers to award damages for violation of environmental laws and take stringent actions against violators. In the past, Indian courts have shut down industrial facilities and imposed fines based on the extent of damage caused to the environment, the type of infringement, magnitude of the enterprise causing the environmental damage and the profitability of such enterprise. Further, in 2010 the National Green Tribunal ("**NGT**") was established as a specialized judicial body primarily for the purpose of adjudicating environmental issues in India, with the goal to ensure speedy and efficient resolution of disputes and provision of effective remedies in environmental matters. The NGT has the authority to provide relief in the form of compensation and damages to the affected parties, and its decisions are legally binding.

Summarily, it is reiterated that for an industry to continue operating in India, full adherence to the EPA and the rules and regulations formulated thereunder is essential. In light of the above, some of the preliminary consents/clearances that would be required for setting up a manufacturing unit for EVs or EV batteries is as follows:

- Consent for establishment and Consent for operations under Water (Prevention and Control Pollution) Act, 1974 ("**Water Act**") and Air (Prevention and Control of Pollution) Act, 1981 ("**Air Act**")

  The Water Act and the Air Act are the primary legislations enacted to combat some major environmental issues that the country has been grappling with. Under these statutes, authorities such as the Central Pollution Control Board ("**CPCB**") and State Pollution Control Boards ("**SPCB**") have been established to regulate the implementation and compliance of these legislations.

  The Water Act prohibits any business, operation, or process from discharging sewage or trade effluents into a stream, well, or sewer without the consent of the relevant SPCB. As per Section 25 of the Water Act, prior consent of the concerned SPCB is required to establish an industry, process or operation or any discharge system which may discharge sewage or trade effluent into a stream or on land, for the discharge of sewage or make any new discharge of sewage. Such prior approval is called the 'consent to establish'.

  Similarly, Section 21 of the Air Act, mandates that a prior consent of the concerned SPCB is required to establish or operate an industrial plant in an air pollution control area.[34] The Air Act further authorizes the SPCBs to notify

[34] 'Industrial plant' is defined under Section 2(k) of the Air Act and reads as "means any plant used for any industrial or trade purposes and emitting any air pollutant into the atmosphere."

standards for air pollution emission from industrial plants and automobiles. Therefore, an EV manufacturer would be required to obtain necessary consent to establish operate its manufacturing unit in accordance with the Air Act and the Water Act.

Although there is no pollution associated with the usage of EVs, it must be noted that the manufacturing process for a majority of EVs still resembles that of a traditional internal combustion engine ("**ICE**") vehicle. As a result, during the manufacturing process, the manufacturing facilities may release hazardous waste including e-waste. Particularly, as stated above, owing to the chemical nature of EV batteries, disposal of such batteries could also damage the environment if the process followed for disposal and waste management is not safe and environmentally conscious. As per reports, States like Maharashtra, which have been actively supporting and contributing to the e-mobility movement in India, have a high waste contribution but very low disposal rate.[35] As a result, it was imperative for the Union Government to lay down certain waste management laws that would be applicable to the manufacturers of EV and EV batteries. We have laid down a broad overview of relevant regulations in this regard:

- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 ("**Hazardous Waste Rules**")

  According to the Hazardous Waste Rules, anybody involved in the generation, processing, or treatment of hazardous waste, as well as its packaging, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer, or similar activities, must acquire an authorization from the relevant SPCB. The Hazardous Waste Rules provide that the SPCB is required to undertake scrutiny on the applicant enterprise and, thereafter, may award the applicant an authorization that is valid for 5 (five) years.

  In this context, 'hazardous waste' is defined to include, amongst others, which by reason of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger to health or environment, whether alone or when in contact with other wastes or substances.

  Given that an EV manufacturer would be dealing with hazardous waste while disposing of EV batteries, it is imperative that the EV facility seeks such authorization from the SPCB for safe disposal of such hazardous waste.

- E-waste (Management Rules, 2022 ("**E-waste Rules**")

  The E-waste Rules have come into effect from April 1, 2023 and have superseded the E-waste Management Rules, 2016. The E-waste Rules apply to every manufacturer, producer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, refurbishing, dismantling, recycling and processing of e-waste or electrical and electrical equipment as listed under Schedule I of these rules (like consumer electrical and electronics, technology and telecommunication equipment etc.) including their components, consumables, parts and spares which make the product operational. It is pertinent to note that the E-waste Rules do not apply to waste batteries as

[35] Hindustan Times, "*Door-to-door e-waste collection begins in Pune*", December 2022 (accessed from https://www.hindustantimes.com/cities/pune-news/doortodoor-e-waste-collection-begins-in-pune-101670349068483.html).

covered under the Battery Waste Management Rules, 2022 (as discussed below in Section 5.2), packaging plastic as covered under the Plastic Waste Management Rules, 2016, micro enterprises as defined in the Micro, Small and Medium Enterprises Development Act, 2006 and radio-active wastes as covered under the provisions of the Atomic Energy Act, 1962. The E-waste Rules defines 'e-waste' to mean electrical and electronic equipment including solar photo-voltaic modules, panels or cells, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded as waste. Manufacturers, producers, refurbishers and recyclers are required to register on the portal developed by Central Pollution Control Board to carry out their business (which is a new concept introduced under these rules). Under the extended producer responsibility framework, producers must ensure that they meet the recycling targets as prescribed under Schedule III and Schedule IV of the E-waste Rules through registered recyclers of e-waste. It must be noted that the concept of environmental compensation has been introduced under the E-waste Rules, that must be paid in case of non-compliance of certain provisions under these rules.

- Battery Waste Management Rules, 2022 ("**Battery Management Rules**")

  The Battery Management Rules are successor to the erstwhile Battery (Management and Handling) Rules, 2001. The Battery Waste Management Rules apply to producers, dealers, consumers, and entities involved in collection, segregation, transportation, refurbishment and recycling of waste batteries. The rules govern all kinds of batteries regardless of their chemistry, shape, volume, weight, material composition and use. Therefore, a manufacturer of EV and its batteries as well as other relevant stakeholders would be required to comply with the provisions of the Battery Management Rules. We have provided an analysis of the salient features of these rules in Section 5.2.

(e) Labour welfare and social security

In addition to the requirements mentioned above, EV and EV batteries manufacturers would need to ensure compliance with relevant labour laws. Below are a few of the labour law compliances that manufacturers must comply with:[36]

*Factories Act, 1948 ("**Factories Act**")*

The law governing the regulation of labour in factories is embodied in the Factories Act and the rules framed thereunder. The Factories Act lays down the requirements for, *inter alia*, working hours, safety, overtime pay, benefits, and leave. The statute empowers the State Governments to implement the provisions in accordance with the state-specific rules framed under the Factories Act. The term 'factory' is defined under the Factories Act as follows:

"any premises including the precincts thereof-

i. whereon ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so carried on, or

ii. whereon twenty or more workers are working or were working on any day of the

[36] Please note that this is an indicative list and not an exhaustive list, and other applicable labour law legislations may also need to be complied with.

preceding twelve months, and in any part of which a manufacturing process is being carried on without the aid of power or is ordinarily so carried on."

The Factories Act requires every 'factory' to procure a license for its operation in accordance with the Factories Act read with the pertinent rules issued thereunder by the concerned State Government. Consequently, any manufacturer running a 'factory' for the manufacture of EVs, EV batteries, or their components under the Factories Act will be required to obtain a license in order to do so in accordance with the relevant state-level regulations. A manufacturer must additionally get auxiliary permissions and consents, which vary from State to State depending on the location of the manufacturing premises, in addition to the abovementioned license to operate a factory. These often pertain to aspects like building plan and site approval, consent to get electricity and water connections, factory plan approval, lift operator license, and no-objection certification from the fire departments of the relevant state, etc.

*Industrial Disputes Act, 1947 ("**ID Act**")*

The ID Act applies to 'workmen' employed in a particular industry and is, intended to, *inter alia*, regulate and control industrial disputes. As per the ID Act, a workman is defined to include any person employed in any industry to do any manual, unskilled, skilled, technical, operational, clerical or supervisory work for hire or reward.[37]

We understand that the ID Act excludes certain employees from the purview of the category of a 'workman'. These excluded employees are those who: (i) are employed primarily in an administrative or managerial capacity; or (ii) are employed in a supervisory capacity and earn more than INR 10,000 (approximately USD 120) per month; or (iii) exercise, either by the nature of the duties attached to the office or by reason of the powers vested, functions primarily of a managerial nature. Nonetheless, it is imperative to highlight that there are enough judicial precedents establishing that the financial threshold of INR 10,000 (approximately USD 120) is not necessarily the criterion to determine whether an employee qualifies as a 'workman'. Therefore, if an employee's employment does not involve any managerial or supervisory duties, then even if such an employee earns more than INR 10,000 (approximately USD 120) per month, he may be categorized as a 'workman' under the ID Act.

The ID Act specifies provisions in respect of, *inter alia*, the procedure to be followed for layoffs and retrenchments, the compensation to be given to employees in situations such as a lay-off, retrenchment, transfer of an undertaking and the closure of a business.

Given that the EV manufacturer would be employing a large number of 'workmen' to work in the manufacturing process, compliance with the ID Act would be crucial.

*Shops and Establishments legislations ("**S&E Act**")*

Every State Government has enacted separate S&E Acts and the regulations thereunder. The S&E Acts (as enacted by the respective State Governments) are applicable on all the commercial establishments; *viz*, business centres, offices, warehouses, stores, hotels, eateries, amusement parks, theatres, etc, in the relevant State. It is one of the most important regulations required to be complied with for any business.

The objective of the S&E statutes is to protect the rights of employees by defining

[37] Please see Section 2(s) of the Industrial Disputes Act, 1947.

uniform benefits to the employees (irrespective of the industry and type of establishment he / she is employed with), such as, to regulate the payment of wages, terms of service, holidays, leaves, work conditions, hours of work, overtime work, maternity leave and benefits, rules for employment of children. It is important to highlight that compliance with S&E Act would be relevant with respect to the employees who are not identified as 'workmen' under the ID Act or establishments not covered under the Factories Act and consequently not protected and governed thereunder.

*Employees' Provident Fund and Miscellaneous Provisions Act, 1952 ("**EPF Act**")*

The EPF Act is a social welfare legislation that aims to establish an investment fund into which both employees and employers make financial contributions, and which is paid out to the employees upon their retirement. The EPF Act covers every factory and establishment which employs 20 (twenty) or more persons (including those employed through a contractor). The EPF Act requires all such persons to contribute towards the employees' provident fund. All establishments to which the EPF Act applies, and the contractors engaged by them, are required to obtain a registration and allotment code from the designated authority to make these contributions, and file returns evidencing their contribution. Thus, if the EV (and battery) manufacturers employee more than 20 (twenty) employees, the obligation to comply with the EPF Act and make financial contributions towards the provident fund would be mandatory.

*Employees' State Insurance Act, 1948 ("**ESI Act**")*

Similar to the EPF Act, the ESI Act is also a social welfare law that aims to provide employees with social security and is applicable to all factories and establishments with at least 10 (ten) employees. According to the ESI Act, a company must make employer contributions with respect to all employees receiving earnings of up to INR 21,000 (approximately USD 254) per month. Factories and establishments to which the ESI Act applies are required to obtain a registration under the ESI Act. Additionally, the ESI Act requires that all employees in factories or other establishments to which the ESI Act applies be insured in accordance with the manner specified by the Union Government. To this end, the employers are required to make contributions in favour of the eligible employees to the Employees' State Insurance Corporation in order to secure this insurance for such employees.

2.1.3. *Policy Initiatives and Incentives*

India is working to ensure a transition to electric transportation by utilizing alternative and less energy-intensive solutions in light of the cost of oil imports, rising pollution, as well as international commitments to combat global climate change. The policymakers in India are keeping up with the global economy to develop a mobility option that is "Shared, Connected, and Electric" in an effort to address the issue of sustainability and reduce reliance on conventional modes of fuel-intensive mobility.[38] The EV industry in India is undoubtedly gaining momentum owing to a variety of initiatives, including the establishment of manufacturing hubs, provision of subsidies and incentives by the Union Government and State Governments, introduction of e-mobility policies, and a greater focus on enhancing and expanding the charging infrastructure. Section 3.2, along with Annexure 1A and Annexure 1B, deals with the salient features and other details with respect to such policy initiatives.

[38] Please refer https://loksabhadocs.nic.in/Refinput/New_Reference_Notes/English/15072022_175056_1021205203.pdf

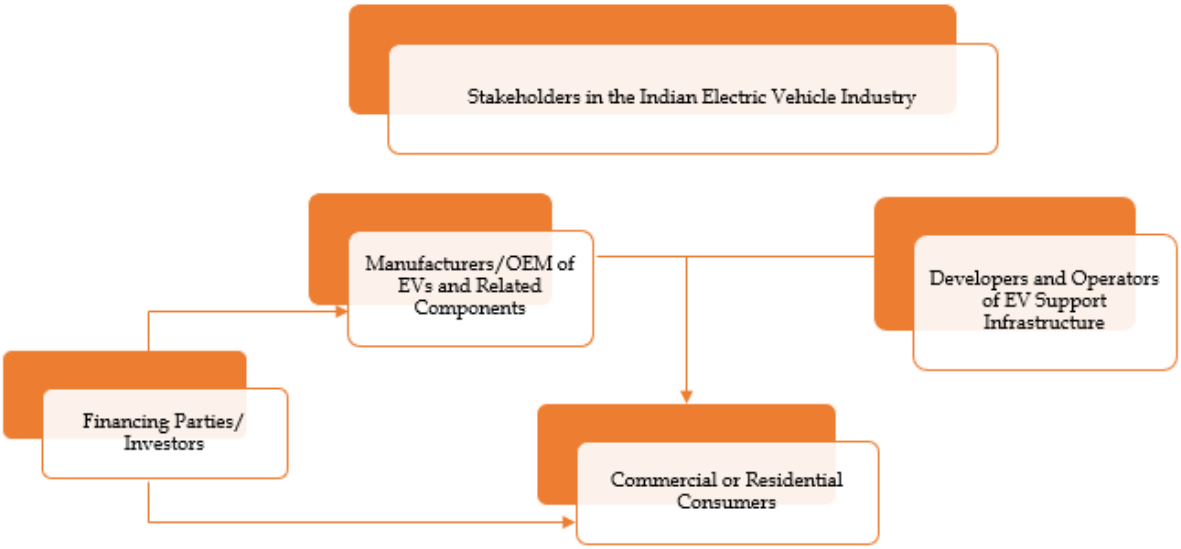
We note that even though several agencies have been put in place to regulate different aspects of EV manufacturing and use, the Indian legal framework still lacks an EV specific regulation. Currently, EVs are governed the same way as any other ICE vehicle, under the MV Act. It is imperative to highlight that EVs function differently than other conventional vehicles. A battery, which forms 60% (sixty percent) of an EV in terms of value, is but a mere part in a conventional vehicle. Hence, in order to regulate and govern EVs, there needs to be laws in place taking into consideration the specific issues and concerns attached with an EV and the charging infrastructure.

2.2. HORIZONTAL LANDSCAPE

While the EV industry in India is still at the nascent stage of development, the increasing trend of adoption of greener non-conventional fuel options and incentives provided by governments have resulted in the EVs gaining considerable traction as a cleaner and fuel-efficient transportation option compared to the traditional ICE vehicles. As discussed in Section 1 of this Report, significant growth is projected for the India's domestic EV market. With the growth in the Indian EV market, major Indian automobile manufacturers which have traditionally been involved in the production of ICE vehicles like Tata Motors and Mahindra & Mahindra[39] have entered the EV market along with a slew of foreign manufacturers and start-ups. This indicates that EVs have the potential to become a viable business model with expected profitability and an increasing consumer base. Since India's EV market is reaching the inflection point of price parity, Indian consumers have higher interest in investing in buying EVs than ever before.[40] An interesting aspect is that the traditional framework of the automobile market is in the process of replacement by a newer model by startups involved in the EV industry along with various stakeholders in the EV and e-mobility industry. Though the demand for traditional ICE vehicles is ever-increasing, startups in the EV industry are creating a niche for themselves in the still undefined consumer market.[41] Further evolution and emerging technologies like artificial intelligence, advanced driver-assistance systems (ADAS) etc., also are a contributing growth factor in the EV industry and e-mobility.

When discussing the business model of the Indian EV industry, it is important to discuss the various stakeholder in the EV industry. The key stakeholders in the Indian EV industry are the manufacturer or OEMs of the EVs and the component parts thereto, companies engaged in the development and operation of EV infrastructure, i.e., the charging infrastructure, power producers, DISCOMS, etc., the residential and commercial consumers of E2W, E3W, and E4W and the financing parties that invest capital in both demand and supply sides. We have represented below the stakeholders in the EV industry in India.

[39] Invest India, "*India's EV Economy: The Future of Automotive Transportation*", February 2023 (accessed from https://www.investindia.gov.in/team-india-blogs/indias-ev-economy-future-automotive-transportation).
[40] Please refer https://e-amrit.niti.gov.in/new-e-mobility-businesses.
[41] IBID



In this section, we have taken a horizontal analysis of the Indian mobility and energy industry at large by evaluating the business of the stakeholders to conduct business in the Indian EV space.

2.2.1 ***Business Models***

The business models for EVs in the domestic Indian market is focused on the following 3 major areas:

(a) Electric Mobility (e-mobility)

Electric mobility is focused on the actual sale and increase of EV penetration in the Indian market.[42] Startups and companies in the e-mobility area use EVs to provide services and value addition to consumers.[43] The products in the e-mobility area include EVs like E2W, E3W, E4W and other hybrid models of EVs.

(b) Infrastructure

One of the major roadblocks to penetration of EVs in the Indian automobile sector is the unavailability of proper public infrastructure for seamless adoption of EVs by the public, for instance, there is a lack of sufficient public charging infrastructure in India that has operated as a hinderance to a widespread EV adoption by consumers. Thus, to make the EV industry in India robust and efficient there is a requirement to develop businesses that are involved in the development and operation of support infrastructure for EVs like EV charging stations, battery swapping stations, etc.

(c) Energy

Energy is the basic component for the growth of EV adoption in India. The traditional engine in ICE vehicles is replaced by an e-motor and a battery pack in EVs along with power electronics. Electricity is stored in an EV in such batteries and such stored energy is used to power the entire EV. EVs require ready access to energy for charging and operations. At present, the electricity used for charging is largely generated by non-renewable sources of energy and in some few cases through renewable energy sources. The energy sector includes the development, distribution,

[42] Please refer https://e-amrit.niti.gov.in/business-models.
[43] IBID

transmission, availability and sale of electricity for charging EVs or for recharging battery packs of EVs for battery swapping. Power producers of renewable energy sources reduce reliance on traditional non-renewable sources of energy. EVs using such energy produced from renewable energy sources also contribute towards lesser emission of greenhouse gases compared to energy sources from non-renewable sources like coal, fuel, etc.

2.2.2 ***Mobility as a Service ("MaaS")***

With the advancement in technology, the business models in the case of e-mobility have become diverse and there are multiple avenues of monetizing and establishing a thriving business in the e-mobility service industry. Newer business models are not limited to only the sale and purchase of mobility components; rather, services related to mobility are being adopted as a business model. We have discussed a few models where mobility is used as a service below:

(a) Micro-mobility

India has a high traffic density which contributes to the EV enabled micro-mobility a profitable business model[44]. Micro-mobility entails the provision of services for travelling short distances for consumers looking for first mile and/or last mile connectivity. Micro-mobility provides support to the public transportation available in a certain area. The most popular services among micro-mobility sectors are electric rickshaws and electric scooters/bikes. Bike sharing and pick-up drop-off at select locations are another kind of micro-mobility service which are established to be successful business models. Bounce, Zypp, Yulu and Vogo are some emerging companies that offer micro-mobility services.[45]

(b) Ride Hailing

The ride hailing model creates a two-sided market and connects a service provider with the end user over a digital platform. For example, a rider may be able to book a cab as and when required. In such a business model, the company acts as a transportation network company and links self-employed drivers with consumers over a digital platform while collecting a fee for brokering such connection. Ola, SmartE, Rapido and Blu SMart are some examples of this business model.[46]

(c) Car Subscription

Under the car subscription business model, customers are offered a unique opportunity to experience the comforts of a private vehicle without the customer having to bear the cost liability of buying a private vehicle. New subscription schemes are being developed by automobile OEMs like Porche, Volvo and BMW72 and independent platform providers that offer to customers the experience mobility under this business model.[47] Some businesses operating in this sphere are Zoomcar, Drover, Myles and Clutch.[48]

[44] Please refer https://e-amrit.niti.gov.in/mobility
[45] IBID
[46] Please refer https://e-amrit.niti.gov.in/mobility
[47] Supra at 46
[48] Supra at 46

(d) Ride Sharing/Carpooling and Car Sharing

Under the ride sharing business model, the service providers develop a digital platform to allow private individuals with cars to share their ride with travelers who do not own vehicles whose destinations are along the same route as such individuals. Blablacar, vRide, Getaround are some global companies involved in the ride sharing/carpooling business model.[49] There are some regional digital platforms in India that also offer carpooling services like QuickRide.

The car sharing business model is similar to bike sharing but for long distance travel. It entails renting a vehicle for a short period of time and billed on an hourly basis or by distance or both. The consumers are offered the choice between a round trip ride (i.e., customers return the vehicles at the original pick up point), one way ride (i.e., customers return the vehicles to anu authorized parking spot or drop location), free floating (i.e., customers locates a nearest car available using a digital platform and drops it off at any location after use) or station based model (i.e., the customer picks up and returns the vehicles at designated stations authorised by the service provider).

The car sharing business model can be of 3 types: (i) business to consumer model where consumers are offered access to vehicles through subscription, user fee, membership or other pricing models, for example, E-Savari Rentals; (ii) business to business model whether vehicles are available to the employees of a company facilitated by way of a principal to principal fixed term contract, for example, Lithium Urban; and (iii) peer-to-peer where non-commercial private individuals can rent their cars to travelers, for example, Drivezy.

(e) E-roaming

Several operators of charging stations are connected over a digital platform under this business model. Any customer of such operators are able to charge their EVs at the charging stations of the other companies linked through such digital platform. This model allows the charging stations to benefit from improved profitability and capacity utlisation since customers of one operator can make use of charging facilities of the other operators. Not only operators of charging infrastructure but service providers of other mobility services like public transportation, parking facilities, car or bike sharing, etc., can also be connected through the e-roaming digital platform. There are no companies operating in India that utilizes this business model, however, it is not a stretch of imagination to look forward to startups in India adopting this business model once there is sufficient charging infrastructure for EVs developed throughout the country. e-clearing.net, subject, grieve, etc. are companies that are involved in providing e-roaming services outside India.[50]

(f) Digital Payment Services

The Central Government has been promoting the adoption of digital infrastructure in India as a part of which digital payments were introduced in India to facilitate ease of doing business and reduce circulation of black money. Consequently, India is gradually transitioning from the traditional modes of cash payment towards adoption of payments through digital modes. Service Provider in the e-mobility

[49] Supra at 46
[50] Please refer https://e-amrit.niti.gov.in/mobility

sphere have introduced mobile wallets in their online platforms or are entering into contracts with payment gateways to offer the benefit of a cashless ride to its consumers. In the case of EVs, such payment gateways are used mainly for making payments to EV mobility service providers and operators of charging stations or battery swapping stations.

MaaS models can potentially address the issue of over-congestion of roads in India, boost positive environmental practices and tackle the economic divides by ensuring access to transportation to all division of individuals in the society irrespective of their socio-economic position or location.[51] While MaaS is hailed as a revolutionary concept that has the effect of positively disrupting the well-settled trends in India's transportation industry, it remains a developing concept and it will be interesting to note how such concept of MaaS is implemented in a complex and vast market like India.

In the Indian market traditionally, there are private transit options which are competing with the public transportation system. With these private and public transit providers competing with each other, it is difficult to deploy MaaS on a large scale. To give support to the MaaS ecosystem and to realise its potential to the fullest, these private and public transit methods are required to collaborate and coordinate with each other which is not possible without the intervention of the regulators by undertaking systematic changes to support interfacing between such private and public transit providers. Further, the introduction of MaaS models like ride hailing, car subscription, car sharing, e-roaming, etc., is expected to affect the use of traditional public transport by consumers who can afford to engage MaaS services as per their requirements.[52] This can potentially lead to an increase of congestion in the already over congested roads in India by increasing the number of cars on the road. In the Indian road, MaaS services still use traditional ICE vehicles instead of EVs and consequently if the number of cards on roads increase, so will the carbon emissions. Therefore, until EVs or other cleaner modes of vehicles and their support infrastructure do not reach a level of saturation in the Indian market, the MaaS model may actually augment carbon emissions.

In India, existing MaaS services, especially Zoomcar, Ola, Uber, etc., are expensive and is not affordable to a large section of the society. The lower income population groups prefer the public transit resources at subsidized rates over MaaS services. Therefore, until and unless MaaS systems can offer competitive pricing options to customers as compared to public transport, it will be difficult for Indian consumers to show interest in the MaaS framework. Alternately, MaaS services can integrate public transportation options into its models. We can expect to see MaaS models in the future that provide for both private and public transit service providers at competitive prices suitable to the Indian population across socio-economic and cultural barriers.

MaaS service providers do not provide mobility services directly but enable consumer and transit service providers to connect in real time over a digital platform. In this model, from a legal perspective, it is difficult to ascertain on whom the accountability lies in case of safety or quality issues faced by the consumer. Therefore, service providers offering MaaS options have to establish proper governance practices that provide clear process of grievance mechanism and accountability matrix and incorporate safety measures for consumers without

[51] Please refer https://www.linkedin.com/pulse/harnessing-maas-india-jeff-lowinger/
[52] Science Direct, "*Questioning mobility as a service: Unanticipated implications for society and governance*", January 2020 (accessed from https://www.sciencedirect.com/science/article/pii/S0965856418309601).

which the longevity of the MaaS model in the Indian ecosystem nay not be achieved.

2.2.3 ***Infrastructure as a Service***

As discussed in detail in Section 4, infrastructure for EVs in India is still developing and has not reached the stage of saturation where it can provide sufficient support to the EV market in India. Infrastructure requirements for EVs include charging infrastructure, battery swapping stations, and traction battery services.

(a) Charging Infrastructure

For development of charging infrastructure, there are two kinds of service-based business models that the EV sector depends on:

Manufacturers of charging infrastructure

Manufacture and sale of components and equipment for charging EVs is a viable model for generating revenue. The Service Provide provides complete charging solutions for charging of EVs for both private consumers and public institutions along with installation of the necessary hardware and software, maintenance service for the hardware or software and other services to support the charging solutions. These components and equipment can be installed at private, public, residential or commercial buildings. In the near future, we may also come across models where the EV infrastructure is provided by EV manufacturers in partnership with service providers of charging infrastructure.

Delta Electronics, Mass Tech, ABB India, Exicom, Okaya, RRT are a few examples of manufacturers of EV charging infrastructure. [53]

Charging Station Operators

Charging station operators provide a network of EV charging points including, *inter alia*, customer support and network solutions. Different payment options can be like fixed fees, Energy-based fees, Time-based fees, Membership fees, etc., can be offered by such operators to its customers for charging their EVs at their charging stations. In India, the Ministry of Power has clarified that charging stations is in nature of a service and do not perform any activities which require license under the provisions of the Electricity Act, 2003, namely, transmission, distribution or trading of electricity. Consequently, charging stations are not required to procure or maintain any license under the Electricity Act, 2003.[54]

Some examples of charging station operators are Tata Power, EESL, Fortum India, Volttic, Charge Zone, Magenta Group[55]

(b) Traction Battery

The most important part of an EV is its battery, and it contributes to a major portion of the total cost of an EV. The business models for services related to batteries of EVs are:

[53] Please refer https://e-amrit.niti.gov.in/infrastructure.
[54] Please refer https://powermin.gov.in/sites/default/files/webform/notices/Clarification_on_charging_infrastructure_for_Electric_Vehicles_with_reference_to_the_provisions_of_the_Electrcity_Act_2003.pdf.
[55] Please refer https://e-amrit.niti.gov.in/infrastructure.

Recycling of Batteries

Lithium ion is a major component of the batteries of EVs which consist of rare elements like cobalt, nickel and lithium. These elements are available in only select locations in the world and demand for these elements increase as the adoption of EV increases, the non-availability of such rare materials may lead to problems in the supply chain. Therefore, recycling of batteries of EVs is an important business model based on circular economy that focuses on asset utilization. Recycling batteries will not only address supply chain issues but will also reduce any adverse impact on the environment. The pricing of an EV can also be lowered by lowering the prices of the recycled batteries.

Gravita India is an active company in the battery recycling sector.[56]

Battery Subscription

The service providers provide batteries to EV owners on subscription and fee is charged for use of such batteries daily or rates per kilometre basis. This provides the customer an opportunity to procure batteries at a reduced price and therefore reducing the cost of buying an EV.

*Battery-as-a-Service ("**BaaS**")*

Under the BaaS business model, newly manufactured batteries are leased out to the end users, like EV owners, energy storage facilities, etc., for use. Once these batteries reach end of life, the service provider either opts for recycling the batteries by manufacturing new batteries from the raw materials extracted from the old batteries or refurbishes such batteries so that it can be used for behind the meter usage or as energy storage. The BaaS model is also based on a circular economy that focuses on asset maximisation.

Esmito and Sun Mobility are BaaS service providers that operate in India.[57]

Pay as you go

Sun mobility is a key player that has adopted the pay as you go model for payment. Pay as you go is a kind of payment mechanism where the user of a certain kind of service undergoes the payment process before the corresponding service is received. This process is mainly used by spontaneous users who do not have any long-term commitment with a charging station operator or for users who prefer direct payment for services over payment against invoices after procurement of services.

2.2.4 ***Energy as a Service***

Energy is the *sine qua non* requirement when it comes to the EV industry. Sale and purchase of energy is regulated under the Indian regulatory framework. The advent of the EV industry has not only augmented the demand for stable and cheap electricity but has also led to the growth of certain service markets that deal with ancillary aspects of the trading of energy vis-à-vis the EV industry. There are two kinds of business models in the EV industry that utilize energy as a service and are explained in detail below:

[56] IBID
[57] Please refer https://e-amrit.niti.gov.in/infrastructure

(a) Renewable Energy and EV Charging System

One of the main objectives of increase in adoption of EVs in the Indian market is to reduce dependance on traditional ICE vehicles that emit greenhouses gasses in the air thereby leading to climate change. EV is a comparatively cleaner means of transportation. If EVs are charged with energy from traditional non-renewable fossil fuels which also contribute to climate change, the objective of reducing greenhouses gases in the atmosphere is defeated. Therefore, to fully realise the potential of EVs in reducing carbon emissions, the charging infrastructure has to be synced with electricity procured from renewable energy sources. Charging stations particularly, therefore, can prioritize procuring electricity from power producers generating energy from renewable sources through DISCOMS or through the captive power plant model. The charging stations themselves can become power generating stations if solar plants are installed nearby such charging infrastructure and by utilizing the incentives available for installation of solar power plants which will substantially reduce the cost of procurement of energy by the charging stations. Renewable sources of energy coupled with charging infrastructure for EVs is not only beneficial for reducing cardon emission but also provide a cost effective mechanism of both generating and utilizing such clean energy for charging EVs.

The business opportunities that combine both renewable sources of energy and EVs are not only limited to charging stations but also include business models use the EaaS model as detailed below:

Storing excess energy

When we discuss energy generation, a major aspect for efficient utilization of energy is storage of excess energy. Energy once generated either has to be consumed or fed into the public evacuation infrastructure without which such energy is lost. Therefore, energy storage facilities are being developed for efficient utilization of energy which will have a positive effect on the EV charging infrastructure as well. Energy storage is especially important in the EV industry since energy which is stored in batteries can be used to power EVs. Development of energy storage stations and technologies in battery storage are new business models that have direct nexus with the advancement of the EV industry.

Equipment

With the increase in demand for EVs, the demand for the components and equipment related to EVs and its charging infrastructure also rise. The market for components and equipment for EVs is an exciting business opportunity since there is a dearth of sufficient OEMs in the Indian market. One important example in this area are solar inverters that convert energy from direct current to alternating current for use by most devices, including EVs. Therefore, as the demand for EVs increases and EV charging stations are equipped with solar energy systems, there will be a rise in the demand for solar inverters as well to be used in the EVs. Business can be developed around the sale, lease or subscription of such solar inverters by charging stations or solar power plants or as a service provider of complete solutions for solar power generating systems, EV and its charging infrastructure, including trading in charging ports, solar panels, solar inverters, etc.

Smart Solutions

The EV market is constantly in demand for smart solutions for the issues ingrained in the EV industry that operate as a hinderance to adoption of EV in India. There are companies that create smart solutions that make the adoption of EV in India effective and efficient. This business model requires offering creative solutions to clients or stakeholders of EV industry that is causing hindrance to their business models or to any disruption in revenue stream.

(b) Virtual Power Plant (VPP)

A virtual power plant is a cloud-based system which is an aggregation of the capabilities and recourses for the heterogenous distributed energy sources like energy producers and retailers, renewable energy operators, power utilities, EVs OEM and suppliers, solar power equipment, batteries, wind turbines, VPP operators and building managers.[58] This system functions for power generation, intra and inter electricity trade, sale and purchase of power in the Indian market.[59] VPP is an efficient method to trade in the electricity market or in grid balancing. Service providers like EVs, fleet or bus operators, etc., contribute to the development of VPP.

3. POLICY INITIATIVES AND INCENTIVES TO BOOST EV ADOPTION

In the evolving age of electric mobility and the market's increased focus on transitioning to EVs, subsidies and incentives offered by the Union Government and State Governments play a crucial role in making the transition to EVs smoother in India. As specified above, since the subject matter of 'mechanicall propelled vehicles' falls under the concurrent list of the Constitution, both the Union Government and the State Governments have framed laws and issued policies in respect of these matters. In this section, we have dealt with the key policies and schemes of the Union and State Governments and the incentives offered under such policies.

3.1. POLICY INITIATIVES BY THE UNION GOVERNMENT

Given below is a snapshot of the timeline of the policy initiatives introduced by the Union Government to promote local production of EVs and their components, increase EV adoption and develop the charging infrastructure in the country:

[58] Please refer https://e-amrit.niti.gov.in/energy.
[59] Supra at 54

Source: https://e-amrit.niti.gov.in/national-level-policy

- Union Cabinet
- Ministry of Housing and Urban Affairs
- Ministry of Power
- Department of Heavy Industry
- Ministry of Road Transport and Highways

3.1.1. ***Automotive Mission Plan 2006-16 ("AMP-I")***

In December 2006, AMP-I was introduced in India with the goal of making the country a prime destination for designing and manufacturing automobiles and auto parts (with output reaching a level of approximately USD 145 billion, accounting for more than 10% (ten percent) of the GDP) and also providing additional employment opportunities to 25 (twenty five) million people by 2016.[60] While the AMP-I did not deal with the specifics of EVs in India extensively, it provided certain incentives such as investment incentives and exemptions from paying duties which were aimed at the development of infrastructure including for EVs.

3.1.2. ***National Mission on Electric Mobility ("NMEM")***

The Union Government announced the NMEM in 2011. The NMEM set an ambitious target to end sales of petrol/diesel run automobiles by 2030 in India and replace the same by EVs. With a view to initiate the roadmap to achieve this target, NCEM was instituted to serve as the apex government authority for making any decisions on such matters. The DHI also set up NBEM to provide secretary-level support and assistance to the NCEM. Further, NAB was constituted to assist both NCEM and NBEM. However, we note that no significant and substantive plan was drawn to commence the implementation of NMEM until the launch of the Energy Mobility Mission Plan 2020 in 2013.

3.1.3. ***Electricity Mobility Mission Plan ("EMP")***

In 2013, the Union Government introduced the EMP which envisioned the roadmap for faster adoption of all kinds of hybrid vehicles and EVs (xEVs) and their manufacturing to achieve increased sales of xEVs across India. The objectives of EMP were created in a way to improve national fuel security, offer accessible, eco-friendly transportation, and to achieve leadership in manufacturing in the automotive industry. The EMP had also targeted to achieve 6 (six) to 7 (seven) million sales of hybrid vehicles and EVs by the year 2020. However, it was realised that in order to meet such targets, a radical modification of the existing charging infrastructure to support the acceptance of EVs in the Indian market is imperative, and such a modification could be undertaken only with governmental support and coordination of various stakeholders. The EMP therefore provided strategies for faster adoption of EVs which included measures such as demand generation, supply related interventions, encouraging domestic manufacturing, promotion of research and development (R&D), infrastructure support, fuel efficiency, and creation of awareness.

3.1.4. ***Scheme of Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India***

Under the EMP, the DHI notified the FAME Scheme in 2015. The FAME Scheme is the current flagship scheme for promotion in adoption of hybrid vehicles and EVs in India. The scheme was implemented in two phases, from 2015 – 2019 (FAME-I) and 2019 – 2024 (FAME-II).

(a) FAME-I

FAME-I was launched in April 2015 with a financial outlay of USD 109 million and primarily focused on the following four areas:

[60] Ministry of Heavy Industries & Public Enterprise, "*Automotive Mission Plan 2006-2016*", January 2007 (accessed from https://dhi.nic.in/writereaddata/Content/Automotive%20Mission%20Plan%20(2006-2016).pdf).

- *Demand creation*: by incentivizing the consumers of EVs and hybrid vehicles through an upfront reduction in the cost of such vehicles;
- *Technology platform*: by sanctioning certain grants for R&D of EVs and their components;
- *Pilot project*: by sanctioning certain grants for building awareness and increasing utilization of eco-friendly vehicles; and
- *Charging infrastructure*: by sanctioning grants for public charging infrastructure, revision of existing legal framework to enable roll out of infrastructure, and evaluation of designs for optimal charging infrastructure.

The NAB served as the primary operating agency to implement FAME-I. During FAME-I, about 2,78,000 (two lakh seventy eight thousand i.e., two hundred seventy eight thousand) xEVs were supported with a total demand incentive of approximately USD 45 million. Under this scheme, various cities and states have also been sanctioned with 465 (four hundred sixty five) buses. Under FAME-I, the demand incentive amount was determined for each category of EVs (i.e., vehicle, technology, battery types) taking into account the principles of total cost of ownership, cost of maintenance, pay-back period on account of fuel savings, etc.[61]

Based on an independent evaluation of FAME-I, it was found that while the implementation of the plan had commenced, the progress of the implementation of FAME-I was slow and limited. It was further realized that to achieve the objectives of FAME Scheme, sufficient charging infrastructure was required to be established to allow for faster adoption of EVs.

(b) FAME-II

The DHI notified FAME-II on 08 March, 2019 with a financial outlay of approximately USD 1.3 billion to incentivize demand for EVs by providing upfront subsidies and creating EV charging infrastructure. The second phase of the FAME Scheme i.e., FAME-II relied on the main findings of the FAME-I as well as comments received from various stakeholders. This phase commenced with effect from 01 April, 2019 and was rolled out for over a period of 3 (three) years which was further extended for 2 (two) additional years till March 2024. FAME-II mainly focuses on supporting electrification of public and shared transportation and aims to support sale of EVs through demand incentives for 7,090 (seven thousand ninety) e-buses, 5,00,000 (five lakh i.e., five hundred thousand) E3W, 55,000 (fifty five thousand) 4W passenger cars and 10,00,000 (ten lakh i.e., one million) E2W.

It is noteworthy that in comparison to FAME-I, FAME-II offers more upfront incentives for EV purchases and offers subsidies to both manufacturers as well as consumers. However, in order to access the incentives under the FAME Scheme, a range of eligibility criteria for EVs including price, range, speed and usage of local supply chains for manufacturing have been specified. Significantly, to access the incentives under FAME-II, all EVs must be manufactured locally in India and at least 50% (fifty percent) of its components must be sourced domestically. OEMs across categories currently struggle to meet this 50% (fifty percent) localization criteria for manufacturing EVs as most components are largely imported.[62] This is primarily owing to the high upfront cost of electric 4Ws as compared to ICE vehicles, lack of raw materials and lack of infrastructure. We note that as of December 2022, owing

[61] Please refer https://pib.gov.in/newsite/PrintRelease.aspx?relid=191377
[62] Catapult Energy Systems, "*The India Electric Vehicle Opportunity: Market Entry Toolkit*", March 2021(accessed from https://cp.catapult.org.uk/wp-content/uploads/2021/03/210318_1020_CPC_India_Report.pdf).

to the eligibility and enforcement of conditions a total of 7,45,713 (seven lakh forty five thousand seven hundred thirteen i.e., seven hundred forty five thousand seven hundred thirteen) EVs had received support by way of demand incentives amounting to approximately USD 390 million.[63] To bridge this gap and to promote local sourcing of components of EVs, the Union Government introduced the 'Phased Manufacturing Program', discussed below.

We also understand that the Union Government may not extend the FAME Scheme beyond this financial year and may instead offer incentives to EV makers through ongoing production linked incentive programmes, as discussed below.[64]

3.1.5. ***Paris Agreement***

In 2016, India became a signatory to the Paris Agreement with the United Nations Framework Convention on Climate Change ("**UNFCCC**"). The UNFCCC deals with concerns relating to mitigation of greenhouse gas emissions. The ultimate objective of the Paris Agreement is to limit the rise in global average temperature, in order to reduce the dangers and effects of climate change. The Paris Agreement, which came into effect in November 2016, requires its member nations to decide, plan, and periodically report specifics of their role in mitigating global warming. India has been reasserting its commitment to the Paris Agreement through a variety of initiatives such as transitioning to non-fossil fuel-based power sources by encouraging the adoption of EVs. In 2021, Hon'ble Prime Minister of India, Shri Narendra Modi pledged at the COP26 climate summit in Glasgow that India would reach net zero carbon emissions by 2070 and increase its non-fossil energy capacity to 500 GW by 2030. Additionally, he pledged that India would meet 50% (fifty percent) of its energy needs through renewable sources and would cut its overall carbon emissions by a billion times by 2030.[65]

3.1.6. ***Automotive Mission Plan 2016-26 ("AMP-II")***

In January 2016, AMP-II was introduced with the aim to make the Indian automotive industry the engine of the 'Make in India' programme, and being one of the largest contributors to the larger 'Skill India' initiative, The key objectives of AMP-II also include making the Indian automobile industry the largest employment generating engine of the country and enhancing mobility by promoting safe, efficient and comfortable mobility for every person in the country.[66] AMP-II aims to provide sufficient incentives for the quick development of an indigenous component design and manufacturing base with the larger goal of developing India's electric and hybrid vehicle industry.

3.1.7. ***Production Linked Incentive ("PLI") schemes***

The Union Government notified the PLI schemes in various manufacturing industries such as textiles, pharmaceuticals, automobiles, etc., with the goal to attract foreign investments into those sectors, to develop a large-scale manufacturing ecosystem in India, to encourage local manufacture and increase employment levels under its 'Make in India'

[63] Please refer https://pib.gov.in/PressReleasePage.aspx?PRID=1883045
[64] Economic Times, "*India may pull plug on FAME II after next fiscal*", March 2023 (accessed from https://economictimes.indiatimes.com/industry/renewables/india-may-pull-plug-on-fame-ii-after-next-fiscal/articleshow/98463433.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst).
[65] Please refer https://www.pmindia.gov.in/en/news_updates/national-statement-by-pm-at-cop26-summit-in-glasgow/
[66] Ministry of Heavy Industries & Public Enterprise, "*Automotive Mission Plan 2016-2026*", January 2016 (accessed from https://heavyindustries.gov.in/writereaddata/Content/AMP%202016-26%20Final%20Approved%20Draft.pdf).

initiative. The PLI schemes offer incentives to the selected investors either in the form of monetary incentives (disbursed through direct bank transfer) or by way of any other adjusting mechanism. The incentives provided are determined by the investors' eligibility requirements, which take into account factors like incremental sales/turnover (i.e., the difference between total sales of manufactured goods over a given period and total sales of manufactured goods in the base year), incremental investments (i.e., investments made after the end of the base year), and investment commitment. The type of investment depends on the sector in which an applicant falls.

With respect to the EV industry, the two key PLI schemes are as follows:

PLI scheme for automobile and auto components:

This scheme was notified in September 2021 with a total financial outlay of approximately USD 3.46 billion for a tenure of 5 (five) years with disbursement starting from financial year 2023-2024 to financial year 2027-2028.[67] The prime objectives of the scheme include overcoming cost disabilities, creating economies of scale, and building a robust supply chain in areas of advanced automotive technology (AAT) products. The scheme had two components viz. champion OEM incentive scheme and component champion incentive scheme.[68] We note that a total of 95 (ninety five) applicants, including Eicher Motors, Ford India, Hyundai Motor, Kia India, Suzuki Motors, Tata Motors, Hero MotoCorp, TVS Motors, Ola Electric, etc. have been approved under this PLI scheme.[69]

*PLI scheme for advanced chemistry cell ("**ACC**") battery storage*:

The DHI notified the national programme on ACC battery storage in June 2021, with a view to incentivize both domestic and foreign investors to set up ACC manufacturing facilities with 50 GWh production capacity and an additional facility of 5 GWh production capacity for niche ACC technologies. The total financial outlay for the scheme was approximately USD 2.20 billion. We note that the bid was awarded in March 2022 and the selected bidders, Reliance New Energy, Ola Electric Mobility and Rajesh Exports, signed the program agreement under the scheme in July 2022.[70] Under the ACC PLI program, the manufacturing facility would have to be set up within a period of 2 (two) years and the incentive will be disbursed thereafter over a period of 5 (five) years on sale of batteries manufactured in India.

3.1.8. ***Phased Manufacturing Program ("PMP")***

In 2019, to promote the production of EVs, their assemblies, sub-assemblies, and parts, sub-parts, and inputs for sub-assemblies in India, the Union Government launched the PMP under the FAME initiative. This was done in order to gradually increase capacity building within India, address the various challenges and setbacks encountered during the initial implementation of FAME-II, and create job opportunities.

According to the PMP, businesses wishing to take advantage of the FAME-II scheme's incentives must steadily boost the local sourcing of the parts used to build their electric vehicles. By increasing the production of these vehicles and enabling the manufacturers in the industry to plan their investments for establishment of a solid domestic EV and

[67] Please refer https://pib.gov.in/PressReleasePage.aspx?PRID=1757651
[68] The PLI scheme attracted proposed investment of approximately USD 9.10 billion against the target estimate of investment of approximately USD 5.11 billion over a period of five years. The proposed investment of about USD 5.46 billion is from approved applicants under 'Champion OEM Incentive Scheme' and about USD 3.64 billion from approved applicants under the 'Component Champion Incentive Scheme'.
[69] Please refer https://pib.gov.in/PressReleasePage.aspx?PRID=1806077
[70] Please refer https://pib.gov.in/PressReleasePage.aspx?PRID=1846078

related sub-assembly/components manufacturing base in India, the program's goal is to make technology-driven sustainable and holistic mobility solutions universal.

3.1.9. ***National Mission on Transformative Mobility and Storage ("NMTMS")***

Launched in 2019, NMTMS is a multi-disciplinary, inter-ministerial steering committee. The main goal of the committee is to recommend and formulate strategies for transformative mobility and PMP for EVs, EV components, and batteries, to localize production across the entire electric value chain, which is detailed out above. NMTMS intends to drive mobility solutions for benefiting the industry, economy, and the nation. The NMTMS also aims to establish the strategy and roadmap necessary for India to take advantage of its size and scale in order to create a competitive domestic manufacturing sector for electric mobility.

3.1.10. ***Vehicle Scrappage Policy***

The Union Government announced the Vehicle Scrappage Policy in August 2021 which became effective from April 2022. Its aim is to replace outdated automobiles on Indian roads with new and modern models. This policy is based on the idea of a circular economy of waste to wealth and seeks to energise India's auto sector and metal sector under the principles of reuse, recycle and recover. The policy is anticipated to lower emissions, generate employment opportunities, and generate demand for new automobiles.

(a) **Key objectives**: By increasing the use of new, fuel-efficient vehicles, the policy aims to (i) reduce India's reliance on foreign oil imports, (ii) decrease environmental and noise pollution, and (iii) improve road and vehicular safety by removing old, unsafe and unreliable vehicles from the road.[71] Another key objective of the policy is to increase the availability of low-cost recycled inputs for OEMs, such as plastic, aluminium, steel, rubber, and electronics. The ultimate goal is to phase out outdated vehicles, lower urban pollution levels, and boost automotive sales.

(b) **Salient features**: The policy mandates that commercial automobiles older than 15 (fifteen) years and passenger vehicles older than 20 (twenty) years be scrapped if they fail the prescribed fitness and emission tests. Vehicles failing the test (defined as 'end-of-life vehicles'), lose their registration certificate and are recommended to be scrapped. The policy further introduces incentives to scrap old vehicles, including discounts on the purchase of new vehicles against a scrappage certificate.[72] The policy considers factors such as a vehicle's brake performance, engine quality, etc. rather than treating a vehicle as scrap merely because of its age. The policy also supports India's 'Green India' initiative by making room for a fleet of cleaner automobiles.

The execution of the policy will be centered on discounts for qualified users, the creation of a well-connected network of scrapping centres, and the development of infrastructure for the fitness testing of old vehicles. The policy also addresses the intent of all parties, including OEMs, vehicle dealers, MSMEs, exporters, importers, and end users.

(c) **Status of implementation**: The vehicle scrappage policy is also reportedly a component of a bigger stimulus package requested by the OEMs to boost automobile

[71] Please refer https://www.pib.gov.in/PressReleasePage.aspx?PRID=1774214
[72] Please refer https://www.iea.org/policies/16909-vehicle-scrappage-policy

demand. Under the policy, automated testing stations and scrapping facilities will be set up in phases. Currently, 75 (seventy-five) stations have been proposed and this count would gradually scale up to 450 (four hundred fifty) to 500 (five hundred) stations across the country. The Union Government has also invited private players to invest in setting up such stations through partnership with the State Governments and plans to set up 50 (fifty) to 70 (seventy) facilities for scrapping vehicles in the next 4 (four) to 5 (five) years.[73]

3.2. EV POLICIES ADOPTED BY THE STATE GOVERNMENTS

In addition to the Union Government's measures noted above, as indicated above, several states have also implemented policies to boost the usage and production of EVs. While some states intend to increase the consumption of EVs, others, at least initially, have opted to encourage the production of EVs. Nonetheless, it is important to highlight that all state EV policies deal with both categories of incentives, i.e., demand side and supply side, albeit with a focus on one of these depending on their infrastructural capabilities, population, short-term and long-term financial plans, etc. Set out in Annexure 1A are the key incentives indicated under the EV policies of certain states that focus on the supply oriented / manufacturing side incentives. Thereafter, Annexure 1B provides a brief of the demand oriented / consumer side incentives proposed by a few states.

4. CHARGING INFRASTRUCTURE

4.1. LACK OF CHARGING INFRASTRUCTURE IN INDIA

There is significant potential for the growth of EVs in India. In 2018, sales of EVs amounted to approximately 20,000 units. However, between April and September of 2022, this figure had risen significantly to 300,000 units[74]. Despite this progress, EVs have yet to achieve parity with their non-electric counterparts. In 2022, out of the 2,726,047 passenger vehicles sold in India, only about 17,802 were EVs. The main challenge facing the EV sector is the lack of adequate charging infrastructure[75]. One of the primary reasons people are hesitant to switch from traditional vehicles to EVs is the range anxiety and limited on-route charging facilities[76]. Therefore, it is crucial that the increase in charging infrastructure be in line with the growth of EVs, despite the government's efforts to expand the EV market.

One of the biggest challenges faced in the development of charging infrastructure is the high cost of installation and maintenance. The installation of charging infrastructure requires a substantial amount of capital investment. While there are many incentives for EVs in general, there are limited incentives for setting up charging infrastructure. This makes it difficult for small and medium-sized businesses to enter the EV market. Apart from the installation of charging stations, there are also other costs to consider, including maintenance, operation, and software upgrades linked to the station. Since there is not a huge demand for EVs, it is difficult for providers of charging infrastructure to collect investments for their charging stations. The cost of public charging infrastructure is determined mainly by three factors: the cost of the EV

[73] India Brand Equity Foundation, "*Vehicle Scrappage Policy*", September 2021 (accessed from https://www.ibef.org/blogs/vehicle-scrappage-policy).

[74] Forbes, "*EVs Are All The Rage. Will The Charging Infrastructure Catch Up In 2023?*", December 2022 (accessed from https://www.forbesindia.com/article/2022-yearend-special/evs-are-all-the-rage-will-the-charging-infrastructure-catch-up-in-2023/82215/1).

[75] IBID

[76] Business Today, "*Charging Up The EV Sector Through EV Policy Reform*", February 2023 (accessed from https://www.businesstoday.in/technology/news/story/charging-up-the-ev-sector-through-policy-reform-371704-2023-02-28).

Supply Equipment (EVSE), the cost of the property, and the cost of power delivery. All 3 can be significantly decreased by implementing a dispersed charging network of standard power charging stations, which are less costly and require less space and electricity at any given location[77].

Another challenge that is pertinent to point out is the allocation of land for public charging infrastructure. Generally, charge point operators do not own the land, which may lead to challenges for setting up charging infrastructure[78]. There are certain cities where land is scarce and expensive. Generally, parking on the streets is illegal, and there remains a shortage of planned parking spaces in several areas, making space an issue for charging EVs. It is important to bring the local authorities on board to make space for charging infrastructure. The lack of coordination among the authorities is challenging and leads to delays. It is critical to develop clear guidelines for land allocation, streamline the land acquisition process, and collaborate with local communities to address their concerns and promote the benefits of charging infrastructure. To increase the efficiency of land allocation for charging infrastructure, urban/town planning should include schemes in which parking spaces are reserved for public EV charging.

The charging time for an EV to reach 80% capacity depends on the model of the vehicle and the battery, but on average it takes 8-9 hours. With the availability of fast chargers in the market, the charging time has been reduced to 30-40 minutes. However, even with fast chargers, it still takes 35-60 minutes to charge the vehicle up to 80%[79]. In contrast, filling up the tanks of a petrol/diesel vehicle only takes a few minutes. Range anxiety is another significant barrier that deters people from choosing EVs. Range anxiety refers to the fear of the owner or potential owner of an EV that the battery will run out before the vehicle reaches its destination. With limited charging infrastructure in the country, people are reluctant to opt for EVs even if they desire to do so. There needs to be an increase in the expansion of the charging point network to address this issue[80].

However, Indian regulators and government at both the central and state levels are taking measures to address this lacunae in charging infrastructure. The Government of Telangana through its nodal agency Telangana State Renewable Energy Development Company has issued an invitation for bid for development and operation of EV charging station. This is the first time PPP model has been implemented in EV Infrastructure, i.e., charging stations. This model is deemed to be a viable option where the government plans to encourage private players for supply and installation of public charging infrastructure in rural and semi-urban areas. The introduction of PPP is not new to India. And the benefits of the PPP model has been tried and tested in almost all infrastructure sub-sectors. It has been proven in more than one case that PPP model has been instrumental in propelling growth in capital intensive sectors and by creating a win-win model, Government has attracted large private sector investments as well as technical expertise of the private sector. As the EV sector is growing the main challenge for the government is to enhance the growth of EV infrastructure, i.e., charging stations. Implementation of PPP model can work as a necessary catalyst in attracting experienced private entities and required funding for large scale growth of charging infrastructure.

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[77] Niti Aayog, "*Handbook For EV Charging Infrastructure Implementation*", (accessed from https://www.niti.gov.in/sites/default/files/2021-08/HandbookforEVChargingInfrastructureImplementation081221.pdf).

[78] IBID

[79] Economic Times, "*7 FAQs On Charging An Electric Car Answered*", February 2022 (accessed from https://economictimes.indiatimes.com/wealth/spend/7-faqs-on-charging-an-electric-car-answered/whats-the-duration-of-a-charging-session/slideshow/89484860.cms).

[80] Business Today, "*What Is Range Anxiety and How Does It Affect EV Buyers*", May 2022 (accessed from https://www.business-standard.com/podcast/automobile/what-is-range-anxiety-and-how-does-it-affect-ev-buyers-122051600045_1.html).

4.2. CHARGING INFRASTRUCTURE RULES AND REGULATION

Revised consolidated policy and standards for charging infrastructure for EV **("Guidelines")** was introduced by Ministry of Power on 14th January 2022. The aim of the guidelines was to streamline the regulations with respect to charging infrastructure. Major elements in the guidelines include types of charging infrastructure, public charging stations, installations and operation of EV charging infrastructure.

Owners have no restrictions with respect to charging the EVs at their residences/offices using existing electricity connections. Any entity or person can set up the charging stations. Such stations will have to meet the safety and technical guidelines brought about by the Ministry of Power, Bureau of Energy Efficiency and Central Electricity Authority. The stations which are to be established shall be aligned with the safety and technical aspects standardized by the Bureau of Energy Efficiency and Central Electricity Authority[81].

4.2.1 *Procurement of electricity*

In case of procurement of electricity for establishing public charging station, the connection can be acquired from a distribution company and the same shall be released by the distribution licensee. The timelines for application for electricity from the distribution licensees are prescribed in Electricity (Rights of Consumers) Rules 2020. According to the said Rules the electricity is transmitted within 7 days in metro cities, 15 days other municipal areas and 30 days in rural areas. In view of the timelines provided, aspects of a new connection or modification of an existing connection shall be covered within the prescribed timeline. In case of lesser time limit, appropriate commission[82] shall specify the timeline.

Another way vide which any public charging station / chain of charging stations can procure electricity from a generation company is via open access. As per the Tariff Policy an open access can usually be available within 15 days from the date of complete application being submitted by the end user. Further, while procuring electricity through open access an end user, in addition to the cost of electricity, shall have to pay applicable surcharge, transmission charges and wheeling charges.[83]

4.2.2 *Locations of charging stations*

Distance or density plays a role in determining the amount of public charging stations. As per the Guidelines, with respect to public charging stations, at least 1 charging station shall be available within the grid of 3 Km X 3 Km or at the distance of 25 Km on both sides of highways and roads. It is further noted that additional charging stations can also be installed.

In the case of long-range electrical vehicles, at least a fast charging station shall be available at the distance of 100 Kms, on both sides of highways and roads.

4.2.3 *Tariffs*

Tariffs till the year 2025, will be a single part tariff. It shall not exceed the average cost of supply. The tariff applicable for EV public charging station shall be similarly applicable

[81]Government of India, "Charging Infrastructure For EV (EV) – The Revised Consolidated Guidelines and Standards- Reg", January 2022 (accessed from https://powermin.gov.in/sites/default/files/webform/notices/Final_Consolidated_EVCI_Guidelines_January_2022_with_ANNEXURES.pdf).

[82] Section 2(5) Electricity Act, 2003.

[83] Please refer https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1790136#:~:text=They%20will%20be%20required%20to,except%20mentioned%20in%20this%20provision.

for battery charging stations as well. The applicability of tariff for domestic consumption shall be applicable for domestic charging. To make sure if the consumption of the electricity is in consensus with the present tariffs, a separate metering arrangement shall be provided for public charging stations. It is further highlighted that any funding taken by the DISCOMs under Revamped Distribution Scheme for the purposes of general upstream network augmentation would not be charged from the consumers of the public charging stations for EVs[84].

4.2.4 ***Rolling-out process of charging stations***

A rollout process for EV charging stations is also introduced for setting up of the charging stations. In mega cities with the population of 4 million or more, which includes cities like Mumbai, Delhi, Bangalore, Hyderabad, Ahmedabad, Chennai, Kolkata, Surat and Pune, important highways or expressways the rollout process for such stations shall be completed within 1-3 years. And for the next 3-5 years, Phase-II shall begin *vide* which the process of rollout will be completed in state capitals and union territories. The rollout process shall be implemented by various Nodal Agencies at the state level, but at the central level Bureau of Energy and Efficiency will be the Central Nodal agency which shall be responsible for setting up of public charging station. The Bureau of Energy and Efficiency in consultation with the State Governments shall finalize roads and highways wherein public charging station will set up. The state nodal agencies will select an implementation agency and the role of these agencies will be to install, operate and maintain such public charging infrastructures.

Reference can be made to Section 2.1.1 (b) and Section 3.1.4 for further details on Charging Infrastructure Rules and Regulation.

4.3 INCENTIVES FOR DEVELOPING CHARGING INFRASTRUCTURE

National Electronic Mobility Mission Plan, 2020

The National Electronic Mobility Mission Plan (NEMMP) was first introduced in 2013 and was later revised in 2020. The National Electric Mobility Mission Plan (NEMMP) 2020 is a national mission document that provides a goal and blueprint for the country's faster adoption of EVs and manufacturing. The strategy aims to enhance national fuel security, provide affordable and environmentally friendly transportation, and position India's vehicle sector for global manufacturing dominance. In 2015, the Department of Heavy Industries (DHI) announced the Faster Adoption and Manufacturing of EVs (FAME) plan under the NEMMP 2020 to support the production of electric and hybrid vehicle technology and ensure its long-term development. The FAME-2 India plan was introduced with an INR 100 billion investment to encourage the demand for EVs through upfront subsidies and the development of EV charging facilities. The plan aims to fund 1 million electric two-wheelers, 500,000 electric three-wheelers, 55,000 EVs, and 7,090 electric buses through subsidies. Additionally, the plan includes INR 10 billion in funding for the installation of EV charging points. As of 2022, 2,877 EV charging points in 68 towns across 25 states and union territories have been authorized. A total of 1,576 charging points has been approved for nine expressways and sixteen highways[85]. The central and state governments have declared GST rate reductions and road tax exemptions and have invested directly in the electrification of vehicles and the establishment of charging infrastructure. The GST on EVs has been reduced from 12% to 5%, and the GST on chargers and charging facilities

[84] Press Release "*6,586 Operational Public EV Charging Stations In India*", March 2023, (accessed from https://pib.gov.in/PressReleasePage.aspx?PRID=1910392)
[85] Press Information Bureau, "*Ministry Of Heavy Industries Sanctions 1576 EV Charging Stations Across 16 Highways & 9 Expressways Under Phase-II Of FAME India Scheme*", March 2022 (accessed from https://pib.gov.in/Pressreleaseshare.aspx?PRID=1808115).

for EVs has been reduced from 18% to 5%[86]. These measures are expected to further promote the adoption of EVs in the country. The NEMMP 2020 and its associated plans, along with the government's support and investments, demonstrate India's commitment to achieving sustainable transportation and reducing the country's carbon footprint.

5. BATTERY ECOSYSTEM

EVs have a longer usable life than their battery packs and an EV's battery pack may need to be replaced at least once in an EV's lifecycle. An EV battery pack includes battery cells, modules, thermal management casing, battery management systems, and battery housing system.[87] According to CEEW's Report on Financing India's Transition Towards Electric Vehicles, annual battery demand which stood at 5 GWh in 2021 is expected to rise to 158 GWh by 2030, with growth driven by replacement battery purchases as well.[88] This section of the Report deals with the various facets of battery production and management, including:

Battery standards and safety norms:

Operating in highly competitive market conditions such as India, E2Ws and E3Ws manufacturers find themselves competing with traditional ICE models and there is substantial effort to bring down the cost of EVs. Battery packs constitute up to 50% (fifty percent) of the cost of total components.[89] OEMs have started deploying lithium-ion batteries ("**LIB**") to meet the criteria of 'advanced chemistry batteries' to be eligible for incentives under the FAME-II scheme and various other State Government led schemes. India currently relies heavily on imports, which tend to be expensive, for meeting its battery demands.[90] Outright reliance on costly imports may lead to corner-cutting by manufacturers. This coupled with lack of R&D can result in poorly suited batteries being deployed. Recent instances of EVs catching fire have raised concerns around the quality of LIBs being used by EV manufacturers in India. The Union Government has responded to these incidents with introduction of minimum quality and testing standards for EV batteries, as discussed in Section 5.1 above.

Battery value chain:

The battery value chain (more specifically LIB value chain) starts with mining of raw materials such as lithium, manganese, nickel, cobalt, aluminium and copper that make up the key components of an LIB. Lithium along with other raw materials is used for manufacturing battery cells and modules. India has recently discovered an estimated large lithium deposit of 5.9 MMT in Reasi, Jammu and Kashmir.[91] While this is good news for the long-term future, ascertaining the actual extent of deposits and viability of commercial operations such as mining

[86] India Briefing, "*India Tightens Release of FAME-2 Subsidies for EV Makers, May Not Extend Scheme*", March 2023 (accessed from https://www.india-briefing.com/news/indian-government-tightens-release-of-fame-2-subsidies-probes-ev-makers-26973.html/).
[87] Centre for Energy Finance, "*Financing India's transition to electric vehicles*", December 2020 (accessed from https://www.ceew.in/cef/solutions-factory/publications/financing-india-transition-to-electric-vehicles).
[88] Centre for Energy Finance, "Financing India's transition to electric vehicles", December 2020, (accessed from https://www.ceew.in/cef/solutions-factory/publications/financing-india-transition-to-electric-vehicles).
[89] SAE Mobilus, "*A Perspective on Battery Swapping as a Viable Alternative to Accelerate EV Adoption in India*", October 2022 (accessed from https://saemobilus.sae.org/content/2022-28-0056/).
[90] Times of India, "*5.9 million-tonne find in J&K makes India 7th largest reserve*", February 2023 (accessed from https://timesofindia.indiatimes.com/india/5-9-million-tonne-find-in-jk-makes-india-7th-largest-resource-of-lithium-in-world/articleshow/97809105.cms).
[91] Scroll.in, "*Lithium reserves were first mapped in Jammu and Kashmir in 1999. So why is everyone excited now?*", February, 2023 (accessed from https://scroll.in/article/1044066/lithium-reserves-were-first-mapped-in-jammu-and-kashmir-in-1999-so-why-is-everyone-excited-now).

is still in the pipeline. Assuming that lithium mining is viable in India, it would still take some time before a localised supply chain is established. Hence, India may still have to rely on lithium imports from countries such as Australia, Argentina, Bolivia, China and Chile, at least in the medium to long term future. Cost of sourcing lithium and other metals such as cobalt can be brought down by recycling. Battery waste in India was largely being disposed of in landfills. The Union Government recently introduced the Battery Waste Management Rules, 2022 (as discussed in detail in Section 5.2), making it mandatory for waste batteries to be recycled. This is an important regulatory development which will push manufacturers to also invest in recycling infrastructure and minimise the negative impact of waste batteries on the environment.

After the battery cells and modules are manufactured, the battery is put together by assembling the thermal management casing, battery management systems, and battery housing system. According to a study by Avendus Capital, following are the key battery sourcing strategies adopted by the OEMs of EVs: [92]

(i) ***Captive end-to-end production by OEMs***: whereby, the OEMs manufacture batteries in-house including cells. This model has been adopted by vehicle OEMs such as BydAuto;

(ii) ***Captive pack production by OEMs*:** whereby OEMs procure (lithium-ion) cells and manufacture the battery packs in-house. In other words, battery cells are procured and then assembled into battery packs. This model has been adopted by vehicle OEMs such as Mahindra whereby Mahindra sources advanced chemistry lithium-ion cells from LG Chem and then assembles them into battery packs;[93]

(iii) ***Co-developed between cell companies and OEMs*:** whereby OEMs strategically tie-up with cell companies to manufacture batteries. Such strategic tie-ups involve joint development of battery technology between the cell supplier and OEM. A noteworthy example of such a model is Tesla's successful partnership with Panasonic to develop automotive grade lithium-ion cells. More recently, General Motors and LG Chem have followed this model by establishing a joint venture in the US;[94] and

(iv) ***Supply by battery pack manufacturing companies***: whereby battery pack manufacturers procure cells from cell vendors and assemble battery packs with battery management systems to meet the requirements of the OEMs. This model has been adopted by vehicle OEMs such as Daimler.

Traditionally, the auto market has relied heavily on outsourcing of components and has benefitted greatly from the diversified supply chains. However, the growing demand for EVs coupled with supply chain disruptions caused by the pandemic pushed the auto industry towards wanting to have tighter control through vertical integration.[95] Hence, automakers are increasingly joining hands with leading battery manufacturers or setting up their own 'giga-factories'.[96] It would be beneficial for Indian auto makers to have end-to-end capabilities

[92] Avendus, "*Electric Vehicle: charging towards a bright future*", July 2020 (accessed from https://www.avendus.com/crypted_pdf_path/img_5efde54946e837.06392761_EVReport2020_Avendus.pdf).
[93] Nikkei Asia, "*Mahindra ties up with LG Chem for lithium-ion battery cells for India*", February 2018 (accessed from https://asia.nikkei.com/Business/Automobiles/Mahindra-ties-up-with-LG-Chem-for-lithium-ion-battery-cells-for-India2).
[94] Reuters, "*LG Energy Solution, GM to build $2.1 billion battery factory in U.S.*", January 2022 (accessed from https://www.reuters.com/business/autos-transportation/lg-energy-solution-gm-build-21-bln-battery-factory-us-2022-01-25/).
[95] Mint, "*Mahindra open to investing in EV battery cell maker to secure supplies*", July 2022 (accessed from https://www.livemint.com/companies/news/mahindra-open-to-investing-in-ev-battery-cell-maker-to-secure-supplies-ceo-11657446560464.html).
[96] Forbes, "*Tesla's Long-Time Partner Panasonic Building $4 Billion EV Battery Plant In Kansas*", July 2022 (accessed from https://www.forbes.com/sites/alanohnsman/2022/07/13/teslas-long-time-partner-panasonic-building-4-billion-ev-battery-plant-in-kansas/?sh=1d424a3d6c51).

including battery cell manufacturing capabilities to drive down costs and make battery cells more suited to Indian conditions. In this respect, the Union Government has floated incentives to boost battery manufacturing through the PLI scheme for ACC battery storage. Further, various State Governments have also incentivised battery cell production through State level EV policies (as discussed in Section 3.2 above).

Battery swapping:

OEMs, especially those in the E2W and E3W market, have been innovating, developing interoperable batteries which can be swapped at battery swapping stations. The swapping approach dubbed as "battery-as-a-service" is being pursued by policy makers as an important part of the EV charging infrastructure in India. This approach has been discussed in detail in Section 5.3 below.

5.1. BATTERY STANDARDS AND SAFETY NORMS

In the past year, multiple incidents have been reported where EVs have spontaneously caught fire, even while standing still, or when they are in motion.[97] Not only has this resulted in the manufacturers coming under scrutiny from authorities,[98] these manufacturers (for example, Ola Electric, JitendraEV, Okinawa, and PureEV among others) have had to recall their vehicles and undertake a diagnostics check across all systems, especially the battery management system ("**BMS**") and the thermal system.

The Centre for Fire Explosive and Environment Safety ("**CFEES**"), (the regulatory and research arm of the Defence Research and Development Organisation) engaged in fire, incendiary products, and environmental safety, in an investigation, has determined that the defects found in the battery packs of these EVs were the cause of these fires. It was discovered that the LIBs employed in the vehicles was made of "low-grade components", done to save costs. Further, problems with the batteries' thermal management systems were discovered as they were not able to deal with the release of excessive heat from cells. These problems may have gone unnoticed in the initial due to limited, and at times, insufficient testing of rechargeable batteries under various temperature settings. Since these battery cells are not being produced in India, the country must rely on the global market to supply its EV manufacturing needs.[99]

Difference in the usage period of the vehicle throughout the day, and varying charging patterns of the consumers are other reasons highlighted for these fire incidents. The reports suggest that the algorithm in the BMS should be extensively tested to adjust and accept the dynamically varying conditions.[100]

Relying on these suggestions and in order to guarantee that the EV ecosystem conforms with global standards, the Union Government has issued a number of criteria to address battery safety issues. These standards are covered in more detail below.

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[97] Mint, *"Why EVs Catching Fire in India"*, April 2022 (accessed from https://www.livemint.com/auto-news/why-electric-vehicles-catching-fire-in-india-11650889269746.html); Inc42, *"Ather Blames Wiring Harness Assembly Issues For Bengaluru EV Fire"*, February 2023 (accessed from https://inc42.com/buzz/ather-blames-wiring-harness-assembly-issues-for-bengaluru-ev-fire/).

[98] Indian Express, *"EV fires: Govt sets up panel to suggest certification, testing SOPs for batteries"*, July 2022 (accessed from https://indianexpress.com/article/business/commodities/ev-fires-govt-sets-up-panel-to-suggest-certification-testing-sops-for-batteries-8013657/).

[99] Times of India, *"Breaking down reasons why Indian electric vehicles need batteries made in India"*, May 2022 (accessed from https://timesofindia.indiatimes.com/blogs/voices/breaking-down-the-reasons-why-indian-electric-vehicles-require-batteries-made-in-india/).

[100] Times of India, *"Breaking down reasons why Indian electric vehicles need batteries made in India"*, May 2022 (accessed from https://timesofindia.indiatimes.com/blogs/voices/breaking-down-the-reasons-why-indian-electric-vehicles-require-batteries-made-in-india/).

5.1.1. ***New standards for battery safety***

As discussed in Section 2.1.2(c) above, the MV Act and the rules framed thereunder govern the functioning and manner of usage of motor vehicles (as well as EVs) in India, including the specifications and standards to be conformed with by a manufacturer of motor vehicles. As stated above, Rule 124 of the CMVR was amended in August 2022 to empower the Union Government to notify the relevant standards specified by the BIS with regards to any component or assembly to be used for manufacturing a vehicle including EVs.

In furtherance of the above amendment, the MoRTH had on August 29, 2022, issued amendments to AIS 156 (applicable to vehicles of category L (motorcycles)) and to AIS 038 Rev.2 (applicable to category M (motor vehicles used for carriage of passengers) and N (4Ws or more used for carrying both passengers and goods)) ("**Amended Standards**").[101] These standards provide for safety requirements with respect to the rechargeable electrical energy storage system ("**REESS**") of vehicles of the above-mentioned categories. These Amended Standards, effective in a phased manner from December 1, 2022 (Phase 1) and March 31, 2023 (Phase II), include, *inter alia,* additional safety requirements related to battery cells, BMS, on-board charger, design of battery pack and thermal propagation due to internal cell short circuit leading to fire. Some of the key technical requirements mentioned in the revised standards are:

S.no	Key features	Brief Particulars
1.	Standards for battery packs	• No fire or explosion should happen during any of the tests conducted for safety purposes; • REESS should: (a) have pressure release vent provided to avoid building up of internal pressure and release of gases in case internal single cell short circuit; (b) have additional safety fuse or circuit breaker in addition to the features available in BMS; (c) be traceable in order to keep a track of cells, BMS, charger used, etc.; and (d) be verified for safety features during testing against over-voltage protection, over-charge protection, over-discharge protection, over-temperature protection, overcurrent protection and short circuit protection. • Cells should: (a) have a manufacturing date clearly written with clear month and year of manufacture; and (b) have sufficient cell-to-cell spacing distance in order to be effective for heat transfer from the cell and also to isolate the cells in case of thermal run away in REESS.
2.	Standards for chargers	• Chargers should have: (a) voltage cut-off to avoid over charging;

[101] Please refer https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1856114

S.no	Key features	Brief Particulars
		(b) time-based charge cut-off function which shuts off further charging based on timeout; (c) pre-charge function to detect over-discharge condition of battery; and (d) input supply variation protection, output voltage and current regulation.
3.	Thermal Propagation Test ("**TPT**")[102]	• REESS manufacturer should: (a) document the risk to vehicle user and bystanders caused by thermal propagation; and (b) have audio visual warning for early detection of thermal event/gases in case of thermal run away of cells. • During TPT of REESS, there should be no evidence of fire or/and explosion.

In addition to the Amended Standards, the BIS had also published test specification standards for 'Lithium-ion Traction Battery Packs and Systems (Performance Testing) for Electrically Propelled Road Vehicles' in June, 2022.[103] The standard includes a test method for assessing the basic performance characteristics, dependability, and electrical functionality of battery packs and systems designed for high-power or high-energy applications. The standard was developed with real-world situations in mind, such as EVs being parked for extended periods of time without using the battery, the battery system being stored during shipping, and the battery being operated at both low and high temperatures. To account for these scenarios, a range of tests have been included in the standard.

5.2. BATTERY WASTE MANAGEMENT

The surge in demand and use of LIB in EVs (and otherwise in energy storage systems) requires a relook at the management of battery waste. Over time with continuous use, a battery's capacity reduces – depreciating it and making it obsolete. Typically, an EV's LIB has a life of around 6 (six) to 8 (eight) years.[104] After an LIB's capacity falls below 80% (eighty percent) (an end of life battery or an "**EoL battery**"), it needs to be replaced or repurposed.[105] If spent batteries are disposed of improperly, environmental problems will arise in the near future when several used EVs start becoming obsolete.[106] Battery waste is typically managed using a variety of practices ranging from landfilling, incineration and full or partial recycling.[107]

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[102] TPT is a test to evaluate the ability of REESS to withstand thermal propagation which is triggered by an internal short circuit.

[103] Please refer https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1836787#:~:text=The%20standard%20IS%2017855%3A%202022,power%20or%20high%20energy%20application

[104] India Spend, "*India's Looming Electric Vehicle Challenge: Spent Batteries*", April 2021 (accessed from https://www.indiaspend.com/earthcheck/indias-looming-electric-vehicle-challenge-spent-batteries-742352).

[105] *Id.*

[106] The Guardian, "*Millions of electric car batteries will retire in the next decade. What happens to them?*", August 2021(accessed from https://www.theguardian.com/environment/2021/aug/20/electric-car-batteries-what-happens-to-them).

[107] *Environmental impacts, pollution sources and pathways of spent lithium-ion batteries*, 12 JOURNAL OF ENERGY AND ENVIRONMENTAL SCIENCE 2021 (accessed from https://pubs.rsc.org/en/content/articlelanding/2021/ee/d1ee00691f).

An EV's LIB consists of lithium, nickel, cobalt iron, copper and aluminium; all of which are in short supply and valuable. In addition to preventing release of toxic chemicals in the environment, recycling of EoL batteries can also help recover valuable resources, ultimately reducing dependence on mining and, in India's case, reducing the dependence on imports as well. Thus, recycling of EoL batteries is the preferred option for minimising the impact on environment.

5.2.1. ***Introduction of new battery waste management rules***

So far, a large volume of e-waste containing spent lithium-ion and other batteries has ended up in landfills in India.[108] Until recently, the Batteries (Management and Handling) Rules, 2001 ("**Old Rules**") governed the management and disposal of battery waste. These rules only applied to lead-acid batteries, thereby, entirely leaving out LIBs out of its scope. The Union Government notified the Battery Management Rules on August 22, 2022 to replace the Old Rules.

(a) Scope and applicability:

The Battery Management Rules have brought about an overhaul of regulation of management of battery waste in India, since the provisions of the Old Rules were insufficient to address the automotive industry at its current stage of evolution. They apply to all types of batteries – electric vehicle batteries, portable batteries, automotive batteries and industrial batteries irrespective of the shape, volume, weight, material composition and use.[109]

The Battery Management Rules also introduces new concepts like Extended Producer Responsibility ("**EPR**") for batteries introduced by the producer in the market; centralized online portal; environmental compensation, etc., which have been explained in more detail below.

(b) Key responsible parties and stakeholders:

The Battery Management Rules have affixed responsibility on distinct entities across the battery waste management process. These key stakeholders and their responsibilities are briefly discussed below:

Producers:

A 'producer' has been defined as an entity engaged in manufacturing or selling new and refurbished batteries or importing batteries including equipment comprising such batteries. It is mandatory for producers to collect batteries for recycling/refurbishment – prohibiting disposal of batteries in landfills or disposal by incineration. Producers must meet targets for recycling and refurbishment set by the Battery Management Rules. The targets are set based on the type of battery, i.e., portable, consumer electronics battery or automotive battery. It also depends on the average lifecycle of a battery. Based on such factors, incremental targets have been set for producers to collect a minimum percentage of the batteries placed by them in the market in prior years. Producers must ensure the recycling or refurbishment of such collected batteries under the EPR framework.

They may either achieve these targets on their own or engage other entities for the same. Although it must be noted that the primary responsibility for attaining these targets lies with the producers. Producers must manage waste batteries in a manner

[108] Observer Research Foundation, "*Recycling Li-ion batteries: Opportunities and challenges*", June 2020 (accessed from https://www.orfonline.org/expert-speak/recycling-liion-batteries-opportunities-challenges-68409/).
[109] Rules 1 and 2, Battery Waste Management Rules, 2022.

to protect human health and environment against any adverse effects.

Further, producers are also mandated to ensure the following in relation to the production of batteries:

- safe handling of batteries and waste batteries to avoid any damage to human health and environment;
- compliance with the minimum use of domestically recycled materials thresholds provided in the Rules for the production of new batteries;
- in case of imported batteries, the producers are required to meet such minimum domestically recycled materials thresholds by utilizing the prescribed minimum quantity of recycled materials in other businesses or exporting such quantity of recycled materials; and
- compliance with the requisite labelling requirements prescribed under the Rules.

The Battery Management Rules require the producers to register with the CPCB and submit an EPR plan with the CPCB and the relevant SPCB. If producers fail to comply with the provisions of the rules or do not meet the EPR targets as prescribed under the rules, their registration may be cancelled or they may be required to pay environmental compensation, a novel concept introduced by the Battery Management Rules, as discussed in detail below.

Consumers:

Under the Battery Management Rules, the consumers are mandated to dispose of waste batteries separately from other waste streams such that the waste or EoL Batteries are disposed of in an environmentally friendly way by giving them to a company that collects, refurbishes or recycles batteries.

Refurbishers and recyclers:

The Battery Management Rules prescribe that refurbishers and recyclers must register on the centralised online portal with the relevant SPCB. Further, they must adhere to the CPCB's guidelines as well as other relevant regulations, such as those governing the management of hazardous waste such as plastic waste management rules, solid waste management rules, etc. They must also submit quarterly reports in prescribed forms comprising of information in relation to the waste batteries that they have collected or received from various sources, the quantity of batteries they have refurbished or recycled, the quantity of hazardous, solid, plastic, and/or other wastes they have produced as a result, etc. Recyclers are also mandatorily required to meet minimum recovery targets for recovering battery material as set by the Battery Management Rules.

Public waste management authorities:

The Battery Management Rules mandate public waste management authorities ("**PWMAs**") to hand over the collected waste batteries to producers for recycling or refurbishment (or the agencies engaged by the producers in this respect). Battery waste may also be handed over to entities engaged in recycling or refurbishment or it can be recycled or refurbished by the PWMAs themselves.

Pollution control authorities:

CPCB and SPCB have been designated as the authorities for registering, auditing and ensuring compliance with the Battery Management Rules. Under the rules, these authorities have been given the power to, *inter alia*, (i) issue guidelines and procedures for the collection, storage, transportation, recycling, and refurbishing of

waste batteries; (ii) issue registrations to various stakeholders; (iii) conduct inspections and periodic audits to verify compliance of the rules by producers, refurbishers, recyclers; and (iv) take actions against violations and non-fulfilment of obligations under the Battery Management Rules (including the EPR obligations).

The Battery Management Rules also require the CPCB to constitute an implementation committee for the effective implementation of the Rules.

(c) Salient features and new concepts:

As stated above, in addition to the expansion of the scope of applicability of the Battery Management Rules (in terms of the nature of batteries regulated as well as the key players), the Battery Management Rules has introduced the following new concepts:

Centralised web portal and EPR framework:

The Battery Management Rules provide for setting up of a portal to allow registration of producers, recyclers, refurbishers; filing of return by various stakeholders; and to enable exchange of EPR certificates between producers and recyclers or refurbishers.

The CPCB has been obligated thereunder to set up a portal, which may also be used by the relevant SPCBs. The Battery Management Rules intend that this web portal will act as a single point data repository with respect to orders and guidelines related to its implementation.

The portal is also the mechanism through which the CPCB would generate the EPR certificates to be issued to recyclers and refurbishers based on the quantity of battery waste recycled or refurbished by them. The recyclers or refurbishers can sell the EPR certificate assigned to them to the producers in exchange for waste batteries. The producers may purchase such EPR certificates from recyclers and refurbishers and adjust the quantities of waste so recycled/refurbished against their liability. The Battery Management Rules clarify that the EPR certificates once used by the producers to meet their EPR obligations cannot be exchanged again.

As per the Battery Management Rules, the web portal would reflect the balance EPR obligation of the producers as well as the details of the audit of producers and entities involved in refurbishing and recycling of waste batteries.

Environmental compensation:

The Battery Management Rules have also laid down certain circumstances wherein a fine may be levied: (i) on entities operating without registration; (ii) for providing false information/deliberate concealment of important facts by registered entities; (iii) for submission of forged/manipulated documents by registered entities; and (iv) for unsound handling of battery waste by entities involved in its collection, segregation and treatment.

Further, the CPCB has been entrusted with the power to suspend or cancel the registration of a producer and even impose environmental compensation under circumstances of violation of the Battery Management Rules. However, the payment of environmental compensation does not absolve the producer of its EPR obligations. The power to levy environmental compensation has also been given to SPCBs in relation to non-compliance of the Battery Management Rules by entities involved in refurbishing and recycling as well as entities in collection, segregation and treatment

of waste batteries. Importantly, it must be noted that the funds collected under environmental compensation will be utilised in the management of uncollected and non-recycled waste batteries as per the press release in relation to the Battery Management Rules.[110]

It is pertinent to not postpone the preparations and planning around management of waste batteries as a problem to be dealt with in the future. Policymakers can anticipate the issues that may arise due to improper waste management of batteries and the introduction of the Battery Management Rules is definitely a step in the right direction.

5.3. BATTERY SWAPPING

Battery swapping is fast emerging as a reliable method of battery charging currently deployed in India.[111] Battery swapping is a form of EV charging through a detachable battery. When a battery's charge gets depleted, the depleted battery can be replaced within minutes at a battery charging station. Hence, this model also obviates the need to own an EV battery and instead is intended to provide battery-as-a-service ("**BaaS**").[112] Under the BaaS model, technical and operational standards for battery interoperability have to be maintained after taking into account solutions from relevant market players.[113]

- Swapping in E2W and E3W segments: Battery swapping is beginning to gain momentum as a potential alternative to plug-in charging in the micro-mobility segment. Battery swapping's deployment in E2Ws and E3Ws is promising as it is relatively easier for micro-mobility companies/fleet operators to agree on standardised batteries with OEMs.[114] Further, commercial fleets will benefit from higher up-time of vehicles as the time spent on charging would be minimised.
- Swapping in passenger car segment: In contrast, it is much more difficult to arrive on a standardised battery for the passenger car segment.[115] Passenger cars are of a much more complex make than E2Ws and E3Ws so converging on a common standard for batteries would mean OEMs would have to carry out several design and technical changes in their vehicles. Passenger car OEMs would be more uncomfortable in giving up control over vehicular design to integrate standardised batteries. Currently, OEMs in the passenger car market compete with each other on several parameters with battery technology and range being a crucial one. In the absence of standardised batteries, it would be economically untenable for battery swapping stations to keep large stocks of batteries with different specifications for passenger cars. Further, the massive weight of batteries in passenger cars would make swapping harder. It would require investment in swap stations with robotic arms making the infrastructural requirements much more expensive.[116] Further, it is unclear if passenger car owners would be receptive to the idea of swappable batteries — a component that constitutes a majority of the vehicle's cost — given the strong sense of 'ownership' associated with cars.

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[110] Please refer https://pib.gov.in/PressReleasePage.aspx?PRID=1854433
[111] Centre for Energy Finance, "*Laying the Groundwork for Electric Vehicle Roaming in India*", July 2021 (accessed from https://www.ceew.in/cef/solutions-factory/publications/CEEW-CEF-EDRV_Laying_the_Groundwork_for_EV_Interoperability.pdf).
[112] Please refer https://www.niti.gov.in/sites/default/files/2022-05/Battery_swapping_report_09052022.pdf
[113] Please refer https://www.niti.gov.in/sites/default/files/2022-04/20220420_Battery_Swapping_Policy_Draft.pdf
[114] Medium, "*Has Battery Swapping's time arrived?*", October 2019 (accessed from https://medium.com/astercapital/has-battery-swappings-time-arrived-ce454e23bcfe).
[115] Medium, "Has Battery Swapping's time arrived?", October 2019, (accessed from https://medium.com/astercapital/has-battery-swappings-time-arrived-ce454e23bcfe).
[116] Economic Times, "*Opinion: How interoperable battery swapping can bring EVs to mainstream"*, February 2022 (accessed from https://auto.economictimes.indiatimes.com/news/auto-components/opinion-how-interoperable-battery-swapping-can-bring-evs-to-mainstream/89715885).

With this context, it becomes imperative to discuss the key players in the BaaS domain, advantages of battery swapping and salient features of the battery swapping policy to understand the battery swapping ecosystem in India in specific.

5.3.1. ***Value chain in the battery swapping ecosystem***

The entire battery swapping ecosystem consists of distinct players such as battery swapping operators ("**BSOs**"), battery manufacturers and EV OEMs. We understand that a single entity may perform all these roles by combining its manufacturing, operational and other technical capabilities; or may collaborate and coordinate with other entities to set up a battery swapping value chain whereby each entity performs distinct functions and fulfils specific responsibilities to develop the battery swapping ecosystem in the country. We have attempted to analyse and discuss the key players and their role in the value chain below:

(a) Vehicle/powertrain designing, manufacturing and commercialisation (OEMs)

OEMs involved in manufacturing EVs, manufacture the entire EV with the battery pack pre-installed. However, under the upcoming BaaS models, OEMs may also supply the EV without a pre-installed battery in the E2Ws and E3Ws segment. Such OEMs include legacy OEMs such as Hero and Ashok Leyland as well as new age OEMs such as Ola.

(b) Swap station designing, installation and operation (BSOs)

BSOs include companies that design, install and operate the battery swapping stations. They act as BSOs removing the discharged battery from an EV and installing a charged one.

In order to implement BaaS models in their vehicle lines, OEMs may choose to partner with BSOs to develop EVs that use interoperable/standardised batteries. OEMs and BSOs may collaborate and operate under the following models:

- OEMs and BSOs partner to develop standardised batteries and EVs which support such interoperable batteries; BSOs manufacture the swappable batteries; and BSOs provide battery swapping services to EV customers/fleets who have purchased such EVs with swappable batteries. For instance, Sun Mobility is one such player that has partnered with OEMs such as Piaggio to develop standardised batteries. Sun Mobility manufactures such batteries and provides them to customers of Piaggio's EV on a BaaS model and also operates charging/swapping stations;
- OEMs partner with BSOs to enable the use of standardised batteries in EVs; OEMs manufacture the swappable batteries themselves; and BSOs develop compatible battery swapping stations and provide battery swapping services to EV customers/fleets who have purchased such EVs with standardised batteries. An example of this business model is Battery Pool which collaborates with OEMs to enable the sale EVs with swappable batteries by operating battery swapping stations compatible with such batteries; and
- BSOs independently develop standard interoperable batteries that may be fitted in E3Ws (primarily e-rickshaws, e-autos, etc.) and provide battery swapping services to such E3Ws users.

(c) Battery manufacturers

This category includes manufacturers of swappable battery packs. This category includes legacy manufacturers of battery such as Exide and Amara Raja. However, as discussed above, newly emerging players in the BaaS ecosystem who act as BSOs may also be manufacturers of batteries as is the case with Battery Smart.

(d) Consumers

The customer may choose to buy the vehicle with the battery or opt to subscribe to BaaS offered by the BSO. In the BaaS ecosystem, there are primarily two kinds of customers:

- Individuals (whether for personal or commercial use); or
- Fleet operators.

Consider the example of Sun Mobility in this regard. It is a venture capital backed start-up in the BaaS ecosystem in India. Sun Mobility has set up more than 180 (one hundred eighty) swapping stations in 18 (eighteen) cities in India. It further aimed to set up 320 (three hundred twenty) more swapping stations by the end of the last quarter of the financial year 2022-23.[117] Sun Mobility partners with auto OEMs to enable battery-less EV sales. It produces batteries compatible with the OEM's vehicle and provides battery swapping services through its swapping stations' network. Customers do not need to own the batteries; rather they pay for the energy utilised by them in what is a pay-as-you-go model. Sun Mobility also partners up with large corporate fleets to provide them with complete vehicles along with batteries on a subscription basis. This eliminates the need for these fleet operators to make massive capex commitments towards fleets and provides the flexibility to scale or shrink their fleets based on need. Other examples of companies innovating in the BaaS segment include Ola, Honda Power Pack Energy, Battery Smart, etc.

The following table represents some players in the battery swapping ecosystem by category and illustrates the overlaps/vertical integration.[118]

Name	Vehicle/powertrain manufacturers (EVs sold with or without battery)	Swap station design, installation and operation	Battery manufacturers
Hero Electric	✓		
Piaggio	✓		
Mahindra Electric	✓		✓
Ola	✓	✓	✓
RACEnergy	✓	✓	✓
Battery Pool		✓	
Lithion Power		✓	

[117] Deccan Herald, "*SUN Mobility to almost triple EV battery-swapping network*", November 2022 (accessed from https://www.deccanherald.com/business/business-news/sun-mobility-to-almost-triple-ev-battery-swapping-network-1166900.html).
[118] Data based on publicly available information.

Name	Vehicle/powertrain manufacturers (EVs sold with or without battery)	Swap station design, installation and operation	Battery manufacturers
Amara Raja		✓	✓
Sun Mobility		✓	✓
Honda Power Pack Energy		✓	✓
Battery Smart		✓	✓
Exide Industries			✓

In the BaaS ecosystem, players acting as BSOs may also be involved in leasing out fleets of vehicles to commercial operators on a subscription basis (an aspect that may fall under the new age service model known as Mobility-as-a-Service or "**MaaS**"). This segment is rife with innovations and it is expected that more players may expand their business models to exploit the huge potential in serving commercial fleets.

Innovation in EV end use through MaaS:

MaaS is a diverse and integrated approach to travel/ transportation and is most commonly used in context of combining the use of various forms of transport services into a single mobility service accessible on demand. It entails providing continuous and seamless travel solutions to people in cities. It may combine the use of public transit systems like metro and last mile connectivity options such as e-bikes on a simple platform to take a user from point A to point B. The platform may have a common payment system for all modes of transport. Out of the emerging models in the fast evolving MaaS space, the following are being widely implemented:

- Demand responsive transport: This model involves demand responsive transport services such as ride hailing platforms like Uber that connect passengers with cab drivers through the use of a mobile application. Lately, there has been an increase in collective transportation operating under this business model such as UberPool where several riders may be pooled together in a car/ minibus.
- Vehicle sharing: Under this model, a user can borrow a vehicle such as an e-bike, a car or a two-wheeler for short durations and return the vehicle at any location. This may involve large fleets of e-bikes owned by a single provider (such as Yulu Bike) or a peer-to-peer car rental service (such as Zoom Car).

As the mobility sector grows, we may see all these different models being integrated with each other. For instance, rideshare apps (Uber and Ola), peer-to-peer rental services (Zoom Car) and micro-mobility services (Yulu Bike)—all current examples of MaaS solutions—may work in tandem. Such business models comprising MaaS have been discussed in detail in Section 2.2.2 of this report.

The ultimate idea of MaaS is to club all these offerings with public transit systems on a single application where a user can plan their trip and make payments without having to book multiple modes of transport on separate platforms, much like the all-in-one Finnish mobility app 'Whim' which combines different public transportation modes in a single app and allows the users to plan, book and pay for their trips on the same platform.

5.3.2. ***Benefits of battery swapping***

Battery swapping could also help overcome the pain-points currently associated with the wired charging:

(a) **Reducing EV Cost:** Under the BaaS model, an EV could be purchased without a battery and batteries could be used as subscribed commodities which can be swapped out.[119] As stated above, batteries currently constitute 50% (fifty percent) of the entire EV cost in India.[120] Successful implementation of the BaaS model could be a significant catalyst in EV adoption by bringing down the up-front cost of EV ownership.

(b) **Managing the load limits on the grid**: Charging through plug-in methods can increase the load on the electrical grid during peak hours when electricity demand is at its highest. During peak hours, the grid infrastructure is at its limit and electricity is procured at a high cost from short-term markets to meet the shortfall thereby increasing energy prices.[121] Typically, the electricity demand in urban areas such as Delhi is the highest at night and this time coincides with the charging time of EVs (with most home chargers being used overnight).[122] In contrast, a swapping station could decide when to charge the batteries and this could be done at times when the grid is not hitting peak demand for electricity.

(c) **Infrastructural advantages**: The plug-in chargers that have currently been deployed at charging stations are slow and capable of charging only one vehicle at a time. A BSO, on the other hand, can stack up batteries and charge them together for swapping. This makes battery swapping more effective and less capital-intensive in terms of the infrastructure required.

(d) **Low charging downtime compared to plug-in charging**: One of the key concerns of EVs is the long-time taken to charge compared to ICEs.[123] By decoupling charging of batteries with their use, battery swapping addresses the key issue of point charging by eliminating the time taken to charge the EV. E2Ws and E3Ws can be charged in a few minutes, with times comparable to traditional refuelling. This is a key development for fleets of EVs in commercial operation as charging downtime was a huge hurdle in deployment of EVs especially with E3Ws with small batteries.

5.3.3. ***Draft Battery Swapping Policy, 2022***

Currently, battery swapping is only commonly seen in the micro-mobility segment, particularly amongst commercial fleets. Mass consumer adaptation of battery swapping will only be possible if there are enough BSOs with the requisite inventory of supported batteries. If there are too many battery specifications in the market, then it will become cumbersome for BSOs to manage battery inventories. Invariably, the entire ecosystem depends upon collaboration between industry players. Hence, there is a need for a

[119] Please refer http://india.nri.com/media/gctkkiw2/20220308_whitepaper-baas_vf2.pdf
[120] SAE Mobilus, "*A Perspective on Battery Swapping as a Viable Alternative to Accelerate EV Adoption in India*", October 2022 (accessed from https://saemobilus.sae.org/content/2022-28-0056/).
[121] Emerging Technology News, "*Battery swapping stations: Can they improve grid flexibility?*", March 2022 (accessed from https://etn.news/iesa-contacts-menu/4822-battery-swapping-stations-can-they-improve-grid-flexibility).
[122] Emerging Technology News, "Battery swapping stations: Can they improve grid flexibility?", March 2022 (accessed from https://etn.news/iesa-contacts-menu/4822-battery-swapping-stations-can-they-improve-grid-flexibility).
[123] International Institute for Sustainable Development, "*Investor Perspectives on Accelerating Growth in the Indian EV Ecosystem*", August 2022 (accessed from https://www.iisd.org/system/files/2022-08/investor-perspectives-growth-indian-electric-vehicle-ecosystem.pdf).

national level policy on battery swapping to ensure such collaboration between industry players. The Niti Aayog announced the Draft Battery Swapping Policy in April 2022 with the aim of bringing about a large-scale adaptation of EVs through the help of the BaaS model. An official policy is expected to be in place to fast-track the collaboration between OEMs. However, no consensus on standards has been reached so far which has delayed the announcement of the policy.[124] Some of the key highlights of the draft policy are as follows:

(a) Standardisation

The draft policy which focuses on E2Ws and E3Ws, provides for technical and operational requirements for players in the battery swapping ecosystem. These standards would act as the baseline minimum to ensure interoperability of equipment. The draft policy talks about the need to have principles and technical standards to enable interoperability of components other than batteries. Some of the requirements to ensure interoperability such as battery pack dimensions and charging connectors may be prescribed by the Union Government. Further, according to the draft policy, the Ministry of Power/BIS/any other competent authorities are responsible for laying down the standards for battery swapping stations. In this regard, a work programme called 'ETD 51' is being jointly led by the BIS and Department of Science & Technology where standards for interoperable batteries, charging stations, interconnection points, etc. are being developed.[125] So far, as mentioned above no consensus has been reported but it is expected that the same can be expected in the short-term.

The draft itself is not entirely clear regarding the extent to which batteries would be required to be standardised.[126] Manufacturers of EVs in the E2Ws segment have adopted diverse designs for their vehicles with distinct connectors, designs and dimensions. Hence, it would be difficult to converge to an interoperable standard without making several companies' R&D on batteries redundant.[127] The industry participants have relayed similar concerns to the Union Government that fixing of battery specifications may stifle innovation in the battery segment as players will not be able to differentiate themselves against the competition.[128] According to news reports, the Union Government has rolled back on its initial plans and it now intends to make battery swapping standardisation norms voluntary.[129] Further, the focus of the prospective policy would be more towards safety and performance.[130] The aim of the Union Government is to have multiple interoperable standards in the market. One concern that arises from making the norms voluntary is the lack of incentive for auto companies to adhere. However, it would be in the best interest of OEMs in the E2Ws and E3Ws segment to collaborate as the lack of plug-in chargers in the country

[124] Financial Express, "*Battery Swapping Policy decision on standards likely by end of January*", January 2023 (accessed from https://www.financialexpress.com/express-mobility/battery-swapping-policy-decision-on-standards-likely-by-end-of-january/2936262/).
[125] EV Reporter, "*BIS to publish new Indian standards for EV charging in India*", March 2021 (accessed from https://evreporter.com/bis-to-bring-new-indian-standards-for-ev-charging/).
[126] The Hindu, "*Industry divided over impact of battery swapping on innovation*", October 2022 (accessed from https://www.thehindu.com/business/industry-divided-over-impact-of-battery-swapping-on-innovation/article66057805.ece).
[127] Please refer https://www.niti.gov.in/sites/default/files/2022-05/Battery_swapping_report_09052022.pdf
[128] The Hindu, "*Industry divided over impact of battery swapping on innovation*", October 2022 (accessed from https://www.thehindu.com/business/industry-divided-over-impact-of-battery-swapping-on-innovation/article66057805.ece).
[129] Business Standard, "*Battery-swapping design norms to be voluntary, policy to be out this month*", January 2023 (accessed from https://www.business-standard.com/article/economy-policy/battery-swapping-design-norms-to-be-voluntary-policy-to-be-out-this-month-123010301069_1.html).
[130] *Id.*

would be a serious hindrance to their own growth. Further, having too many standards of swappable batteries in the market will lead to confusion amongst consumers and threatens to undermine the entire BaaS model. Thus, any policy finalised by Union Government must walk the thin line between ensuring adequate level of standardisation without compromising on R&D and being user friendly.

(b) Safety

The draft policy also provides for implementation of standards approved or defined by the BIS for EVs, battery safety, technical specifications, etc. According to the draft policy, batteries should be tested as per Automotive Industry Standards (AIS) 156 and 036, testing protocols and relevant regulatory standards. All batteries should have a BMS for battery monitoring and data analysis in order to prevent overheating issues that cause battery fires. Further, EVs with swappable batteries should be tested as per the applicable regulatory standards. OEMs must obtain approval of ARAI for their vehicles to accept swappable batteries. It must be noted that since the publication of the draft policy, new standards for battery safety have been implemented as discussed above in Section 5.1.

OEMs have also expressed their concern over the issue of sub-standard batteries entering the market at the hand of unprofessional manufacturers. Any safety issues caused by such batteries could cause damage to the entire ecosystem. The policy draft does provide for testing of batteries in line with the prescribed BIS standards. In addition, other components in the battery swapping design such as connectors would also be subject to testing and standards for the same may be prescribed. Further, the draft prescribes rigorous standards of testing and self-certification for testing the fitness of swappable batteries employed. The batteries should be open to testing to check their combability with various systems, and capability to meet safety requirements.

(c) Direct subsidies

The draft policy also talks about extending the existing demand side incentives (under the FAME-II scheme) to EVs sold with swappable battery systems. Further, battery providers will also be eligible for subsidies as long as they are in a swapping ecosystem that satisfies the prescribed technical and operational requirements. Subsidies may be linked to the Unique Identification Number (UIN) of EVs to avoid double dipping and contracts may need to be signed between EV users and battery providers for a minimum duration to ensure battery providers continue to provide swapping services after receiving battery-linked subsidies. However, it must be noted that the FAME-II scheme may not be continued beyond the financial year 2023-2024 as reports have emerged and the focus of the Union Government is to boost EV production through PLI schemes.[131]

(d) Indirect subsidies

As per the draft policy, the BSOs will benefit from (i) reduced electricity charges under the time-of-day tariff regimes (cheaper energy prices when demand is low), (ii) land from public entities and government for establishing charging stations, (iii) possible reduction of GST on LIBs, and (iv) power supply to BSOs at concessional prices ensured by State Governments.

[131] Business Standard, "*Centre likely to discontinue second phase of Fame-II scheme after FY24*", March 2023 (accessed from https://www.business-standard.com/article/economy-policy/centre-to-discontinue-second-phase-of-fame-ii-scheme-after-fy24-report-123030700389_1.html).

It is clear that EVs are the future of mobility and batteries are the most important component of EVs. For ensuring a smooth transition to EVs, it is *sine qua non* to have a robust battery supply and value chain in India. LIB seems to be the most favoured battery chemistry due to its high energy storage capacity. For the time being, India will need to rely on imports of lithium and other metals used in battery cell production. However, domestic value addition needs to go beyond putting together battery packs towards manufacturing battery cells locally. This will prove to be an important step in bringing down the cost of EVs. The Union Government has hoped to boost local production of LIBs through the PLI scheme for ACC battery storage. However, more of such incentives would be required considering the scheme did not cover smaller players as the net worth criteria of the scheme was INR 225 crore (approximately USD 27 million).

Locally produced battery cells would also play an important role in the 'indigenisation' of battery cells for local conditions. The safety concerns prompted the Union Government brought amendments to the CMVR to require EV batteries to be BIS compliant. Further, the BIS standards for battery safety and testing were also updated. Reports that the imported battery cells were not suited to Indian conditions must also act as a prompt for the players in the private sector to increase R&D expenditure on batteries.

To locally produce batteries, it is important that all avenues of sourcing lithium and other precious metals used in LIBs are tapped into and recycling of LIBs is of utmost importance for minimising reliance on imports and decreasing harmful impacts of waste batteries ending up in landfills. With the number of EVs on Indian roads projected to rise sharply — aim of having 30% of vehicles would mean an estimated annual battery capacity of 158 GWh would be required by financial year 2030.[132] The introduction of the Battery Management Rules was again a step in the right direction and marked a significant shift in the regime as compared to the Old Rules. The introduction of EPR would ensure that accountability flows from the top of the value chain and the question of apportionment of responsibility does not arise. The same has to be followed-up with proper implementation on the part of the Union Government and the relevant State Governments.

With such a sharp increase expected in battery demands, it would naturally mean that the charging infrastructure also has to move at a similar pace. So far, the policymakers' idea is to rely on battery swapping as a solution for the E2Ws and E3Ws segment (which also constitute majority of automobile sales in India). There is an urgent need for a government backed policy in this regard. However, that has not stopped automobile makers from initiating collaborations for developing common standards for batteries. BaaS models made possible by battery swapping will also help shape consumer decisions as currently, cost is a significant hurdle in EV penetration in a price sensitive market like India.

[132] Centre for Energy Finance, "*Financing India's transition to electric vehicles*", December 2020 (accessed from https://www.ceew.in/cef/solutions-factory/publications/financing-india-transition-to-electric-vehicles).

6. COMPARATIVE ANALYSIS

Comparative Analysis of EV policies of certain Asian countries

Topic	India	Japan	China	Korea	Singapore
EV Adoption Stage	- The EV technology in India is still growing. - There are many targets set by the government to achieve sustainability. One of the major targets being making the country net zero by the year 2070[133]. Setting up of fast charging station, subsidizing EVs and EV infrastructure, convenience of charging on the go led to the adoption stage in India. - EV though a very promising sector, is still at a nascent stage. India's growth is expected to reach to 5 Million in 2025[134].	- Japan is the home to some of the best automobile industries including Toyota, Honda and Nissan. - Japan has been known to make their mark in the market of hybrid vehicles. - Japan's EV penetration rate of 1% is lower than the worldwide average of 4% automakers, such[135].	- China is at a very progressed stage when it comes to adoption of EV. - China plans to be carbon neutral by 2060[136]. - China is not only ahead when it comes manufacturing and usage of EV, but also is very advanced when it comes export of EVs [137].	- The EV adoption stage is progression in South Korea. - The South Korean government aims to be responsible for 10 % of global EVs[138]. - EV purchases made for approximately 5.5% of the South Korean car market during the period of 2021, compared to 9.4% in China and 2.3% in the United States[139].	- The pace of adoption of EVs had been slow due to a variety of factors. - The factors including the high cost of EVs, limited charging infrastructure, and the relatively small size of the Singaporean market. - In the initial five months of 2022, EVs accounted for 8.4% of all new registrations, which is more than double the rate for the entire year of 2021[140].

[133] Hindustan Times, "*COP27: India Unveils Strategy For Net Zero Goal By 2070, Takes Moral High Ground*", November 2022 (accessed from https://www.hindustantimes.com/india-news/cop27-india-unveils-strategy-for-net-zero-goal-by-2070-takes-moral-high-ground-101668447611871.html#:~:text=The%20overall%20climate%20finance%20requirement,into%20over%20100%20pages%20said.).

[134] India Business & Trade, "*Indian Automobile Industry Set To Be Charged With EVs*", January 2023 (accessed from https://www.tpci.in/indiabusinesstrade/blogs/indian-automobile-industry-set-to-be-charged-with-evs/).

[135] Nickel Institute, "*How EV Markets Differ: The Curious Case of Japan*", October 2021 (accessed from https://nickelinstitute.org/en/blog/2021/october/how-ev-markets-differ-the-curious-case-of-japan/).

[136] China Dialogue, "*China's 2060 Carbon Neutrality Target: Opportunities And Challenges*", October 2020 (accessed from https://chinadialogue.net/en/climate/chinas-2060-carbon-neutrality-target-opportunities-and-challenges/?gclid=Cj0KCQjwla-hBhD7ARIsAM9tQKsfU37HipIgaXVBefDu4i1zQG_W0kYIg_mEbWCEDsq5cuBa2WH6MSUaAh2sEALw_wcB).

[137] Wired, "*China Is Racing To Electrify Its Future*", June 2022 (accessed from https://www.wired.com/story/china-ev-infrastructure-charging/).

[138] Technavio Blog, "*South Korea's Plan To Boost Its EV Industry*", January 2020 (accessed from https://blog.technavio.org/blog/south-korea-boost-electric-vehicle-industry).

[139] Just Auto, "*South Korean EV sales almost double in January-September*", November 2021 (accessed from https://www.just-auto.com/news/south-korean-ev-sales-almost-double-in-january-september/).

[140] Channel New Asia, "*Take-up for electric cars jumps, registrations this year already twice the rate for all of 2021: Iswaran*" June 2022, (accessed from https://www.channelnewsasia.com/singapore/electric-cars-registration-ev-green-transport-sustainability-2733691).

Topic	India	Japan	China	Korea	Singapore
Special Governance Framework/ Features	- India's EV policy, i.e. NEMMP was announced in 2013, through which two schemes were introduced including FAME-I and FAME -II. - Apart from NEMMP, significant guidelines were introduced which were specific to charging infrastructure, i.e. revised consolidated policy and standards for charging infrastructure for EV. - The purpose of above-mentioned policies, guidelines and schemes are to encourage faster adoption of EVs through various incentives and schemes.	- As far as the policy initiatives in Japan is concerned the government aims to focus and re-focus on rules pertaining to efficiency. - Some of the key focuses of the government of Japan includes public procurement of EVs, expanding charging facilities, and large-scale investment in EV supply lines. - To support the carbon neutral goals that the government had set up as a target by the year 2050 LDVs may be reinforced to realise the above-mentioned goal[141].	- In July 2014, the State Council of China issued the Guiding Opinions on Accelerating the Popularisation and Application of New Energy Vehicles, which laid out a comprehensive plan to promote the adoption of EVs. - The plan covered various aspects such as the construction of infrastructure, technology and innovation, financial subsidies, and tax benefits. - The Guiding Opinions also specified that EVs should be the preferred choice for government procurement [142].	- South Korea, has been committed to promoting eco-friendly vehicles since 2011 through the implementation of its EV policy. - This policy has been driven by the country's strong environmental stance, which seeks to reduce greenhouse gas (GHG) emissions and fine particulate matter from large manufacturing sectors and transportation. - With the transportation sector accounting for more than 20% of fossil energy usage in South Korea, the need for a sustainable alternative has become imperative[143].	- In Singapore, the regulations pertaining to EVs are not governed by a single, comprehensive legislation. Instead, they are dispersed across several subsidiary legislations under the Road Traffic Act (Chapter 276). - The Road Traffic (Vehicular Emissions) Tax Rules 2017 is one such legislation, which outlines the criteria for calculating the vehicular emission tax for taxable vehicles, including EVs. The Road Traffic (Motor Vehicles, Quota System) Rules is another legislation that governs the issuance of certificates of entitlement for vehicles, including EVs. - The Road Traffic (Motor Vehicles, Registration and Licensing)

[141] Global EV Outlook 2021, "Policies to promote EV deployment", (accessed from https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment).

[142] CMS, "*EV Regulation And Law In China*", (accessed from https://cms.law/en/int/expert-guides/cms-expert-guide-to-electric-vehicles/china).

[143] International Energy Conference "*Study On Electrical Vehicle Policy In South Korea As A Lesson Learning For Indonesia*", (accessed from https://iopscience.iop.org/article/10.1088/1755-1315/927/1/012003/pdf).

Topic	India	Japan	China	Korea	Singapore
					Rules is yet another legislation that covers the licensing fees and rebates for EVs. Lastly, the Road Traffic (Motor Vehicle, Construction and Use) Rules is responsible for regulating the construction and installation of electrical apparatus and circuits in EVs[144].
Special Policies For Adoption	- India since 2013 has formulated a lot of policies including NEMMP, FAME. - As reiterated in the above paragraphs, the main focus of the FAME policy was to cover the aspects of technology, pilot projects, technology development and infrastructure for charging. - The focus on E2W and E3W have increased via these policies. The FAME scheme has been extended till 2024. The funds of the scheme was also increased[145].	- In October 2020, the Prime Minister of Japan announced the nation's goal to achieve carbon neutrality by 2050. - In December of the same year, the Ministry of Economy, Trade and Industry (METI) unveiled the Green Growth Strategy, which outlines action plans for 14 sectors to reach this target.	- China has implemented policies to encourage the adoption of plug-in EVs. -Subsidies were also introduced including tax reduction, low loan interest. - Subsidies were also introduced on public charging stations as well.	- Guidelines were set for steady adoption of EVs. An increase in the funding for subsidies of EV was by 57%. - The plan was to subsidize 99,950 EVs[147]. Tax for EV falls under Article 127 (Tax Base and Tax Rate) of the Local Tax Act as other passenger vehicle. - On purchase of an EV, 5% reduction is given in order to encourage growth of EV in South Korea.	- In Singapore, the government has taken several initiatives to encourage the adoption of EVs. - One such initiative is the EV Early Adoption Incentive, which provides a refund on the Additional Registration Fees (ARF) for EVs. -Additionally, the government has revised the traffic tax structure to promote the

[144] CMS, "*EV Regulation And Law In Singapore*" (accessed from https://cms.law/en/int/expert-guides/cms-expert-guide-to-electric-vehicles/singapore).

[145] E-Vehicle Info, "*Government Policies and Incentives for EVs in India*" March 2022 (accessed from https://e-vehicleinfo.com/government-policies-and-incentives-for-electric-vehicles-in-india/).

[147] HEV TCP, "*Republic of Korea Major Developments in 2020*" (accessed from https://ieahev.org/countries/Republic-of-Korea/).

Topic	India	Japan	China	Korea	Singapore
		Specifically for the transportation sector, the strategy aims to increase the use of EVs[146].			use of electric cars, signaling its commitment to reducing carbon emissions and promoting sustainability [148].
Policies/Steps for Mitigation of Hurdles	- One of the major issues which causes hurdles in the market of EV in India is the lack of adequate infrastructure structures. - the scheme FAME-II includes INR 10 billion in funding for the installation of EV charging points. As of 2022, 2,877 EV charging points in 68 towns across 25 states and union territories have been authorized. A total of 1,576 charging points has been approved for nine highways and sixteen roads[149]. - Due to unorganized urban planning in the country, overcrowding is one of the major issues that people face. To deal with the above-mentioned issue the	- One of the major issues persisting in Japan with respect to adoption of EV is monopolisation of by hybrid automobiles. - Japan in order to increase the usage of EV proposed various strategies which were a combination of grants for research, development, and demonstration projects, regulatory reforms related to EV. Tax incentives for capital investment, research and development were also introduced to	- China had introduced number of subsidies in order to promote EVs. - However, due to the high cost of providing subsidies and the large price differential between EVs and conventional internal combustion engine (ICE) vehicles, the government had decided to phase out the subsidies by the end of 2020. - Instead, car manufacturers will be required to meet a mandate that a certain percentage of	- South Korea has always been committed to increase the usage of EVs. There are certain shortcomings in various aspects including concerns such as design, safety, speed. - In order to address these concerns Hyundai Motor Group, had launched an Electric Global Modular Platform (E-GMP). - E-GMP is an underlying structure vide which Hyundai and Kia EVs are built. Few of the features include skateboard type platform,	- One of the biggest hurdles in Singapore is lack of adequate charging stations. - In December 2014, the Land Transport Authority (LTA) and the Economic Development Board (EDB) issued a Request for Information (RFI) to launch the initiative. - The plan aims to introduce 1000 EVs and a charging infrastructure network with 2000 charging stations[152].

[146] Global EV Outlook 2021, "*Policies to promote EV deployment*", (accessed from https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment).
[148] SP Group, "*FAQs for Drivers*", (accessed from https://www.spmobility.sg/support/what-is-singapore-doing-to-encourage-adoption-of-electric-vehicles).
[149] Press Information Bureau, "*Ministry Of Heavy Industries Sanctions 1576 EV Charging Stations Across 16 Highways & 9 Expressways Under Phase-II Of FAME India Scheme*", March 2022 (accessed from https://pib.gov.in/Pressreleaseshare.aspx?PRID=1808115).
[152] Science Direct, "*Planning Car-Lite Neighbourhoods: Examining Long-Term Impacts Of Accessibility Boosts On Vehicle Ownership*" (accessed from https://pdf.sciencedirectassets.com/277910/1-s2.0-S1876610217X00404/1-s2.0-S1876610217364044/main.pdf?X-Amz-Security).

Topic	India	Japan	China	Korea	Singapore
	government has announced its intention to create dedicated mobility zones specifically designed for EVs.	boost up the sales of EV [150]	all vehicles sold each year must be battery-powered. In order to meet this requirement, manufacturers must earn a stipulated number of points each year based on a complex formula that takes into account range, energy efficiency[151].	integrated into the floor of vehicle, which increases the space in the vehicle hence making the design more efficient.	
Battery	- As the growth of EV begins, there will be an increase in the usage of lithium-ion as well, and because India does not have adequate resources, there will be a rise in prices of import. - The government is currently looking to make self-sufficient batteries by discovering local options. - Recently large lithium deposit was discovered in Reasi in Jammu & Kashmir. But mining of lithium deposit is still a challenge that Government will need to find solution for.	- Japan has always been a significant player when it came to EV battery industry. - Recently, i.e, March 2023, Japan and United States signed a deal. The agreement aims to ensure a steady supply of these minerals, which are essential for the production of lithium-ion batteries used in EVs. - By prohibiting the implementation of export restrictions,	- China currently holds the title of the world's largest EV market, responsible for over 40% of global sales in 2022, with 1.3 million cars sold. - Contemporary Amperex Technology (CATL), a Chinese battery manufacturer, holds a considerable share of roughly 30% of the global EV battery industry.	- Battery makers take a dip globally to 12.3 per cent from 19.6 per cent[155]. - The Korean market for battery makers include LG Energy Solution Ltd, SK Innovation Co. and Samsung SDI Company - With respect to LG Energy Solution the global ranking dropped from 19.6% to 12.3%.	- Despite being a small market for EVs and EV batteries, Singapore has been proactive in developing its EV industry and promoting the uptake of greener modes of transportation. - The country has been directing significant investments towards research and development in battery technology, charging infrastructure, and mobility solutions, with

[150] Global EV Outlook 2021, "*Policies To Promote EV Deployment*", (accessed from https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment).
[151] MIT EI, "*China's Transition To EVs*", November 2020 (accessed from https://energy.mit.edu/news/chinas-transition-to-electric-vehicles/).
[155] Business Standard, "Three South Korean EV Battery Maker's Global Market Sinks In 2022", January 2023 (accessed from https://www.business-standard.com/article/markets/three-south-korean-ev-battery-maker-s-global-market-sinks-in-2022-123010400539_1.html).

Topic	India	Japan	China	Korea	Singapore
		the two countries aim to encourage cooperation and trade in the EV battery market[153].	- According to Darton Commodities, Chinese factories supplied 85% of the world's battery-ready cobalt, a mineral essential in securing lithium-ion batteries, in the previous year[154].		the aim of establishing itself as a leading hub for EV innovation and advancement.
Insurance Products	- According to the Motor Vehicles Act of 1988, it is mandatory to have insurance coverage for any car you purchase, particularly third-party liability insurance. - This insurance coverage provides protection to you in the event that an accident involving your EV causes harm to a third party's person or property.[156] - Bajaj Allianz EV insurance provides professional help for all EV inquiries or problems relating to the covered car, its battery, charging	- Japanese insurers are competing to provide telematics-based car insurance policies, which they claim will lead to lower rates for drivers who practice safe driving habits. - These pay-as-you-drive or pay-how-you-drive policies rely on data collected by vehicle-mounted devices, including mileage, driving patterns, and other	- One of the largest markets of EV's is China. The EV premium in China is 20% higher than the usual vehicles. - The reason for the same is the high electrification of the Chinese mobility sector[159]. - Another reason for the increase in the premium is the safety concerns attached to EVs. In 2021 alone 640 fire	- According to a Korean Re report, the growing use of EVs have fueled the development of the EV auto insurance industry in Korea. - Insuring EVs can be more expensive due to their higher cost compared to non-electric counterparts. - In 2021, the average real cash value of EVs was 2.7 times that of conventional cars. For personal auto insurance	- EV in Singapore have encountered several challenges, such as paying higher insurance rates, receiving fewer insurance quotes, and facing inconvenience when transporting their vehicles for maintenance. - These issues highlight a disparity in the EV landscape in Singapore. While the

[153] Reuters " *US, Japan Sign Trade Deal On EV Battery Minerals*", March 2023 (accessed from https://www.reuters.com/business/autos-transportation/us-japan-strike-trade-deal-electric-vehicle-battery-minerals-2023-03-28/).

[154] The Guardian, "*Battery Arms Race': How China Has Monopolised The EV Industry*", November 2021 (accessed from https://www.theguardian.com/global-development/2021/nov/25/battery-arms-race-how-china-has-monopolised-the-electric-vehicle-industry).

[156] Mint, "*Purchased New EV? Here's A Quick Guide For Electric Car Insurance!*", September 2022 (accessed from https://www.livemint.com/brand-stories/purchased-new-electric-vehicle-here-s-a-quick-guide-for-electric-car-insurance-11662038859152.html).

[159] HT Auto, "*EVs Attract As Much As 20% Higher Insurance Premiums In China, Know Why*", October 2022 (accessed from https://auto.hindustantimes.com/auto/electric-vehicles/evs-attract-as-much-as-20-higher-insurance-premiums-in-china-know-why-41664787735538.html).

Topic	India	Japan	China	Korea	Singapore
	stations, and so on[157].	information, to determine insurance premiums[158].	incidents were registered which were caused by these vehicles[160].	policies in Korea, the typical premium for EVs was $698.50 (KRW 943k), significantly higher than the $564.43 (KRW 762k) premium for gas-powered cars. Between 2018 and 2021, the average premium for EVs increased by 34.5%, while regular car premiums increased by 11.2%[161]	government has made considerable efforts to promote EV usage, with plans to improve infrastructure and provide financial incentives, the insurance market has not kept up with the pace of development [162].

[157] Times of India, "*Bought An EV? Now Protect The EV With EVs Insurance*" February 2023, (accessed from https://timesofindia.indiatimes.com/spotlight/bought-an-ev-now-protect-the-ev-with-electric-vehicle-insurance/articleshow/98200530.cms).

[158] Nickel Institute, "*How EV Markets Differ: The Curious Case of Japan*", October 2021 (accessed from https://nickelinstitute.org/en/blog/2021/october/how-ev-markets-differ-the-curious-case-of-japan/).

[160] IBID

[161]Insurance Asia, "*EVs To Drive Motor Insurance Growth In South Korea*", December 2022 (accessed from https://insuranceasia.com/insurance/in-focus/electric-vehicles-drive-motor-insurance-growth-in-south-korea).

[162] The Business Times, "*Premiums For EVs Still Relatively High As Insurers Struggle To Price*", (accessed from https://www.businesstimes.com.sg/companies-markets/transport-logistics/premiums-evs-still-relatively-high-insurers-struggle-price).

7. HURDLES IN EV PENETRATION IN INDIA

While there is no doubt that EVs have several benefits especially for the environment when compared to the traditional ICE vehicles, it cannot be ignored that move from ICE vehicles to EVs is at is nascent stages in India. Consumers have been facing several issues in switching to EVs, which acts as a major hurdle in smooth electrification in India. We have discussed below some of the major hurdles that needs to be addressed to realize full potential of EVs in the Indian market.

7.1. REPUTATIONAL CONCERNS WITH EV COMPANIES

A spate of high-profile battery fires has caused some reputational damage to EVs, particularly in the E2Ws segment that forms a majority of the country's registered EVs. Several fire incidents throughout the country which also resulted in casualties raised concerns about the regulation and safety standards of this rapidly growing segment of the automobile industry.[163]

As discussed in Section 5.1, these EVs catching fire prompted the Union Government to investigate the issue. A probe by CFEES revealed production defects with the batteries' BMS — the software for managing battery performance monitoring based on data analysis. Further, it was revealed that poor quality cells were used in the batteries that caught fire. The batteries also lacked a proper venting mechanism (i.e., poor thermal management systems) for the release of excessive heat from cells. According to the CFEES probe, the BMS which forms the basic function of cutting-off battery in case of overheating was not able to do this task properly. Lastly, the report reveals that several OEMs cut corners which ultimately resulted in these incidents.

Claims circulating that the batteries got overheated due to higher temperature conditions in India strengthens the need for proper testing and quality control keeping in mind Indian conditions. This requires updating testing standards and standards regulating the making of batteries. The Union Government has updated the battery related standards and further regulations regarding battery safety and design of swappable batteries are also in the pipeline.[164] The standards implemented so far are for battery cells, on-board charger, battery management system, design of battery pack, and thermal propagation due to internal cell short circuit. Regulatory changes in relation to batteries undertaken by the Union Government have been outlined in greater detail in Section 5.1. While public confidence in EVs has not dipped as per the reported sales,[165] market participants would do well by going the extra mile to restore consumer optimism in their products. They may be able to do so through following best-in-class safety standards over and above the prescribed ones and voluntary third-party certifications.

7.2. EXCESSIVE ELECTRICITY DEMAND

As a part of the EV 30@30 campaign[166], India is aiming to have EVs account for 30% (thirty percent) of all new automotive sales by 2030. The EV industry is pegged to grow at a CAGR of 90% (ninety percent) until 2030.[167] It is estimated that, the demand for electricity to power EVs

[163] Times of India, "*How new policies will impact overall growth of EV industry in 2023*", December 2022 (accessed from https://timesofindia.indiatimes.com/blogs/voices/how-new-policies-will-impact-overall-growth-of-ev-industry-in-2023/).
[164] Battery swapping safety standards.
[165] Analytics Mag, "*Explosion of India's EV Battery Manufacturing and Its Troubles*", August 2022 (accessed from https://analyticsindiamag.com/explosion-of-indias-ev-battery-manufacturing-and-its-troubles/).
[166] Please refer https://www.cleanenergyministerial.org/initiatives-campaigns/ev3030-campaign/.
[167] Analytics Mag, "Explosion of India's EV Battery Manufacturing and Its Troubles", August 2022 (accessed from https://analyticsindiamag.com/explosion-of-indias-ev-battery-manufacturing-and-its-troubles/).

in India is projected to increase to almost 640 TWh by 2030 and later to 1,110 TWh.[168]

The Union Government aims to increase EV penetration significantly by 2030. The demand for electricity for charging EV batteries will further increase, putting further strain on the country's electricity grid. However, setting up charging infrastructure is proving to be a chicken and egg problem, as EV uptake is constrained by the lack of available infrastructure, low utilization is a hurdle for investment.[169]

7.2.1. ***Grid overload during peak hours***

While the larger issue of adequate power generation is not a huge concern since India's current installed power capacity (at 382 GW) has a comfortable buffer of 27 GW to power any huge and sudden surge in demand. In any case as far as usage is concerned, EVs account for, and will continue to account for, only a tiny fraction of power under generation. The total energy demand for EVs is expected to be approximately 37 TWh by 2030. The total energy production by 2030 is expected to be around 2075 TWh.[170] Thus, the total energy consumption by EV charging would represent a meagre 1.7% (one point seven percent) of the total energy demand. National grid issues such as power generation and transmission inadequacy during peak demand periods and overloading of distribution cables and transformers during demand spikes caused by EV charging need to be addressed.[171] Policymakers have sought to address the issue of managing spikes during peak demand hours by offering time-of-day charging incentives to promote charging during lower demand hours. Another solution to this problem is charging through battery swapping (as discussed in Section 5.3 above) — decoupling battery charging and use.

7.2.2. ***Electricity production through fossil fuels***

Coal is currently the largest source for power generation in India. Thermal energy produced through burning of coal results in release of harmful emissions that have adverse environmental consequences and affects human health. Currently, electricity demand for EVs is being met by thermal power produced from coal. Meeting increased electricity production through burning of coal is not ideal given the increased threat of climate change. Therefore, to meet future electricity demand, it will be necessary to tap safer and cleaner sources.

India is rapidly increasing its renewable energy generation capacity and has pledged to install 500 GW of power capacity by 2030 powered by renewable sources. However, renewable energy which primarily comprises of solar energy is in excess during the day while it cannot be generated during the night. Even though wind energy would be available during the night, but it is seasonal, and the intermittency of wind energy may be a cause of concern. With the advent of battery technology, batteries would soon be deployed for large scale energy storage thereby allowing solar energy generated during daytime to be utilised during the night hours. The growth in the EVs has also seen a significant growth in the lithium-ion battery industry in the country. The recent discovery

[168] Inc42, "*How Electric Vehicles Will Impact Electricity Demand, India's Grid Capacity*", April 2020 (accessed from https://inc42.com/features/how-electric-vehicles-will-impact-electricity-demand-indias-grid-capacity/).
[169] Economic Times, "*Opinion: The big opportunity of EV charging infrastructure*", January 2023 (accessed from https://energy.economictimes.indiatimes.com/news/power/opinion-the-big-opportunity-of-ev-charging-infrastructure/96981587).
[170] Economic Times, "*India stares at power outages, will EVs add to the burden of its stretched power sector in future?*", October 2021 (accessed from https://auto.economictimes.indiatimes.com/news/industry/india-stares-at-power-outages-will-evs-add-to-the-burden-of-its-stretched-power-sector-in-future/87010652).
[171] Economic Times, "*The speed bumps in India's electric vehicle drive that no one's talking about*", December 2021 (accessed from https://economictimes.indiatimes.com/industry/renewables/the-speed-bumps-in-indias-electric-vehicle-ride-that-no-one-is-talking-about/articleshow/88144625.cms).

of lithium in parts of Jammu and Kashmir is very encouraging to the domestic battery manufacturing industry. India presently imports a large quantity of lithium-ion battery for meeting the domestic demand, especially in the EV space. The availability of lithium in the country would open up significant opportunities in the manufacturing space and also boost the domestic production of batteries to cater to domestic EV market.

7.3. HIGH COST

Towards the end of 2021, it was predicted that EV prices would increase in India due to the rising cost of raw materials. The cost of raw materials used in the cathode, including lithium, cobalt, and nickel, and other key components such as electrolyte, have all increased. A looming demand-supply mismatch in global lithium-ion cell production further compounded the issue, putting pressure on manufacturers to increase their prices. As India relies entirely on imports for lithium cells, the depreciation in the exchange value of the Indian rupee vis-à-vis the US Dollar has also increased the cost of EV batteries. Batteries make up a significant portion of an EVs' cost, and the 5% (five percent) to 10% (ten percent) increase in battery prices is likely to result in about a 3.5% (three point five percent) increase in the cost of EVs from April 2023, according to experts.[172]

Several companies stated that the production costs would need to be passed on to consumers, resulting in the first price hike for the new-age sector. To begin with, EVs have generally been more expensive than ICE vehicles and the upfront premium paid by the consumer is an important reason behind relatively slow EV sales.

7.3.1. ***PLI scheme***

For LIBs to become cheaper for auto manufacturers, Indian companies need to start manufacturing battery cells domestically. Indian companies have fallen behind on manufacturing of battery cells due to inadequate raw materials and lack of R&D. To encourage domestic manufacturing of LIBs, as stated above, the Union Government had introduced a PLI scheme to incentivize the setting up of 50 GWh of ACC battery capacity with an investment of INR 18,100 crore (approximately USD 2 billion) in order to promote domestic production.

7.3.2. ***Lower overall ownership cost***

EVs are generally longer lasting, easier to maintain due to less wear and tear and electricity for charging is cheaper than fuel. The total cost of ownership ("**TCO**") of EVs is already lesser than ICEs in case of E2Ws and E3Ws.[173] Further, as for passenger cars, TCO of EVs is lesser than ICE powered cars in case of commercial fleets.[174]

7.3.3. ***Battery-as-a-service***

For now, another way to mitigate the issue of high up-front cost of buying an EV is through deployment of BaaS model as detailed above in Section 5.3. The ability to purchase an EV without a battery and using swappable batteries on a subscription basis will make EVs affordable, even cheaper than ICE counterparts in terms of up-front cost, at least for E2Ws and E3Ws.

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[172] Inc42, "*High Inflation, Weak Rupee, New Standards To Make EV Batteries Expensive From April 2023*", November 2022 (accessed from https://inc42.com/buzz/high-inflation-weak-rupee-new-standards-to-make-ev-batteries-expensive-from-april-2023/).

[173] Sage Journals, "*Total Cost of Ownership Analysis of the Impact of Vehicle Usage on the Economic Viability of Electric Vehicles in India*", September 2020 (accessed from https://journals.sagepub.com/doi/10.1177/0361198120947089

[174] *Id.*

7.4. RANGE ANXIETY

Many EV owners suffer from "range anxiety" when the distance between charging stations is too far, and bridging this gap would encourage more drivers to migrate to e-mobility. Another reason behind this consumer anxiety is the time it takes for EVs to charge — if an EV is plugged to the fastest DC charger in deployment, it would still take the vehicle approximately 30 (thirty) -40 (forty) minutes to fully charge.[175]

7.4.1. *Charging infrastructure*

India's adoption of EVs has been hindered by the lack of sufficient charging infrastructure, which leads to this anxiety among consumers. India currently has approximately 5,200 (five thousand two hundred) EV charging stations to cater to around 2,065,000 (twenty lakh sixty five thousand i.e., two million sixty five thousand) EVs.[176] This means that for every 393 (three hundred ninety three) EVs, there is only one charger. This ratio is already much lower than other countries such as China (1:6) and US (1:19).[177] To address this issue, both the Union and State Governments need to offer greater incentives to private players and housing societies to ensure that charging infrastructure is not only deployed in commercially viable spaces but also in locations that offer equitable access to a diverse range of EV users.[178]

7.4.2. *Battery swapping*

As discussed above, the Niti Aayog formulated a draft battery-swapping policy in April 2022 pursuant to detailed stakeholder discussions representing BSOs, battery manufacturers, vehicle OEMs, financial institutions, charging station operators, think tanks, and other experts. The draft battery swapping policy primarily aims to establish technical standards to enable interoperability amongst various auto manufacturers' battery designs. Battery swapping stations solve many problems associated with setting up plug-in chargers in densely populated urban areas as they can charge multiple batteries in a small kiosk. On the other hand, plug-in chargers require large parking spaces with individual chargers deployed. Further, battery swapping also eliminates the down-time of EVs when charging as battery swaps can be carried out faster than refueling of ICE vehicles. Battery swapping is already booming in the E2Ws and E3Ws segments and it is expected to be an important part of India's charging infrastructure along with plug-in chargers.

7.5. LACK OF INSURANCE FRAMEWORK SPECIFIC TO EVS

EVs are currently insured just like their ICE counterparts and there are no specific regulatory requirements for an insurance policy for EVs. The MV Act mandates every vehicle operating in public space to have a third-party liability insurance cover. A motor vehicle insurance policy typically covers the following: (i) any injury caused to a third-party or damage to a third-party property (statutorily required), and (ii) injury caused to the insured or damage to the vehicle (if the insured has opted for a comprehensive insurance policy that covers personal damage as well). Loss or liability arising from an EV catching fire may or may not be covered depending

[175] Economic Times, "*7 FAQs on charging an electric car answered*", February 2022 (accessed from https://economictimes.indiatimes.com/wealth/spend/7-faqs-on-charging-an-electric-car-answered/can-the-electric-car-be-charged-at-home-itself/slideshow/89484863.cms).
[176] Hindu Business Line, "*Low plug points: India's EV charging infrastructure falls quite short*", February 2023 (accessed from https://www.thehindubusinessline.com/data-stories/data-focus/indias-ev-charging-infrastructure-falls-woefully-short/article66484999.ece).
[177] Hindu Business Line, "*Low plug points: India's EV charging infrastructure falls quite short*", February 2023 (accessed from https://www.thehindubusinessline.com/data-stories/data-focus/indias-ev-charging-infrastructure-falls-woefully-short/article66484999.ece).
[178] Oxford Policy Management, "*India's transition to electric vehicles - the road ahead*", November 2021 (accessed from https://www.opml.co.uk/blog/india-transition-electric-vehicles-road-ahead).

on the coverage of the insurance policy. Basic insurance policies covering only third-party liability do not cover damages such as those caused by fire (self-ignition or lightning).

Further, the price range of EVs in India is higher than the ICE variants in the same category which increases the Insured Declared Value ("**IDV**") of the product making insurance premiums more costly. The Insurance Regulatory and Development Authority of India, in an attempt to incentivize EV owners and to promote the use of EVs, provided a 15% (fifteen percent) discount on premiums for third-party liability insurance for private electric cars compared to the rates for general private cars of similar category, with effect from June 2019. With the recent fire incidents involving EVs and EV standards released recently, EV hardware specifically the battery will change drastically. Since the development of EV is still a work in progress, it is difficult for insurance companies to decipher the risks involved and subsequent coverage to be provided. Although the Union Government has been proactively addressing the concerns pertaining to rising cases of EVs catching fire, no EV-specific insurance coverage has been introduced yet by the Indian insurance industry as previously mentioned. As discussed, the current insurance policies do not include coverage for over-heating of vehicles, or other mechanical defects. Therefore, the insurance companies are currently monitoring claims of EVs, including instances of fire and may consider incorporating such risks while pricing premiums.[179]

Additionally, in India, if a consumer incurs any loss due to a defective automobile (EV, hybrid or ICE) such customer, may approach the relevant authority under the Consumer Protection Act, 1986 ("**CPA**") at the district, state or union level. In the absence of specific insurance policies, consumers of EVs can claim damages for death, injury or losses suffered due to manufacturing defects in an EV.

It is pertinent to note that despite several hurdles, the Union Government as well as the State Governments in India are continuously thriving towards achieving electrification goals of the nation. Production linked incentives, battery swapping policy, permitting sale of EVs without batteries and tax exemptions are some measures taken by the governments to make EVs more consumer friendly and less expensive. Instant measures undertaken by the Union Government by amending existing standards and rules in light of cases of EVs catching fires being reported, can be seen as India's eagerness and motivation towards a smooth transition to EVs. With the introduction of Battery Management Rules, 2022, a much-needed ecosystem to curb pollution attributable to lithium-ion batteries used in EVs has been established by distributing responsibilities of collection, labelling, disposing, handling, recycling and refurbishing amongst all relevant stakeholders. Incentives and subsidies offered by the Union Government and the State Governments contribute towards faster adoption of EVs by consumers in India. Barriers discussed above can be overcome through intervention of the government at various levels and collaboration and coordination with different stakeholders in the EV space and serious commitment to short-term and long-term goals.

[179]World Resources Institute, "*Status quo analysis of various segments of electric mobility and low carbon passenger road transport in India*", February 2021 (accessed from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjAx9SNw5v7AhW1XmwGHZwsBI0QFnoECAsQAQ&url=https%3A%2F%2Fwww.niti.gov.in%2Fsites%2Fdefault%2Ffiles%2F2021-04%2FFullReport_Status_quo_analysis_of_various_segments_of_electric_mobility-compressed.pdf&usg=AOvVaw1da32rnYlf8UNrIeLYITkk).

8. EMERGING TRENDS AND DEVELOPMENTS

8.1 BUDGET 2023 AND FOCUS ON EV GROWTH IN INDIA

The economic survey of 2023 was presented before the presentation of Union Budget 2023, according to the said survey Indian EVs are likely to grow at 49% CAGR between 2022-2030, which means that one crore unit sales by the end of this period as compared to the sale of 10 lakhs in 2022[180]. Government has been focused on making EVs as accessible as possible. In those attempts the government had introduced many policies, schemes and incentives which would boost the production and usage of EVs in the market. Amongst the seven priorities including that of infrastructure and investment, India's green growth is one of the top priorities projected via the Budget 2023 with Rs. 35,000 crore allocated towards realizing the goals of net zero and energy transition[181]. Many announcements were made to help reach India to its green goals including the extension on subsidies on EV batteries for a year, allocation of adequate funds to the states to scrap old polluting vehicles, a green credit card programme was launched under the Environment (Protection) Act[182]. Following are the major elements covered in the Budget 2023 which was EV centric -

The Indian government has taken several steps to promote the use of EVs in the country. One of these measures includes providing tax exemptions for capital goods and machinery used to manufacture lithium-ion cells for batteries that power most plug-in hybrids and all-EVs[183]. Additionally, the custom duty on lithium-ion cells used in EV batteries has been reduced from 21% to 13%. To further support the growth of the EV sector, the government has extended subsidies for an additional year[184]. However, the lack of charging infrastructure remains a major obstacle to the widespread adoption of EVs in India. To address this issue, the government has allocated 2.7 lakh crore to the Ministry of Road and Transport (MoRTH) in the current budget, up from Rs 1.99 lakh crore in the previous year.. The budget for the Faster Adoption and Manufacturing of Hybrid & EVs (FAME-II) scheme has also been doubled from Rs. 2,898 crores to Rs. 5,172 crores[185]. This incentive program has played a crucial role in increasing the usage of EVs in the Indian market. The process of replacing old vehicles with newer EV models, combined with the incentives provided, is expected to encourage more people to choose and utilize EVs. Overall, these measures indicate that the Indian government is committed to promoting the adoption of EVs in the country[186]. The various incentives, subsidies, and infrastructure development programs are aimed at making EVs a viable and attractive option

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[180] Outlook India, "*Budget 2023: Center Takes Measures To Boost EV Adoption in India*", February 2023 (accessed from https://startup.outlookindia.com/analysis/budget-2023-center-takes-measures-to-boost-ev-adoption-in-india-news-7391).

[181] Financial Express, "*India's Budget Provisions for Clean Energy Transition Will Fast-Track The Journey to Net Zero*", March 2023 (accessed from https://www.financialexpress.com/budget/budget-2023-ev-industry-reacts-on-govts-green-push-2968379/).

[182] Inc 42, "*Union Budget 2023 Growth Oriented But Needed More Specifics For The EV Sector: Experts*", February 2023 (accessed from https://inc42.com/buzz/union-budget-2023-growth-oriented-but-needed-more-specifics-for-the-ev-sector-experts/).

[183] Times of India, "*Budget 2023: EVs Could Get Cheaper As Lithium-Ion Cell Machinery Gets Exempt From Import Duties*", February, 2023 (accessed from https://timesofindia.indiatimes.com/auto/news/budget-2023-evs-could-get-cheaper-as-lithium-ion-cell-machinery-gets-exempt-from-import-duties/articleshow/97519701.cms?from=mdr).

[184] IBID

[185] Outlook Planet, "*Budget 2023-24: Green Light For EVs*", February, 2023 (accessed from https://planet.outlookindia.com/news/budget-2023-24-green-light-for-evs-news-414802).

[186] SAG Infotech, "*Budget 2023: FM Enhances 1+ Year on EV Batteries Under Subsidy*", February, 2023 (accessed from https://blog.saginfotech.com/budget-2023-fm-1-year-ev-batteries-subsidy).

for Indian consumers, thereby reducing the country's dependency on fossil fuels and contributing to a cleaner environment.

Although the Indian government has introduced commendable schemes, such as doubling the funds for FAME II and extending subsidies for an additional year, there are still some issues that need to be addressed. For example, the deduction of up to Rs. 1.5 lakhs per year for interest on loans sanctioned for buying EVs is only available until March 31, 2023[187]. Furthermore, this benefit can only be claimed for EVs and not hybrid vehicles. In addition, the Goods and Services Tax (GST) on EV spare parts is as high as 28% surcharge, while the GST on EVs is only 5%. Although the funds for FAME II have been doubled, there is no indication of an extension beyond 2024, which may limit the long-term stability of the EV market in India. Given that EV is still a niche market in India, stable long-term policies are required to enable the production and usage of EV and its components. Furthermore, the budget does not focus on research and development for new fields such as EV. While the budget addresses short-term goals, it tends to avoid the long-term implications of EVs in the market.

In conclusion, the Indian government's efforts to promote the adoption of EVs in the country are laudable. However, there are still areas where improvements are needed, such as extending tax benefits and reducing the GST on EV spare parts. Furthermore, the government should focus on developing long-term policies and investing in research and development to ensure the sustainable growth of the EV market in India[188].

8.2 100% FDI TO ATTRACT INVESTMENT

As mentioned in Section 2.1.2 (b), in India, foreign investment up to 100% (hundred percent) is permitted through the automatic route for manufacturing of automotive and auto components, including EVs. The automatic route of investment implies that a foreign investor is not required to procure any governmental approval before making an investment in a particular sector. Allowing 100% FDI for manufacture of EVs and its components under the automatic route enables foreign investors to seamlessly explore investment opportunities in India by only complying with certain regulations. This has allowed the Indian EV industry to realise major foreign interest and attention. Between the years 2002 and 2022, the e-mobility sector in India received 6% of all FDI , i.e., of am amount approximately equal to $32 billion out of which 20%, i.e., approximately $6 billion was received in 2021.[189] However, FDI inflows has been restricted to the top players in the EV market and smaller firms still struggle to procure sufficient financing from foreign investor; for example, in the year 2021, 60% of all FDI went to Hyundai, Tata Motors and Mahindra.[190] During the financial year 2022-2023 (April-December), the Indian automobile industry received FDI equity inflow of US$ 1275 million.[191] It has been projected that India will receive foreign investment inflow of US$ 20 billion by the year 2023.[192]

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[187] Outlook India, "*Budget 2023: Center Takes Measures To Boost EV Adoption in India*", February 2023 (accessed from https://startup.outlookindia.com/analysis/budget-2023-center-takes-measures-to-boost-ev-adoption-in-india-news-7391).

[188] Down to Earth, "*Hit-&-Miss: EV Sector Gets Support in Budget 2023-24, But Misses Out On Long Term Vision*", February 2023 (accessed from https://www.downtoearth.org.in/blog/science-technology/hit-miss-ev-sector-gets-support-in-budget-2023-24-but-misses-out-on-long-term-vision-87435).

[189] Invest India, "*Investment Landscape Of Indian E-Mobility Market*", March 2023 (accessed from https://sarepenergy.net/wp-content/uploads/2023/03/Investment-Landscape-of-Indian-E-Mobility-Market-V3-FINAL.pdf).

[190] IBID

[191] Please refer https://dpiit.gov.in/sites/default/files/FDI_Factsheet_December_2022.pdf.

[192] Arthur Little, "*Unlocking India's Electric Mobility Potential - Comprehensive Report on the Future of EVs in India*", August 2022 (accessed from https://www.adlittle.com/sites/default/files/reports/ADL_Unlocking_Indias_EV_potential_2022.pdf).

Therefore, since the early years, the Indian EV industry has been a hot bed of foreign investment and interest. FDI in EV allows Indian startups to grow their operations and promote innovation and efficiency among the market stakeholder and corporate operations. India has unique advantages in its EV industry that contribute to creating a competitive corporate ecosystem which attracts foreign investment. Foreign investment also boosts the productivity of EVs in India and introduces international standards and good industry practices in the EV industry. The FDI in India has increased research and development activities.

Fostering a strong and sustainable investment environment in India for EVs is however subject to certain preconditions. The process of transition from non-renewable to renewable has to be made simpler with minimum interface of the government or other regulatory agencies. Collaboration between all stakeholders in the EV industry, including both public and private service providers, is imperative to establish healthy competition in the EV market leading to the consumers getting best options at cheapest rates.

8.3 ACTUAL EV GROWTH AND CONSUMER PATTERNS

As we have discussed in this report, the growth of the EV market in India is expected to increase exponentially in the next few years, especially with the Central Government's objective to replace the market share of conventional ICE vehicles with non-polluting options in the form of EVs. However, the same is largely reliant on consumers having behaviour patterns that favour the adoption of EVs.

Despite the developments and incentives available in the Indian EV market, the opinion of private non-commercial consumers is not in favour of EV adoption. As per a survey conducted by Deloitte of 3022 Indian consumers, 40% of consumers were interested in buying HEVs/EVs as their next vehicle, only if the prices of fuel of ICE vehicles rose an additional 40%-50%.[193] The primary reason given by the consumers for purchase of EVs was lower carbon emission. Only 14% were willing to bear additional cost liability for an EV over a similar ICE vehicle. It is interesting to note that about 65% of the consumers thought the responsibility of developing charging stations and other infrastructure for EVs lies with either the EV manufacturers or the government. Therefore, while consumers are willing to adopt EVs, such decision is largely dependent on factors like cost of operating ICE vehicles and additional cost liability for such transition to EVs.

The contribution of the incentives and subsidies of the Central Government and State Governments on consumer behavior cannot be underestimated. EV sales have increased after the introduction of the FAME II scheme and state EV policies whereas EV sales in states that are yet to offer demand side incentives remain stagnant. Lack of options in the EV space is also a factor that hinders the interest of customers in the EV market. This is a cyclic problem since manufacturers and OEM do not develop new categories of EV due to low interest shown by the consumers and while in turn hinders consumers from adopting EVs.[194] The lack of charging stations and other EV infrastructure is another factor that has affected consumer interest in EVs. It does not make practical sense for consumers to shift to a transit option that limits their mobility.

[193] Niti Aayog, "Status quo analysis of various segments of electric mobility and low carbon passenger road transport in India" (accessed from https://www.niti.gov.in/sites/default/files/2021-04/FullReport_Status_quo_analysis_of_various_segments_of_electric_mobility-compressed.pdf).
[194] IBID

The Indian consumer likes stability, efficacy and predictability in their choices. The reputation and reliability of EV industry has taken a hit in recent times due to several incidents of E2Ws catching fire in response to which several remedial steps have been taken by both the government and manufacturers, as discussed in Section 5.1 and Section 7.1 to ensure safety of consumers.

8.4 TYPES OF EV - E2W, E3W AND E4W

8.4.1 *E2W*

According to a recent study conducted by Bain & Company, it is anticipated that the Indian EV industry will witness a significant growth in the acceptance of electric two-wheelers, with an estimated increase of 40-45 percent. This is a significant development for the Indian EV market, which has seen a steady growth in recent years. Passenger cars are expected to generate the majority of revenue in the EV industry in terms of value, despite having lower adoption and fewer numbers, followed closely by two-wheelers[195]. The government of India has made a strong commitment to promote the use of electric cars nationwide. To this end, the National Electric Mobility Mission Plan (NEMMP) was initiated in 2011 and published in 2013. In April 2015, FAME India was introduced, which comprises of three key components: demand incentives, infrastructure development, and R&D support. The first phase of the FAME plan concluded on March 31, 2019, and the second phase, FAME-II, began on April 1, 2019. As part of this plan, the maximum number of electric two-wheelers eligible for demand incentives is 10,000, with an ex-factory price of Rs. 1.5 lakh. The incentive for electric two-wheelers is Rs.15,000 per kWh of battery capacity, up to a limit of 40% of the cost of the vehicle[196].

In order to address the charging aspect, NITI Aayog conducted a survey to gain insights into consumer behaviour and preferences for charging electric two-wheelers (E2Ws) either at home or at charging stations. The survey results indicated that 63 percent of consumers preferred using fast chargers at charging stations, while 37 percent preferred slower chargers at home. Consequently, it is imperative to rapidly develop charging infrastructure to meet the growing demand for E2Ws[197]. Based on a recent study conducted by Redseer Strategy Consultants, it is predicted that the E2W market will constitute over 80% of the entire E2W market by 2030[198].

8.4.2 *E3W*

In the early stages of India's automotive market history, sales of E3W have surpassed those of internal combustion engine-powered three-wheelers. Based on data from the Vahan Portal and the Federation of Automobile Dealers Association (FADA) of India, 23,321 electric three-wheelers were sold in May 2022, compared to 18,187 ICE three-wheelers. As of May 2022, the E3W sector was able to capture over 56% of the entire three-wheeler industry in India. In contrast to E2Ws, electric passenger automobiles, and heavier EVs, E3Ws hold a higher market share than their ICE equivalents. On the other hand, the two-wheeler segment, which is India's biggest vehicle-selling vertical, only had

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[195] Hindu Business Line, "*Electric 2-Wheelers Likely to Bag 40-45% Market Share By 2030: Bain & Company*", February 2022, (accessed from https://www.thehindubusinessline.com/companies/electric-2-wheelers-likely-to-bag-4045-market-share-by-2030-bain-company/article66262333.ece).

[196] NITI Aayog, "*Forecasting Penetration Of Electric Two-Wheelers In India – Bottom-UP Analysis*", (accessed from https://www.niti.gov.in/sites/default/files/2022-06/ForecastingPenetration-ofElectric2W_28-06.pdf).

[197] IBID

[198] The Economic Times, "*EV 2-Wheeler Sales In India To Reach 22 Million By 2030: Report*", February 2023, (accessed from https://economictimes.indiatimes.com/industry/renewables/ev-2-wheeler-sales-in-india-to-reach-22-mn-by-2030-report/articleshow/97512568.cms?from=mdr).

a 3.2% share of EV in its total sales statistics for May 2022. During that month, only 39,490 E2Ws were sold in India, out of a total of 1,222,994 two-wheeler vehicles sold across the country. States have started introducing policies to support the sale and production of E3W. For example, Uttarakhand, Chandigarh and Assam are the top three states which have such high level of electrification[199].

The E3W segment appears to be more valuable than the E2W segment, as E3Ws are significantly more expensive than E2Ws. Additionally, the battery capacities used in E3Ws are larger and more expensive, thereby increasing their overall value[200].

8.4.3 E4W

In December 2022, electric automobiles are expected to account for 3.30% of overall EV sales, representing a 39% increase every year. As the EV industry continues to expand, consumers are becoming more interested in four-wheeled electric options. The electric car sales statistics for January 2023 showed a significant monthly drop of 1.6%. However, the yearly coverage was higher because EV sales have nearly tripled since January 2022, indicating that more people are turning to EVs. The Auto Expo 2023 showcased the increasing appeal of E4W[201].

8.5. EVs – FOR PERSONAL USE AND COMMERCIAL USE

Use of EVs in the commerce of the country is driving the demand for EVs in India. Integrating EVs with business processes and operations result not only in the reduction of costs but earning carbon credits. It is commercial consumers that have the resources to establish private charging station to augment their business processes - a bright example for this is mobility companies such as OLA switching to EVs and installing their own charging infrastructure at parking bays in airport and railway stations. EV penetration has increased in the logistic industry, for fleet operators and mobility service providers. In 2022, E3W accounted for 34% of all EV sales in the commercial EV market. Indian states have also introduced plans to incorporate EVs into their public transportation channels. As the prices of fossil fuels, including natural gas, increases, commercial entities have looked towards transitioning to EVs as it saves cost and allows commercial entities to claim incentives from both the Central Government and State governments. Further, commercial entities can raise resources to set up captive power plants together with charging stations at their premises to support the EV vehicles without waiting for the EV support infrastructure in the country to catch up with the demand.

8.6 HYDROGEN AS A FUEL

The Indian government's Budget 2023 is focused on fulfilling its green goals, with a major element being a focus on hydrogen. To provide a more sustainable environment, the government announced an amount of Rs. 19,700 crore for its Green Hydrogen Mission. The target is to produce five million tonnes of hydrogen by 2030. In order to achieve net-zero emissions, it is essential to introduce alternatives to fossil fuels that emit low or no carbon

[199] Hindustan Auto, "*This State Is Likely To Achieve 100% Electric Three-Wheeler Sales by 2025: Study*", January 2023 (accessed from https://auto.hindustantimes.com/auto/electric-vehicles/this-state-is-likely-to-achieve-100-electric-three-wheeler-sales-by-2025-study-41674281561644.html).

[200] Mobility Outlook, "*Electric Three-Wheelers Are Now The Poster Boy Of India's EV Adoption*", June 2022 (accessed from https://www.mobilityoutlook.com/analysis/electric-threewheelers-are-now-the-poster-boy-of-indias-ev-adoption/).

[201] E-Vehicle Info, "*Electric Four-Wheeler Sales Report: January 2023*", February 2023 (accessed from https://e-vehicleinfo.com/electric-four-wheeler-sales-report-january-2023/).

emissions[202]. Developed countries like the United States and China are also looking for alternatives, with hydrogen potentially comprising 12% of global energy use by 2050[203]. The Green Hydrogen Mission was introduced on 4th January 2022 to enable and increase the production of hydrogen in the country[204]. Although the use of hydrogen is still in its nascent stage, immense government support is required. Many incentives have been introduced, including tax incentives, reductions in import duties, and the creation of infrastructure that could facilitate hydrogen production[205]. Overall, the government's focus on hydrogen is a positive step towards achieving a more sustainable future. With significant investment and incentives, India has the potential to become a leader in hydrogen production and usage. This, in turn, could contribute to the reduction of carbon emissions and the development of a more environmentally friendly energy system.

8.6.1 ***Hydrogen fuel cell vehicles***

Hydrogen fuel cell vehicles operate similarly to EVs. Hydrogen is stored as energy and converted into electricity via the fuel cell. The fuel cells work by using a positive and negative electrode, where hydrogen reacts with the anode and oxygen with the cathode. The molecules then break apart into protons and electrons, causing a reaction at the cathode and anode. Protons, electrons, and oxygen combine to form water[206]. The size of the hydrogen fuel tank determines the amount of energy that can be stored in the vehicle. Unlike fossil fuel-powered vehicles that emit pollution, hydrogen fuel cell vehicles emit only water vapour and warm air. There is growing interest in hydrogen power as it can be produced using renewable energy and biomass[207]. On March 16, 2022, the Department of Road Transport and Highways launched a first-of-its-kind Green Hydrogen Fuel Cell EV, the Toyota Mirai. The Toyota Mirai will be manufactured in India and will cost around Rs. 50,00,000 for a pilot project. With consumers showing an increasing preference for green energy, the cost of fuel-powered vehicles may decrease in the future. India aims to become self-reliant by 2047[208].

8.6.2 ***Differences between the EVs and hydrogen***

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[202] Economic Times, "*Budget 2023: Sitharaman Announced Rs. 35,000 Crore Towards Energy Transition: Rs. 19,700 crore For Green Hydrogen*" February, 2023 (accessed from https://economictimes.indiatimes.com/news/economy/policy/sitharaman-announces-rs-35000-crore-towards-energy-transition-rs-19700-crore-for-green-hydrogen/articleshow/97515447.cms).

[203] Times of India, "India Budget 2023: Financial Incentives For Green Hydrogen In India" January 2023 (accessed from https://timesofindia.indiatimes.com/business/budget/india-budget-2023-financial-incentives-for-green-hydrogen-in-india/articleshow/97475289.cms?from=mdr).

[204] Government of India, "*National Green Hydrogen Mission*" (accessed from https://www.india.gov.in/spotlight/national-green-hydrogen-mission#:~:text=The%20National%20Green%20Hydrogen%20Mission,Green%20Hydrogen%20and%20its%20derivatives).

[205] Invest India, "*Budget 2023: Accelerating Green Transition Through The National Green Hydrogen Mission*", February 2023 (accessed from https://www.investindia.gov.in/team-india-blogs/budget-2023-accelerating-green-transition-through-national-green-hydrogen-mission).

[206] Alternate Fuels Data Center, "*Fuel Cell EVs*" (accessed from https://afdc.energy.gov/vehicles/fuel_cell.html#:~:text=Fuel%20cell%20electric%20vehicles%20(FCEVs,the%20early%20stages%20of%20implementation.).

[207] Tata AIG, "*Hydrogen Fuel Cell EVs*", February 2023 (accessed from https://www.tataaig.com/knowledge-center/car-insurance/hydrogen-fuel-cell-electric-vehicles).

[208] Republic World, "*Toyota Mirai: All About India's 1st Hydrogen-Powered Car*", March 2023 (accessed from https://www.republicworld.com/auto-news/cars/toyota-mirai-launch-date-price-and-all-about-indias-1st-hydrogen-powered-car-articleshow.html).

While EVs have already begun to make their mark in the Indian market, hydrogen fuel cell vehicles are set to make a significant impact on Indian consumers. With the Indian government focusing on sustainable development, both hydrogen fuel cell vehicles and lithium-ion electric cars will play important roles in achieving the government's goals and agendas. There are several reasons why consumers may want to shift to alternative fuels. One of the major reasons is that they are environmentally friendly and are not as costly as petrol or diesel. There are significant differences between the two, however. EV infrastructure is more technologically advanced than hydrogen-powered vehicle infrastructure. Governments all over the world have been investing in infrastructure, such as charging stations at current gas stations and highway rest stops, retail mall parking lots, and even on the side of some streets. The United Kingdom also provides grants for the acquisition and installation of domestic charging stations[209].

EVs are also less expensive than hydrogen-powered vehicles, and the cost of refilling is lower during off-peak grid hours, making EVs an excellent long-term investment. EVs run silently and emit no exhaust fumes, resulting in no noise or air pollution, and they consume no energy when stationary. Hydrogen vehicles have many of the same advantages as electric cars, including the crucial absence of polluting pollutants. While the procedure of producing hydrogen gas can be complicated, hydrogen is the most common element in the natural world, making it a source of sustainable fuel. Hydrogen cars are also much quicker to refuel than electric cars and have a greater range than EVs[210]. The range of EVs is possibly the most significant disadvantage when compared to the time it takes to refuel. This is dependent on the battery and the filling station used, but in general, the range and refuelling periods make long-distance driving in an EV more challenging than traveling with hydrogen or traditional gas vehicles[211]. One of the primary challenges with hydrogen vehicles is the lack of infrastructure to support their use. With limited refuelling stations available, hydrogen cars are not yet a feasible option for many people. However, scaling up hydrogen infrastructure is believed to be relatively straightforward, and with sufficient funding and support, this issue can be resolved. Another significant issue is the cost of hydrogen electricity, as hydrogen-powered vehicles are not cheap.

Safety is also a major concern when it comes to hydrogen fuel cells due to the highly volatile nature of hydrogen gas, which can burn in air at concentrations ranging from 4 to 75%. However, many potential safety concerns have been addressed through technological advancements. For instance, the Toyota Mirai employs a proprietary design to prevent hydrogen leaks while shutting off the hydrogen flow in the event of a crash and storing the fuel canister outside the interior[212]. This ensures that, in the unlikely event of a breach, the gas will discharge harmlessly into the atmosphere, as hydrogen is lighter than air and diffuses into space at a rate of 20 mph.

Similarly, electric batteries have their own safety issues and challenges. Overheating or overcharging lithium-ion batteries can cause damage, and if a fire breaks out, the batteries can spark and be challenging to extinguish because the fuel for the fire is not released as

[209] TWI, "*Key Differences between Hydrogen and Electric Cars*", (accessed from https://www.twi-global.com/technical-knowledge/faqs/hydrogen-vs-electric-cars#WillHydrogenCarsReplaceElectricCars).
[210] Hindustan Auto, "*Key Differences between Hydrogen and Electric Cars*" October, 2022(accessed from https://auto.hindustantimes.com/auto/electric-vehicles/key-differences-between-hydrogen-fuel-cell-and-electric-cars-41665476116096.html).
[211] IBID
[212] Republic World, "*Toyota Mirai: All About India's 1st Hydrogen-Powered Car*", March 2023 (accessed from https://www.republicworld.com/auto-news/cars/toyota-mirai-launch-date-price-and-all-about-indias-1st-hydrogen-powered-car-articleshow.html).

with hydrogen. To address these issues, vehicle manufacturers have been regulating temperatures and using multiple sets of smaller batteries to prevent overcharging.

Ultimately, both hydrogen and EVs face similar safety concerns as any other fuel source, and it is essential to ensure that appropriate safety measures are in place to minimize any potential risks. At present, battery EVs seem to have an edge over hydrogen fuel cell vehicles, partially because hydrogen technology is relatively new. However, with sufficient research and time, hydrogen fuel cell vehicles could catch up as EVs continue to progress. This will require investment in infrastructure to support the use of hydrogen fuel cell vehicles. With this funding and potential cost reductions for hydrogen vehicles, there is a good chance that they could challenge electric cars as the next generation of clean transportation. However, the true solution may lie in an integrated environment where both types are incorporated into future transportation strategies

8.7. HYBRID V. EVS

A hybrid electric vehicle (HEV) uses both a battery powered motor powertrain and an ICE.[213] Therefore, a HEV is charged with two types of engines which work to run the vehicle. HEVs either come with (a) an electric traction motor which uses power from batteries to run the vehicles; or (b) an electric generator tat produces electricity from regenerating energy while braking which recharges the batteries; or (c) a traction battery pack that stores electricity to run the vehicle which gets recharged through an electric generator. In a HEV, the ICE engine remains the primary engine that runs the vehicle and the battery packs in HEVs cannot be charged without the ICE engine.

This is the primary difference between an EV and a HEV – an EV runs on only one engine charged with electricity. HEVs, when compared to traditional ICE vehicles offer high fuel and power efficacy on one hand and lower emissions of carbon on the other. Even compared with EVs, HEVs can cover longer distances and offer better fuel efficiency. However, HEVs emit more pollutants when compared to an EV since HEVs are reliance on ICE to perform. Further, a HEV does not require charging infrastructure since battery packs are recharged by the ICE engine, whereas EVs rely on stable charging infrastructure to recharge their batteries.

8.7.1 *Analysis of the Advantages of HEV*

Hybrid cars offer several advantages over the ICE vehicles and even EVs. As mentioned earlier in this section, HEVs offer cleaner emissions when compared to the ICE vehicles but not as much as EVs. There is less fuel dependency since HEVs use electric engine for powering the vehicle after fuel in the ICE engine is depleted. Petrol engines in HEVs are comparatively small in size and more fuel efficient.[214] One main benefit of HEVs is that it does not require a charging infrastructure since the electric engine is recharged by the electric generator when the brake is applied; however, a corollary of the same is that the electric engine is dependent on the ICE engine for recharging the battery packs. Although, plug-in hybrid electric vehicles combine a battery charged from an external socket and can be charged without reliance on the ICE engine. The cost of EVs is also comparative on the higher side – there are 26 brands of EVs in India, 26 of which cost more than Rs. 50 lakh which is outside the affordability of the majority population of India.[215]

There are certain drawbacks to HEVs as well considering that the acceleration and power of HEVs is not as effective as those vehicles with ICEs. Further, HEVs are more expensive

[213] Please refer https://e-amrit.niti.gov.in/types-of-electric-vehicles.
[214] IBID
[215] ET Auto, "Can Affordable Electric Cars provide a fillip to fledging electric PV segment in India", September 2022 (accessed from https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/can-affordable-electric-cars-provide-a-fillip-to-fledgling-electric-pv-segment-in-india/94093848).

than conventional ICE model vehicles through manufacturers and suppliers of HEVs are always in an attempt to reduce the costs. Moreover, the maintenance cost of HEVs are higher when compared to an ICE vehicle or EV since maintenance of two engines is required. HEVs can only be maintained and repaired by designated centres with mechanics who are trained and experienced in their maintenance and not at all vehicle support centres. Since the adoption of EVs lies on the underlying objective of reducing polluting emissions, HEVs cannot be said to be the best available option – it emits less pollutants than ICE vehicles but not as less as EVs. Therefore, HEVs may not be a sustainable green option for a longer period.

8.7.2 ***Cost Comparison of HEVs and EVs***

The cost of fuel for ICE, HEVs and EVs differ. Fuel prices in India are forever rising due to several input factors which has made the maintenance cost of ICE vehicles increase. Since HEVs run on both ICE and electric engine, the cost of fuel is lesser than that of an ICE vehicle as some distance can be covered by the electric engine thereby saving the need to refuel as frequently as an ICE vehicle. In a typical setup, charging of EVs cost less than vehicles suing fossil fuels since only the electricity tariff is required to be paid. As mentioned in Section 7.5, the MV Act mandates every vehicle operating in public space to have a third-party liability insurance cover therefore, insurance costs are applicable on the owners of ICE vehicles, HEVs and EVs.

HEVs are the smarter choice over ICE vehicles since it has both ICE and electric engine and offer better fuel efficiency when compared to traditional ICE vehicles the maintenance costs of HEVs do not differ much from traditional ICE vehicles. HEVs can prepare the Indian consumers to easily transition to EVs when related support and infrastructure is developed.

HEVs emit more pollutants then EVs thereby making EVs more sustainable for the environment in the long run than HEVs. In India where charging infrastructure and other support facilities for EVs facilities are still being developed, range anxiety, high cost of maintenance and inconvenient and inefficient repair practices remains valid concern of the EV consumers, whether potential or current. In this scenario, the HEVs can be a buffer to replace ICE vehicles till the EV infrastructural support is developed and the Indian landscape is ready for EVs. HEVs can be treated as stepping stone towards the adoption of EVs.

8.8. KEY MARKET PLAYERS

8.8.1 *Key manufacturers of E2W, E3W, E4W*[216]

Type of EV	Name of Manufacturers	No. of Models Approved under FAME II
E2W	Ampere Vehicles Private Limited	6
	Ather Energy Private Limited	3
	Bajaj Auto Limited	2
	Hero Electric Vehicles Private Limited	10
	Jitendra New Ev Tech Private Limited	3
	Tunwal E-motors Private Limited	5
	Microcon I2i Private Limited	1
	Okinawa Autotech Private Limited	4
	Revolt Intellicorp Private Limited	2
	TVS Motors Company Limited	1
E3W	Piaggio Vehicles Private Limited	9
	Mahindra Electric Mobility Limited	7
	Kinetic Green Eneryg and Power SOlutons Limited	5
	Keto Motors Private Limited	5
	Victory Electric Vehicles international Private Limited	4
	U. P. Telelinks Limited	4
	Champion Polyplast	3
	Etrio Automobiles Private Limited	3
	Goenka Electric Motor Vehicle Private Limited	3
	Jitendra New Ev Tech Private Limited	3
E4W	Altigreen Propulsion Labs Private Limited	4
	Mahindra and Mahindra Limited	8
	Tata Motors Limited	11

8.8.2 *Indian v. Imported*[217][218]

98% share of the EV market in India is held by Tata and MG. In the financial year 2021-2022, the EV models 'Tata Nexon EV' has 63% of the EV market share, 'Tata Tigor EV' had 24% and 'MG EZS' had 11.5%. In the same period, luxury EVs like Audi e-Tron, Jaguar I-Pace, Mercedes EQC, Audi e-Tron Sportback, BMW iX had a combined market share of approximately 9%.

Out of the total imports in that financial year, 12% of EVs were imported through the completely knocked down route[219] and the remaining 1% were luxury cars imported through the completely built unit route[220]. EVs of Hyundai and MG motors are imported

[216] Please refer https://e-amrit.niti.gov.in/Manufacturers.
[217] Team BHP, "Electric vehicle sales in India | 2 companies command 98% of the market", June 2022 (accessed from https://www.team-bhp.com/news/electric-vehicle-sales-india-2-companies-command-98-market).
[218] Catapult, "The India Electric Vehicle Opportunity: Market Entry Toolkit", March 2021 (accessed from https://cp.catapult.org.uk/wp-content/uploads/2021/03/210318_1020_CPC_India_Report.pdf).
[219] Completely Knocked Down vehicle is one which is imported or exported in parts and not as one assembled unit. Such units are first sent to an assembly plant in the target country where all these parts are assembled, and one complete vehicle is made using the imported components.
[220] Completely Built Units refer to imported/exported vehicles which are bought as fully assembled, complete units. These vehicles do not require assembly before they can be sold to buyers in the importing country's markets.

in India as completely built unit or semi knocked down model[221] whereas Tata Motors and Mahindra Electric locally manufacture their EVs.

The market share of imported EVs is miniscule and is mostly limited to luxury vehicles and the market shared of EVs assembled or manufactured in India is substantial. It is important to note that most EVs on the road in India are manufactured in India even though most of the constituent component of an EV are imported from China and other countries.

9. CONCLUSION

EVs have emerged as the best alternative to overcome the challenges posed by traditional ICE vehicles. Driven by concerns of climate change, environmental pollution and energy security, the Union Government and the State Governments have been actively placing reliance on the need to transform the conventional fossil fuel-based transport with electric mobility. Additionally, a shift to EVs is important for India given the heavy petroleum imports and the adverse impact of the same on the trade balance and foreign exchange. With the aim of 30% (thirty percent) electrification of the vehicles by 2030 and energy transition with net zero emissions by 2070, the Union Government has introduced several policies to support the growth of EVs. Further, the Union Government has increased allocation for FAME-II by approximately 80% (eighty percent) in the budget of 2023-2024 along with reducing the custom duty on LIB.[222]

In addition to the governmental initiatives, to achieve the desired shift to e-mobility, it is imperative that all the stakeholders in the EV ecosystem (governmental bodies, manufacturers and consumers), work closely together to promote and enable faster adoption of EVs and develop a seamless charging infrastructure across the country. Further, despite specific authorities regulating and governing different aspects of manufacturing and usage of EVs in India, there is still a lack for an EV specific regulation. It cannot be ignored that EVs and ICE vehicles are inherently different and, hence, separate laws must be formulated by keeping in mind the specific issues and concerns attached with an EV, batteries, EV components, charging and swapping infrastructure.

With Union and State Governments aiming towards mass adoption of EVs, there is most likely to be surge in demand of EVs powered by government incentives. Both producers and consumers of EVs (including their batteries and components) in India have been incentivized through various government backed incentives such as tax subsidies, registration fees exemption, waiver of road tax for demand generation and production linked incentives, FAME schemes, and the phased manufacturing program. Further, to eliminate concerns relating to disposal of waste generated from manufacturing of EVs, the Union Government had earlier in 2022 notified Battery Waste Management Rules.

It is pertinent to note that while government incentives through various schemes, initiatives and policies are welcome, EV adoption in India is still at a nascent stage. It is important for the government to further strengthen domestic manufacturing capacity to reduce dependence on imports. Further, one cannot ignore the need for increased public awareness and consumer acceptance for seamless and smooth electrification. Factors like high cost, lack of adequate

[221] Semi Knocked Down are partially stripped down 'finished' vehicles, reassembled in target/importing country. SKD vehicles help manufacturers save taxes in the importing country since most countries levy more than 100% tax for fully assembled (CBU) vehicles.
[222] Invest India, "*India's EV Economy: The future of automotive transportation*", February 2023 (accessed from https://www.investindia.gov.in/team-india-blogs/indias-ev-economy-future-automotive-transportation#:~:text=The%20Indian%20government%20has%20set,growth%20of%20the%20EV%20industry).

charging infrastructure, range anxiety are barriers to acceptance and adoption of EVs by the demand side. However, India is looking towards locally tailored solutions such as battery swapping and developing extensive charging infrastructure to find a market-acceptable solution to elementary concerns.

The growth of EV charging infrastructure would require significant push from the Government. Innovative models of growth such as implementation through PPP model, as introduced by Government of Telangana, can certainly be adopted by other states as well as the Union Government. While metro cities would see a potential rise in the growth of EV infrastructure, the cause of concern would be penetration in rural and semi-urban areas, which can be achieved through the public private partnership mode.

The Union Government has done well in announcing PLI scheme in automotive and EV battery technologies. As incentives in PLI schemes are linked to actual production the implementation of targets can be monitored and would gradually boost domestic manufacturing capacities thereby reducing our dependency on imports. The Union Government should consider focusing on the research and development in collaboration with the private sector manufacturers so that EV market in India is better equipped to meet future demands.

The Union and State Governments should jointly develop plans to incentivize the open access space of electricity generation. Easing open access policy and promoting captive generation of electricity through renewable sources would encourage charging infrastructure operators to set up off-grid captive units. This can not only ease the pressure on grid during peak hours but also enhance sourcing green energy for EVs.

Increased demand of EVs in the market presents itself as a massive investment opportunity for OEMs and other stakeholders engaged in developing a charging infrastructure in India. However, increasing demands does not eliminate the hurdles associated with adoption of EVs, hence, there is a need to address the issues concerning EVs systemically and in a timely manner to ensure increased adoption of EVs in India. Set out below are some of the additional steps that India can take in order to enable mass adoption of EVs and enable smoother transition to EVs:

- In addition to providing incentives, the Union Government should work towards developing mass EV charging and swapping infrastructure across India;
- Along with promoting adoption of EVs, focus should also be towards conversion of existing ICE vehicles to EVs;
- Developing an insurance product specific to EVs to gain consumer confidence and trust; and
- Legislate a specific law governing EVs to tackle the specific concerns and hurdles arising out of EVs, batteries, components and the charging/swapping infrastructure.

ANNEXURE 1A

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
Tamil Nadu Electric Vehicle Policy 2023	The policy is unique because of its inclusion of R&D related expenses in eligible fixed assets. Further the policy focuses on intellectual property creation by granting projects 50% reimbursement on cost incurred for patents copyrights and trademarks up to INR 1 crore (approximately USD 121,000).	Investment Promotion Subsidy	Projects can avail one of the following mutually exclusive options: • SGST Reimbursement: Projects (new or expansion) of EV OEMs shall be eligible for 100% (hundred percent) reimbursement of gross SGST for a period of 15 (fifteen) years subject to minimum investment and employment generation thresholds; or • Turnover based subsidy: All projects (new or expansion) eligible for subsidy of 2% (two percent) of annual turnover subject to a cap of 4% (four percent) of the cumulative investment in eligible fixed assets for a period of 10 (ten) years; or • Capital subsidy: All projects (new or expansion) eligible for capital subsidy of 15% (fifteen percent) of investment in eligible fixed assets to be disbursed in 10 (ten) equal annual instalments subject to minimum investment or employment generation thresholds; or • Special ACC Capital Subsidy: New/expansion projects in EV battery manufacturing shall be eligible for a special capital subsidy of 20% (twenty percent) of investment in eligible fixed assets to be disbursed in 15 (fifteen) equal annual instalments. Projects in advanced chemistry cells (ACC) manufacturing shall be eligible for a special capital subsidy of 20% (twenty percent) of investment in eligible fixed assets to be disbursed in 10 (ten) equal annual instalments. In both scenarios, subsidy is subject to minimum investment or employment generation thresholds.
		Subsidy on cost of land	• Land to be made available at a concessional rate of 10% (ten percent) or 50% (fifty percent) up to INR 2 crore and other conditions. If land cost subsidy is availed, such land will be excluded from eligible fixed assets for the purpose of investment promotion subsidy.
		Tax exemption/subsidies	• 100% (hundred percent) of electricity tax payable exempted for projects on power purchased from the Tamil Nadu Generation & Distribution Corporation Limited (TANGEDCO) or generated and consumed from captive sources for 5 (five) years. • 100% (hundred percent) exemption on stamp duty for projects seeking to obtain land.

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
		Employment incentive	• Reimbursement of employer's contribution to the EPF for all new jobs created during policy's period for a period of 1 (one) year up to INR 48,000 (approximately USD 580) per employee.
		MSME benefits	• Additional capital subsidy of 20% (twenty percent) over and above the eligibility limit for capital subsidy under the existing capital subsidy scheme to MSME engaged in E-vehicle component or charging infrastructure manufacturing.
Karnataka Electric Vehicle and Energy Storage Policy 2017	Aims to promote manufacture of EVs and EV batteries as well as development of charging infrastructure in the state.	Facilitation to EV, Battery and Charging Equipment Manufacturing	• Facilitating, fast tracking and enabling a combined online application to obtain clearances from environmental, labour and other departments for setting up of manufacturing facilities. • Provides incentives to the EV battery manufacturers to encourage manufacture of modular design lithium-ion batteries with higher mileage per charge.
		EV manufacturing parks / zones	• Intends to make industrial land available (preferably in clusters) so that EV manufacturing zones can be created. • Provides infrastructure facilities such as power, water, sewage and testing facilities on ready built basis in such parks/zones to enable ancillaries to be set up by the manufacturing enterprises.
		Other supply side / manufacturing incentives	• EV and components manufacturing o 25% (twenty five percent) subsidy of value of fixed assets (VFA) up to INR 15,00,000 (approximately USD 18,000) for micro enterprises. o 20% (twenty percent) subsidy of VFA up to INR 40,00,000 (approximately USD 48,000) for small enterprises. o INR 50,00,000 (approximately USD 60,000) for medium enterprises. • EV battery manufacturing or assembly o 25% (twenty five percent) subsidy of value of fixed assets (VFA) up to INR 15,00,000 (approximately USD 18,000) for micro enterprises. o 20% (twenty percent) subsidy of VFA up to INR 40,00,000 (approximately USD 48,000) for small enterprises. o INR 50,00,000 (approximately USD 60,000) for medium enterprises. • 20% (twenty percent) subsidy of VFA up to INR 20,00,00,000 (approximately USD 242,000) for large, mega, ultra, or super mega battery, cell, module manufacturing

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
			projects (available to first two units set up in the state). • Interest free loan on net SGST for setting up EV, EV component manufacturing and battery manufacturing enterprises o **Large enterprises** (10 crore < investment on fixed assets < 250 crore): period of 8 (eight) years o **Mega enterprises** (250 crore < investment on fixed assets < 500 crore): period of 10 (ten) years o **Ultra mega enterprises** (500 crore < investment on fixed assets < 1000 crore): period of 11 (eleven) years o **Super mega enterprises** (investment on fixed assets > 1000 crore): period of 13 (thirteen) years *(Figures in INR)* • 100% (hundred percent) exemption from stamp duty and concessional registration charges in respect of loan agreements, credit deeds, mortgage and hypothecation deeds as well as for lease/ sub-lease / sale deeds, etc. executed in respect of the industrial plots, sheds, tenements and approved private industrial estates/ parks. • Reimbursement of land conversion fee for converting land from agricultural to industrial use. • 100% (hundred percent) exemption from payment of tax on electricity tariff for a period of 5 (five) years for MSMEs. • Subsidies for setting up of effluent treatment plants.
		EV incubation centre and venture capital fund	• Creation of an incubation centre and an 'EV Venture Capital Fund' by the state government to support research in this area.
Electric Mobility Policy 2018-23 (Andhra Pradesh)	The Policy targets to bring in manufacturing units of high-density energy storage of at least 10GWh capacity in a period of 5 years from the notification of the policy to cater to both domestic as well as export markets	Development of electric mobility industrial parks	• Allocation of 500 (five hundred) to 1,000 (one thousand) acres of land for developing EV parks with necessary external infrastructure, plug and play internal infrastructure and common facilities to attract manufacturers across the EV ecosystem • Incubation centre for handholding start-ups will also be planned in the EV parks. • Developers of auto clusters and automotive suppliers manufacturing centres (ASMC) specific to EVs shall be provided financial assistance of 50% (fifty percent) of fixed capital investments in building and

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
			common infrastructure, up to a maximum of INR 20,00,00,000 (approximately USD 242,000) under the policy.
		Infrastructural support to manufacturing firms	• Providing land to OEMs and dependent ancillary units at subsidized rate. • Ensuring supply of water at subsidized rates and facilitating / supporting setting up of water treatment plants. • Improving rail and road connectivity, etc. • Incentives under the exports policy of the state for export oriented units.
		Financial support to manufacturing firms	• Capital subsidies on fixed capital investment for (as a % of fixed capital investment): o Micro – 25% (twenty five percent) up to INR 15,00,000 (approximately USD 18,000) o Small – 20% (twenty percent) up to INR 40,00,000 (approximately USD 48,380.58) o Medium – 20% (twenty percent) up to INR 50,00,000 (approximately USD 48,000) o Large – 10% (ten percent) up to INR 10,00,00,000 (approximately USD 1,200,000) for first 2 (two) units in each segment such as E2W, E3W, 4W, battery and charging equipment, hydrogen storage and fuelling equipment manufacturing o Mega – 10% (ten percent) up to INR 20,00,00,000 (approximately USD 2,435,000) for first 2 (two) units in each segment such as E2W, E3W, 4W, battery and charging equipment, hydrogen storage and fuelling equipment manufacturing • Additional special incentives for mega integrated automobile projects and ultra-mega battery manufacturing plants on a case to case basis.
		Subsidy for specific clean production measures	• 35% (thirty five percent)subsidy on cost of plant and machinery for MSMEs and large projects up to a maximum of INR 35,00,000 (approximately USD 42,000) for complying with clean production measures as certified by the Andhra Pradesh Pollution Control Board. • Additional 25% (twenty five percent) subsidy for MSMEs and large projects for employing sustainable green measures on the total fixed capital investment of the project, subject to a ceiling of INR 50,00,00,000 (approximately USD 6,000,000).

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
		Tax and stamp duty incentives	• 100% (hundred percent) net SGST accrued to the state will be reimbursed for a period of 5 (five) years for micro and small industries, 7 (seven) years for medium industries and 10 (ten) years for large industries. • 100% (hundred percent) of stamp duty and transfer duty on purchase or lease of land meant for industrial use; and stamp duty for lease of land/shed/buildings, mortgages and hypothecations, will be reimbursed.
Telangana Electric Vehicle and Energy Storage (EV & ES) Policy 2020-2030	Framework consists of promoting EV adoption for end users, setting up of charging infrastructure and promoting manufacturing of EV & ES components in the state of Telangana.	Capital investment subsidy	• Tailor made benefits for mega and strategic projects on a case-to-case basis. Such projects would need to have investment of more than INR 200 crore (approximately USD 24.20 million) in plant and machinery/ provide employment to more than 1000 (one thousand) people. • Subsidy of 20% (twenty percent) of investment capped at INR 30 crore (approximately USD 3.6 million) for mega enterprises.
		Tax incentives and subsidies	• 100% (hundred percent) net SGST (capped at INR 5 crore (approximately USD 605 thousand) per year with a cumulative cap of INR 25 crore (approximately USD 3 million) over a period of 7 (seven) years) would be reimbursed for mega enterprises. • Reimbursement of 100% (hundred percent) of electricity duty for 5 (five) years (capped at INR 0.5 crores (approximately USD 60 thousand). • Reimbursement of stamp duty/transfer duty/registration fee of 100% (hundred percent) on the first transaction and 50% (fifty percent) on the second transaction.
		EV & ESS clusters	• EV & ESS cluster with global standard infrastructure shall be developed. • EV cluster shall have common facilities such as built-up space with ready factory sheds.
		Other incentives	• Provides for lease rental assistance, assistance in patent filing, reimbursement of quality certification costs, cleaner production cost reimbursement, skill development assistance, etc.
Uttar Pradesh Electric Vehicle Manufacturing and Mobility Policy, 2022	The policy aims to make Uttar Pradesh a global electric mobility development and manufacturing hub. The policy aims to promote EV clusters	Capital Subsidy	• Capital subsidy to be provided under the policy as follows: o First 2 (two) integrated EV projects and First 2 (two) ultra mega battery projects – capital subsidy of 30% (thirty percent) on eligible fixed capital investment up to INR 1000 crore (approximately USD 121 million) over a 20 (twenty) year period.

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
	catering to EV and EV batter and related components manufacturing.		○ First 5 (five) mega EV projects and first 5 (five) mega battery projects – capital subsidy of 20% (twenty percent) on eligible fixed capital investment up to INR 500 crore (approximately USD 60.50 million) over a 10 (ten) year period. ○ Large EV projects and large battery projects – capital subsidy of 18% (eighteen percent) on eligible fixed capital investment up to INR 90,00,00,000 (approximately USD 10.90 million) over a 10 (ten) year period. ○ MSME projects – capital subsidy of 10% on eligible fixed capital investment up to INR 5 crore (approximately USD 605 thousand) over a 2 (two) year period.
		Other incentives	• Stamp duty reimbursement of up to 100% (hundred percent) to integrated EV projects and ultra mega battery projects anywhere in UP; 50 (fifty percent) to 100% (hundred percent) stamp duty reimbursement to mega/large/MSME projects depending on region. • Patent registration fees reimbursement for large and MSME EV/battery projects • Skill development reimbursement incentives of INR 5,000 (approximately USD 60) per employee for first 50 (fifty) employees for all manufacturing projects under the policy.
Punjab Electric Vehicle Policy, 2022	The policy aims to curb the problem of vehicular emission in Punjab's cities, establish Punjab as an EV manufacturing hub and promote R&D in EVs.	Anchor Units	• EVs to be added as a sector for Anchor Units making them eligible for fixed capital incentive of INR 50 crore (approximately USD 6 million) • Infrastructure in form of readymade factories, power, water, sewage, testing facilities. • Capital incentive of 20 (twenty percent) to 40%(forty percent) (up to INR 40 crore (approximately USD 4.8 million)) for anchor manufacturing units.
		Tax incentives and subsidies	• 100% (hundred percent) reimbursement of gross SGST for intra-state sales and 50% (fifty percent) for inter-state sales a period of 6 (six) years subject to a maximum of 200% (two hundred percent) of fixed capital investment is provided under the policy. • 100% (hundred percent) exemption from electricity duty for 10 (ten) years.
		Employment subsidy	• Subsidy of INR 36,000 (approximately USD 435) per male employee per year for a period of 3 (three) years and INR 48,000 (approximately USD 580) per employee per

INCENTIVES AND MEASURES FOR SUPPLY SIDE			
State policy	**Salient features**	**Particulars**	**Incentives**
			year for a maximum period of 3 (three) years in case of females and SC/ST/OBC employee.
		Other incentives	• Government to actively encourage EV battery manufacturers to enable setting up of at least one giga battery manufacturing unit in the state.

ANNEXURE 1B

INCENTIVES AND MEASURES FOR THE DEMAND SIDE		
State policy	**Salient features**	**Incentives**
Delhi Electric Vehicle Policy, 2020	Objective is to establish Delhi as the EV capital of India and accelerate the pace of EV adoptions across different segments especially the category of E2Ws, public/shared transport vehicles and goods carriers.	• 100% (hundred percent) registration fee exemption and 100% (hundred percent) road tax exemption. • Demand boosting subsidies on EVs that meet the eligibility criteria of FAME-II scheme. • For vehicles sold without batteries, 50% (fifty percent) of the purchase incentive to be provided to the energy operator for defraying the cost of deposits required from the end user for use of swappable batteries.
Maharashtra State Electric Vehicle Policy, 2021	Objective is to accelerate the adoption of EVs in the state so that they contribute to 10% (ten percent) of new vehicle registrations by 2025. The Government is also focusing on public transport and promises 100% (hundred percent) public transport to go electric by 2027.	• All EVs are exempted from motor vehicle tax. • Demand boosting subsidies on EVs that meet the eligibility criteria of FAME-II scheme. • For vehicles sold without batteries, 50% (fifty percent) of the purchase incentive to be provided to the energy operator for defraying the cost of deposits required from the end user for use of swappable batteries.
Electric Vehicle Policy, 2021 (West Bengal)	Government aims to promote innovation through grants and venture funds to research organizations, incubators and start-ups working on battery technology, EV power trains and EV electronics.	• Various categories of vehicles are eligible to claim demand incentives including buses, 4Ws, E3Ws and E2Ws.
Odisha Electric Vehicle Policy, 2021	Aims to accelerate the pace of adoption of EVs in the vehicle segments especially in the category of E2Ws, E3Ws and light motor vehicles. It is aimed to achieve adoption of 20% EVs in all vehicle registrations by 2025.	• 100% (hundred percent) registration fee exemption and 100% (hundred percent) road tax exemption during the policy period. • Subsidies for E2Ws, E3Ws and 4W @15% or up to INR 3,000 (approximately USD 36); INR 12,000 (approximately USD 145) and INR 1,00,000 (approximately USD 1,210) respectively. • Scrappage incentive will be provided to consumers as per the guidelines issued by the Union Government. • Electricity to be provided to consumers at INR 5.70 per unit. • Subsidy on each charger of INR 5,000 (approximately USD 60).

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M. ARUN KUMAR
Partner, IndusLaw

DEEPAK CHOWDHURY
Partner, IndusLaw

SWATHI SREENATH
Principal Associate, IndusLaw

RITVIKA THAKUR
Senior Associate, IndusLaw

AHONA PAL
Associate, IndusLaw

VIDHI MARWAHA
Associate, IndusLaw

KAJAL KASHYAP
Associate, IndusLaw

GURSIMAR SETIA
Associate, IndusLaw

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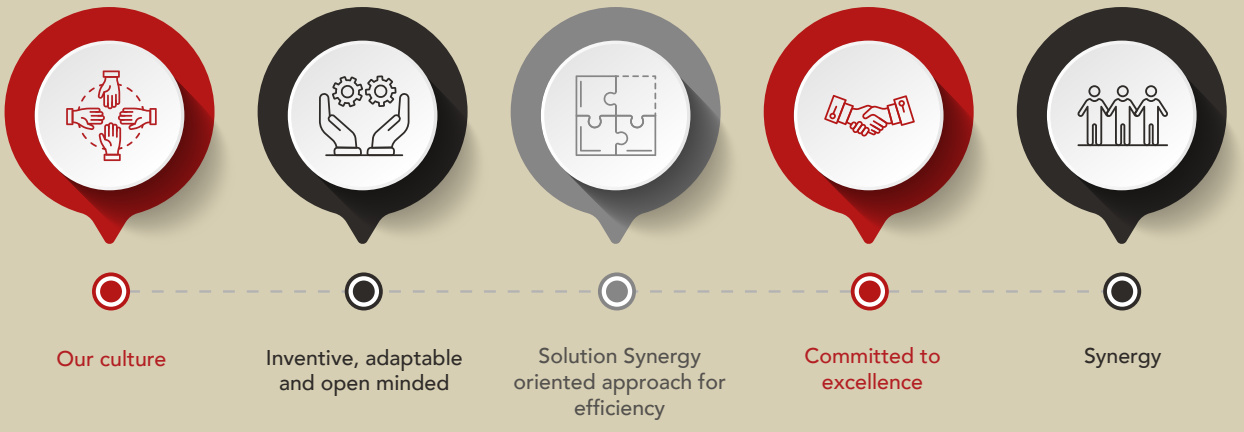

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Taxes including transaction / investment structuring, tax litigation, exchange control regulations, fund structures, AIF & NBFC regulations, succession planning and international tax matters

Confederation of Indian Industry

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering Industry, Government and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, with around 9000 members from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 300,000 enterprises from 286 national and regional sectoral industry bodies.

For more than 125 years, CII has been engaged in shaping India's development journey and works proactively on transforming Indian Industry's engagement in national development. CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, livelihoods, diversity management, skill development, empowerment of women, and sustainable development, to name a few.

As India completes 75 years of Independence in 2022, it must position itself for global leadership with a long-term vision for India@100 in 2047. The role played by Indian industry will be central to the country's progress and success as a nation. CII, with the Theme for 2022-23 as Beyond India@75: Competitiveness, Growth, Sustainability, Internationalisation has prioritized 7 action points under these 4 sub-themes that will catalyze the journey of the country towards the vision of India@100.

With 62 offices, including 10 Centres of Excellence, in India, and 8 overseas offices in Australia, Egypt, Germany, Indonesia, Singapore, UAE, UK, and USA, as well as institutional partnerships with 350 counterpart organizations in 133 countries, CII serves as a reference point for Indian industry and the international business community.

Confederation of Indian Industry
Northern Region – Delhi State Office
Second Floor, Andhra Association Building, 24-25, Institutional Area, Lodi Road
New Delhi - 110 003, India
W: www.cii.in
For CII Delhi State Membership: 011-40028898 / 800
For Yi Delhi and IWN Delhi Membership: 011-40028896
Other Tel Nos: 011-40028899 / 40028823/40028800/40028894/40028895/40028897/40028863

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www.induslaw.com

OUR OFFICES

BENGALURU
101, 1st Floor, "Embassy Classic"# 11
Vittal Mallya Road
Bengaluru 560 001
T: +91 80 4072 6600
F: +91 80 4072 6666
E: bangalore@induslaw.com

HYDERABAD
204, Ashoka Capitol, Road No. 2
Banjarahills
Hyderabad 500 034
T: +91 40 4026 4624
F: +91 40 4004 0979
E: hyderabad@induslaw.com

CHENNAI
#11, Venkatraman Street, T Nagar,
Chennai - 600017 India
T: +91 44 4354 6600
F: +91 44 4354 6600
E: chennai@induslaw.com

DELHI & NCR
2nd Floor, Block D
The MIRA, Mathura Road, Ishwar Nagar
New Delhi 110 065
T: +91 11 4782 1000
F: +91 11 4782 1097
E: delhi@induslaw.com

9th Floor, Block-B
DLF Cyber Park
Udyog Vihar Phase - 3
Sector - 20
Gurugram 122 008
T: +91 12 4673 1000
E: gurugram@induslaw.com

MUMBAI
1502B, 15th Floor
Tower – 1C, One Indiabulls Centre
Senapati Bapat Marg, Lower Parel
Mumbai – 400013
T: +91 22 4920 7200
F: +91 22 4920 7299
E: mumbai@induslaw.com

#81-83, 8th Floor
A Wing, Mittal Court
Jamnalal Bajaj Marg
Nariman Point
Mumbai – 400021
T: +91 22 4007 4400
E: mumbai@induslaw.com