INITIATIVES TO POPULARIZE EVs IN INDIA

— SUPPLY OF PARTS AND BATTERY MATERIALS IS AN ISSUE; RELYING ON IMPORTS FOR THE TIME BEING —

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SUMMARY

- For India, where the air pollution problem is serious, the promotion of electric vehicles (EVs) is expected to be a solution. At the same time, it is expected to contribute to the country's goal of becoming “energy independent” by 2047.
- By 2030, India aims to achieve its EV penetration targets of 30% for four-wheeled vehicles, and 80% for two-wheelers and three-wheelers. Lithium-ion battery (LIB) production, which holds the key to the uptake of EVs, is still in the early stages in India. Achieving the government's goal of EV adoption is expected to depend on the progress of domestic production of inexpensive batteries.
- Although India is strong in the field of software, it relies on technological know-how from overseas in manufacturing. In battery manufacturing as well, India needs to collaborate with leading companies in Japan, South Korea, Europe, the US, and other countries to build a supply chain.

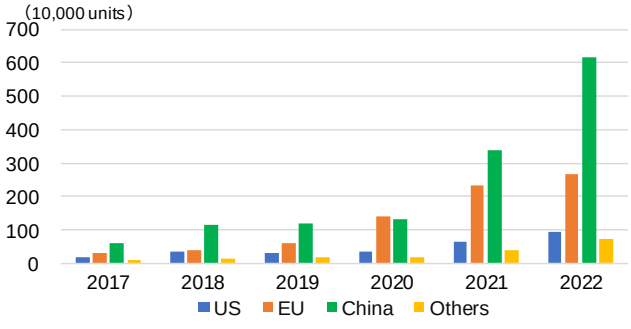
India has one of the most serious air pollution problems in the world, and vehicle emissions are considered the biggest contributor. The promotion of EVs holds promise as a first step in addressing such environmental issues. In addition, promoting EVs is also essential for India to achieve its goals of becoming a “self-reliant India” and “energy independence” by 2047, which the country aims to accomplish by fostering the development of industries that do not rely on imports and strengthening its international competitiveness. This report discusses EVs and battery manufacturing in India, as well as the EV promotion initiatives of the government and major industry players.

1. EV DEPLOYMENT IN INDIA AND OTHER COUNTRIES

1-1. Overview of the global EV market

Global sales of EVs (in this context defined as battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs)) grew 55% year on year to 10.52 million units in 2022, accounting for 13% of total passenger car sales (BEVs: 9.5%, PHEVs: 3.5%). By country/region, China accounted for 59% of total sales, the EU 25%, the US 9%, and others 7% (Figure 1). As for sales composition[1], BEVs and PHEVs represented

Figure 1: Global sales volume of EVs (BEVs and PHEVs)



Source: Compiled by MGSSI based on data of EV-Volumes, CleanTechnica, Tridens Technology, and others

[1] In the EU, PHEVs account for 46% of all EVs, compared to 26% in the US and only 18% in China. In terms of sales growth in the first half of 2022, sales of BEVs grew by 75%, while that of PHEVs grew by only 37%.

73% and 27% of total EV sales, respectively. Figure 2 shows McKinsey & Company's forecasts for sales of EVs as a percentage of total four-wheeled vehicle sales.

Figure 2: Forecasts of EV sales as a percentage of sales of four-wheeled vehicles in major countries/regions

Country, region	Actual sales in 2022	2030			2035		
		Worst-case scenario	Best-case scenario	Net Zero	Worst-case scenario	Best-case scenario	Net Zero
US	6.6%	33%	40%	50%	50%	65%	80%
EU	20.3%	60%	75%	85%	90%–100%		
China	24.2%	50%	70%	90%	98%–100%		
Japan	2.7%	20%	30%	50%	Around 100%		
India	1.1%	20%	30%	50%	40%	50%	60%

Note: Sales in 2022 are based on CleanTechnica data and include only BEVs and PHEVs. Forecasts include fuel-cell electric vehicles.
Source: Compiled by MGSSI based on data of CleanTechnica, McKinsey & Company, and others

1-2. Current market status and forecast for EV uptake in India

The Indian government's targets for EV penetration by 2030 are: commercial vehicles 70%, private cars 30%, buses 40%, and two- and three-wheelers 80%. Although India ranks third in sales of passenger cars[2] after China and the US, EVs accounted for only about 1.1% of four-wheeled vehicle sales in 2022. However, given that India had the world's highest year-on-year growth rate of EV four-wheeled vehicle sales in 2022 (+273%) and the fact that the per-household ownership rate of passenger cars in India is about 10%, compared to 40% in China, there is ample room for growth over the long term.

Figure 3 shows forecasts for the market uptake of EVs (two-wheeled, three-wheeled, and four-wheeled vehicles) in India, taking into account the government's EV promotion measures and the battery manufacturing plans of various companies.

Figure 3: EV market forecasts for two-wheelers, three-wheelers, and four-wheelers in India and government targets

Vehicle type	Year	2021 (Actual results)	2022 (Actual results)	2023	2025	2028	2030	2030 Government target
Two-wheeler	Total units	13,700,176	15,458,092	16,230,997	17,894,674	20,715,322	22,838,642	
	EV units	153,523	624,182	973,860	2,684,201	6,214,597	13,703,185	
	EV%	1.1	4.0	6.0	15.0	30.0	60.0	80%
Three-wheeler	Total units	373,152	641,375	673,444	742,472	827,073	877,441	
	EV units	154,173	338,559	390,597	519,730	661,658	789,697	
	EV%	41.3	52.8	58.0	70.0	80.0	90.0	80%
Four-wheeler	Total units	3,748,733	4,255,341	4,553,215	5,212,976	6,386,119	7,311,468	
	EV	12,851	47,953	91,064	260,648	638,612	1,462,294	
	EV%	0.3	1.1	2.0	5.0	10.0	20.0	30%

Note: Four-wheeled vehicles are defined as passenger cars and light passenger vehicles.

Source: Compiled by MGSSI based on information from Vahan (India's national vehicle registration system) from actual results and from government policies, corporate activities, and other sources for estimates.

2. CENTRAL AND STATE GOVERNMENT'S INITIATIVES TO PROMOTE EVs

2-1. FAME[3] program for EV sales promotion

The government of India launched the FAME I scheme in 2015 with a total budget of Rs. 5.29 billion (approximately ¥8.4 billion based on an exchange rate of 1 rupee = ¥1.6) to encourage the use of EVs. However,

[2] Light motor vehicles, medium motor vehicles

[3] Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles. The subsidy program focuses on demand creation and charging infrastructure development. It consists of four components: (1) creation of demand through incentives, (2) establishment of technology platforms, (3) implementation of pilot projects, and (4) installation of charging infrastructure.

due to the high cost of EVs and the government's inability to create demand, the FAME II program[4] was introduced in April 2019 at a total cost of Rs. 100 billion. Of the total budget, up to Rs. 80 billion has been appropriated to subsidize EV purchasers and waive registration fees (Figure 4), and approximately Rs. 10 billion will be used to improve charging infrastructure.

Figure 4: Assistance for EV purchasers under the Indian government's FAME II policy (revised June 2021)

Vehicle type	No. of units eligible	Installed battery capacity (projected)	Subsidy per kWh (Rupee)	Maximum subsidy per vehicle (Rupee)
Electric two-wheeler	1 million	2 to 5kWh	15,000	Up to 25% of vehicle price
Electric three-wheeler	500,000	3 to 6kWh	10,000	50,000
Electric four-wheeler (EV)	35,000	15 to 90kWh	10,000	150,000
Electric four-wheeler (PHEV)	20,000	1.5 to 20kWh	10,000	13,000
Electric bus	7,090	250kWh	20,000	5 million

Source: Compiled by MGSSI based on announcements by the Indian Ministry of Heavy Industries

The FAME II program has significantly increased the amount of support and it is providing momentum for the uptake of EVs, as described in section 1-2 of this report. The Indian government is currently preparing the FAME III scheme to expand support not only for BEVs but also for PHEVs, and also to cover fuel cell electric vehicles (FCEVs) and vehicles that run on biofuel blends.

2-2. Support schemes for domestic production of EVs and related components and batteries

In April 2020, with the main objective of promoting domestic manufacturing and expanding exports, the Indian government announced its Production Linked Incentive (PLI) schemes targeting the large-scale electronics manufacturing sector. Since then, the government has expanded the number of target sectors in stages, and currently 14 sectors, including pharmaceutical raw materials, EVs, and lithium-ion batteries (hereinafter referred to as LIBs), are eligible for the financial incentives. Plans call for successively implementing the schemes with outlays totaling more than Rs. 2 trillion. The following are being implemented in relation to EVs:

1. PLI Scheme for Automobile and Auto Component Industry (manufacturing automobiles and auto components[5]): Aims to establish a global supply chain for automotive technologies and products. The PLI program will provide a total of Rs. 259.38 billion for electric vehicles, fuel cell vehicles, etc. to be produced over a five-year period from January 2022. The scheme has been expected to generate more than Rs. 425 billion in new investment over the next five years, but in fact, the total proposed investment is much higher, at Rs. 748.5 billion. Among the 75 approved beneficiary companies are Maruti Suzuki, Hero MotoCorp, Bosch, and Ola Electric. In addition, the government is raising import tariffs on EVs[6] to encourage domestic production.

2. Support for LIB production: Battery production is key to the uptake of EVs. Currently, battery cells are imported and packaged domestically, but under the PLI scheme for domestic production of batteries, including cells, the government will promote domestic production of LIBs amounting to total capacity of 50 gigawatt hours (GWh) by 2025. A public tender was held in March 2022, and in July, three companies were selected to produce batteries with total capacity of 30 GWh[7]. In addition, six companies for a

[4] The scheme was originally introduced to cover a 3-year period, but in June 2021, the government announced an increase in support and an extension of the program period to March 2024.

[5] Under the "sales value-linked" scheme, subsidies equivalent maximum 18% of increase in sales will be provided to companies that build or expand EV production plants or manufacture related parts, provided that certain sales growth and other requirements are met.

[6] As part of efforts for the promotion of domestic production of EV vehicles, the budget proposal included an increase in tariffs on imports of finished EVs with a CIF price of US$40,000 or more from 60% to 70%. In addition, tariffs on vehicles, including EVs produced in the semi-knockdown (SKD) format, in which parts are imported and assembled in bulk to a certain extent, were also raised from 30% to 35%.

[7] Ola Electric (20 GWh), Rajesh Exports (5 GWh), Reliance New Energy (5 GWh)

combined capacity of 58 GWh are awaiting approval[8]. Under the scheme, Rs. 181 billion in subsidies will be allocated over the next five years. If EV adoption accelerates by 2030, battery demand is expected to grow to 260 GWh worth. Support is also being prepared for domestic production of batteries and other products, aside from LIBs, that are still in the development stage[9]. In addition, given that LIB cell manufacturing is in the start-up phase in the country, the government has exempted import duties on raw materials, components, and manufacturing machinery necessary for EV LIB cell manufacturing in the budget proposal for 2023-24.

2-3. State government's initiatives to support EV introduction and manufacturing

In India, as it is difficult to promote EVs with support from the central government alone, state governments need to take the initiative in promoting EVs. Of India's 28 states and 8 union territories, 31 states and territories have already formulated their own EV policies and are in the implementation phase. The efforts are largely divided into two groups, depending on whether the incentives target purchasers or manufacturers. The states of Delhi, Maharashtra, and West Bengal, which suffer from severe air pollution, are focusing on promoting purchases (Figure 5). On the other hand, states such as Tamil Nadu and Haryana, which have concentrations of automobile industry companies, are focusing on supporting manufacturers (Figure 6).

Figure 5: Incentives offered by Indian states to promote EV purchases

State	Purchase subsidy (Per kWh of on-board battery; Unit = Rupee)	Maximum purchase subsidy (Unit = Rupee)	Exemption on road tax
Union Territory of Delhi	・Two-wheeler: 5,000 ・Four-wheeler: 10,000	・Two-wheeler: 30,000 ・Three-wheeler: 20,000 ・Four-wheeler 150,000	100%
Uttar Pradesh	-	・Two-wheeler: 5,000 ・Three-wheeler: 12,000 ・Four-wheeler 100,000	100%
West Bengal	・Two-wheeler: 10,000 ・Four-wheeler: 10,000	・Two-wheeler: 20,000 ・Three-wheeler: 30,000 ・Four-wheeler 150,000	100%
Maharashtra	・Two-wheeler: 5,000 ・Four-wheeler: 5,000	・Two-wheeler: 30,000 ・Three-wheeler: 30,000 ・Four-wheeler 150,000	100%
Gujarat	・Two-wheeler: 10,000 ・Four-wheeler: 10,000	・Two-wheeler: 20,000 ・Three-wheeler: 50,000 ・Four-wheeler 150,000	50%

Source: Compiled by MGSSI based on each state's announcements of its EV policies

[8] Mahindra & Mahindra (15 GWh), Reliance New Energy (15 GWh), Exide Industries (6 GWh), and others are awaiting approval.

[9] Also in the pipeline is a PLI scheme for supercapacitors (capacity of approximately 5 GWh), which was not included within the framework of the existing ACC battery PLI scheme, and all-solid-state LIB batteries, which are still in the research and development stage and are expected to be commercialized within the next five years. A public tender is expected to be announced in the next few months. Moreover, a plan is also being formulated to secure resources (Li and Co) for batteries.

Figure 6: Incentives offered by Indian states to promote EV-related manufacturers

State	Details of local government incentives
Uttar Pradesh	・Announced a new EV manufacturing policy in October 2022. Aiming to become an international manufacturing base for EVs and related equipment and batteries. Targeting EV conversion rate of 100% for government vehicles by 2030. ・Subsidy of 30% for investments (up to Rs. 10 billion) for the first two companies that invest in the manufacturing of batteries with total capacity exceeding 1 GWh. Reimbursement of stamp duty. Support for expansion of charging and battery swapping stations.
Tamil Nadu	・Strengthening EV and battery manufacturing base and focusing on charging infrastructure. Establish two mobility parks centered on EVs. ・Subsidy of 15% for investments in manufacturing operations for EVs and charging-related intermediate goods and components, and 20% of land purchases. Exemptions for electricity tax. ・Exemptions for electricity tax and stamp duty, and 15% subsidy for land costs for EV-related and charging infrastructure manufacturing businesses. ・Providing subsidies of 20% for investments in EV battery manufacturing, 20% for land purchases, etc.
Haryana	・The EV policy in the November 2022 notification stated that emphasis would be placed on attracting new entrants to the EV sector and encouraging existing automotive-related companies to shift to the EV sector. ・Aiming to convert 100% of buses owned by all state-related agencies to EVs or fuel cell vehicles by 2030. ・Subsidize fixed capital investment outlays made by companies that manufacture EVs, EV components, EV batteries, charging equipment, etc. Subsidize capital outlays for mega investments at 20% of the investment amount or Rs. 200 million, for large investments at 10% of the investment amount or Rs. 100 million, and for medium-scale investments at 20% of the investment amount or Rs. 5 million, whichever is lower. Other incentives include stamp duty reimbursement, electricity tax exemption, and SGST (state goods and services tax) refund. Subsidize up to 15% of FCI (fixed capital investment) for companies engaged in battery recycling.
Andhra Pradesh	・Allocate land for EV parks. Support up to 50% of the investment cost for buildings and common facilities for EV-related startups, EV clusters, and developers of manufacturing facilities. ・Provide grants totaling Rs. 5 billion for innovative R&D in the field of electric mobility and assistance for human resource development in related fields. ・Investment subsidies for companies that manufacture EVs, EV components, EV batteries, etc. Subsidize capital outlays for mega investments at 10% of the investment amount or Rs. 200 million, for large investments at 10% of the investment amount or up to Rs. 100 million, and for small and medium-scale investments at 20% of the investment amount or Rs. 4 million and Rs. 5 million, respectively, whichever is lower. Other incentives include SGST refund.

Source: Compiled by MGSSI based on each state's EV policy announcements

3. CHARGING INFRASTRUCTURE INSTALLATION INITIATIVES AND KEY PLAYERS IN THE EV SECTOR IN INDIA

3-1. Charging infrastructure installation initiatives

The Indian government has plans to significantly increase the number of public charging stations[10], with 1,826 installed as of July 2022. Within the timeframe of FAME II, the plan is to install a total of 2,700 stations, at least one per 3 km^2 in Tier 1 cities (population of over 4 million), as well as another 1,576 stations on both sides of the road at 25 km intervals on highways. A longer-term plan envisions three scenarios for the installation of public charging stations by 2030 — minimum: 3,263 units, mid-level: 23,524 units, highest: 46,397 units. In addition to the government, a number of private companies are also working to develop charging infrastructure (Figure 7).

Figure 7: Major private-sector EV charging infrastructure development initiatives in India

Company	Main initiatives
BOLT	India's largest EV infrastructure provider (established in 2017 in Bengaluru). It has installed over 15,000 chargers already in India, and the goal is to install 100,000 chargers within the next two years. The company's charging system is compatible with a variety of EVs. It has also established a system whereby charging station owners (individuals and corporations) can earn income based on the use of their stations by other users.
Convergence Energy Services	A government-affiliated company that develops and installs EV charging ecosystems in collaboration with other government-affiliated companies and others. It is also working with TVS Motor, a leading manufacturer of two-wheelers. The company has already installed 2,173 charging stations nationwide. It is also undertaking the installation of solar-powered charging stations.
CHARGE ZONE	The company is based in the state of Gujarat. It is focusing on strengthening the electric bus charging network and public EV charging infrastructure using renewable energy, and it has already installed 1,600 charging stations.
Tata Motors	The company offers free home chargers for EV purchasers. It has already installed 2,200 public charging stations in more than 200 cities. With the aim of alleviating the concerns of EV owners, it is in the process of installing an additional 1,400 charging stations.

Source: Compiled by MGSSI based on various news reports

[10] Public charging stations (PCS) are typically located along streets, in shopping centers, government facilities, and other general parking areas, and are accessible to all. There are also private charging stations, which are generally installed in private residences/apartments, workplaces, etc., and are not available to the general public.

3-2. Major players in the EV manufacturing sector

Maruti Suzuki India, which has a greater-than-40% share of automobile sales in India, has been slow to introduce EVs. In contrast, local manufacturer Tata Motors, which had been under pressure from competition with Japanese and South Korean automakers in terms of its share of car sales in India, has introduced affordable EVs and now holds an 80% share of sales of domestic four-wheeled EVs (Figure 8). Maruti Suzuki unveiled its EV concept model at Auto Expo 2023 held in January 2023 in India, and has recently announced plans to release a BEV to the Indian market during FY 2024. Even so, it is Tata Motors that has stronger prospects of boosting its share of the country's car market going forward.

Figure 8: Major EV-related corporate initiatives in India

Company	Business details
Maruti Suzuki India	Suzuki, which together with its local subsidiary has a greater-than-40% share of sales in India's automobile market, is building a plant for EVs and automotive batteries on land adjacent to its passenger car plant in Gujarat. The company unveiled its eVX EV concept vehicle at Auto Expo 2023 in India in January 2023. It plans to manufacture and sell EVs in India by the end of FY 2024. The company announced that by 2030 it will launch six models in India and have EVs account for 15% of its total sales. It is collaborating with Toyota in India, and there are prospects of further expanding the collaboration in the areas of EVs and PHEVs.
Hyundai/ Kia	Hyundai and its subsidiary Kia have the second largest share of car sales in India (20%) after Suzuki. Like Suzuki, the company has been expanding its market share by leveraging the small size and low prices of its vehicles. The company is also proactively introducing EVs, and has already launched the Kona EV and Ioniq 5, as well as the e-Niro by subsidiary Kia. The automaker is planning a full-scale launch of EVs in 2024.
Tata Motors	Tata Motors is in third place in India with a 14% share of car sales, but is expanding its market share by leading the shift to EVs. It accounts for 80% of passenger car EV sales in India. At this stage, the company has three EVs on the market and plans to introduce three more (Tiago EV, Sierra, and Altroz). It showcased its Sierra and Avinya concept vehicles at Auto Expo 2023. As Tata Chemicals, a group company, is planning to manufacture LIBs, the automaker aims to further extend its lead in India's EV market by manufacturing batteries in-house.
Mahindra & Mahindra	Mahindra has introduced a number of popular SUVs and has increased its share of India's car market to just under 10%, giving it a 4th place position. It launched the eXUV400, an EV SUV, in January 2023. The first 5,000 units are priced at Rs. 1.5 million each. It plans to supply 20,000 units in 2023. The automaker has a view to introduce up to 16 types of EVs by 2027 (8 EV-SUVs and 8 EV light commercial vehicles and passenger cars).
TOYOTA	Toyota ranks 5th in India with an approximate 4% market share of car sales, but aims to increase its share by strengthening cooperation with Suzuki. In May 2022, the Toyota Group announced planned investment of Rs. 48 billion in the Indian state of Karnataka to produce EV-related components. The automaker exhibited its EV-SUV bZ4x at Auto Expo 2023, and plans to release it to the market in April 2023. The company is considering introducing Lexus EVs in India and has begun drive tests for several EV models, including SUVs.
Mercedes-Benz	The company currently sells 3 types of EVs in India (EQC, EQS, and EQA). It is also planning to launch an EQS SUV in the second quarter of 2023. All three models are manufactured or assembled in India.
MG Motors	The company is a subsidiary of SAIC Motor Corporation of China. It is vulnerable to deteriorating India-China relations and requires prior government approval for investment. The company plans to procure batteries in India and roll out more than 10 types of EVs in the future. It was second only to Tata in EV sales in India in 2022. To compete with Tata, the leader in the EV segment, the company plans to introduce a low-cost EV (under Rs. 1.5 million).
BYD Auto	The company currently sells its e6 and Atto 3 SUVs in India. At Auto Expo 2023, the automaker announced that its luxury model BYD Seal will be released by the end of the year. The company is considering shifting production of the BYD vehicles to a JV in India by 2025.

Source: Compiled by MGSSI based on various news reports

3-3. Leading names in LIB-related fields

Currently, there are no companies manufacturing LIB cells in India, and cells are imported from China and South Korea, packaged domestically, and sold with added value such as with battery management systems (BMS). Companies that import cells from abroad and sell them in India include Nexcharge and Okaya Power[11].

Furthermore, initiatives have been launched to incorporate technological know-how from overseas and manufacture everything from battery cells to final products in India. The activities of the major names in this field are described in Figure 9.

[11] Other companies include Exicom, Battrixx, Amara Raja, Inverted Energy, Grinntech Motors & Services, Coslight, IPower Batteries, Trontek Electronics, Cygni Energy, and PURE.

Figure 9: Major battery manufacturing-related corporate initiatives in

Company	Business details
TDSG	The company is a JV of three partners: Suzuki (50%), Toshiba (40%), and Denso (10%). It will manufacture LIBs in Gujarat for supply primarily to Suzuki. The JV will make the most of Toshiba's cell technology and Denso's module technology, and its LIB will feature Toshiba's technology that uses oxide (lithium titanium oxide) as the negative electrode material. LIB production and supply are expected to start in 2024.
Amperex Technology Limited (ATL)	ATL made Navitasys, a company engaged in the manufacture and sale of rechargeable battery packs in India, into a subsidiary, and in November 2022, TDK made ATL a wholly owned subsidiary. ATL has already secured 72 hectares of land in Haryana, India. The company will produce lithium-ion polymer (LIPO) batteries at the site. Given the current tensions in China-India relations, the technology behind Chinese LIBs will be deployed in India through Japanese companies.
Nash Industries	The company is planning to produce LIBs in India through a partnership with Forte, an IT startup in Aomori City. Forte, in cooperation with Iwate University and the Iwate Prefectural Industrial Research Institute, has succeeded in replacing the organic electrolyte that causes ignition of LIBs with an inorganic oxide solid electrolyte that does not ignite, and is shipping sample lithium solid-state batteries in Japan. Although lithium-ion solid-state batteries are still in the development stage and have not reached the mass production stage, Nash has partnered with Forte in anticipation of the technology's potential.
24M Technologies/Lucas TVS	Lucas TVS of India and 24M Technologies of the US, which possesses semisolid-state LIB technology, have partnered and are planning to set up a semisolid-state LIB gigafactory in Tamil Nadu, India. The company plans to expand production to capacity of 10 GWh in the future. Itochu has also invested in the company.
Tata Chemicals	The company has secured land in Gujarat for a factory, where it plans to manufacture a range of products, from materials for LIBs to cells and batteries, as well as recycle them. It targets annual LIB production of up to 10 GWh total capacity, and intends to expand production as the market grows. The company has signed a non-exclusive technology transfer agreement with the Indian Space Research Organization (ISRO), which has LIB technology, and plans to use ISRO's technology for LIB production.
Nexcharge	The company is a JV between Exide Industries, India's largest and the world's fourth largest manufacturer of automotive and industrial lead-acid batteries, and Leclanché SA of Switzerland. As it plans to manufacture LIBs, it has already started constructing a plant in Bengaluru and completion of the facility is expected by the end of 2024. For the time being, the company will import cells from Germany, but it plans to manufacture cells domestically in the future.
Ola Electric	The company plans to manufacture LIBs in India using battery technology from Israel's StoreDot. It has been approved as a beneficiary of the Indian government's PLI scheme of subsidies to support LIB production (20 GWh). There are plans to expand capacity to 40 GWh in the future. It is a subsidiary of OLA, in which Japan's Softbank Group has invested.
Reliance Industries	Reliance, India's largest conglomerate, acquired LIB cell manufacturing technology through its purchase of shares in Faradion, a UK company that is involved with sodium ion battery technologies, and Lithium Werks (LW), which produces lithium iron phosphate (LFP) batteries. LW acquired a manufacturing plant in China belonging to A123 Systems. The company has been approved for the government's PLI scheme of subsidies supporting LIB production (5 GWh) and is awaiting approval for additional capacity of 15 GWh .
Munoth Industries Ltd (MIL)	The company set up India's first lithium-ion battery plant in Andhra Pradesh with technology cooperation from Chinese LIB manufacturer Tianjin Lishen Battery and BPI. It is said to be the first to manufacture LIB cells in India. With a capacity of 270 MWh, the plant is currently producing 20,000 cells per day of 10Ah capacity for smartphones, and plans to manufacture LIB cells for motorcycles and tricycles in the second phase. The company's policy is to manufacture mainly on an OEM basis.

Source: Compiled by MGSSI based on various news reports

While India is strong in areas where BMS and software can be utilized, it still relies on technological know-how from overseas in manufacturing. Especially in the manufacturing of cells, where complex and technical expertise is crucial, it is essential for Indian companies to cooperate with Japanese, South Korean, and Chinese companies.

Chinese companies are leading the world in LIB development and manufacturing, and have succeeded in manufacturing LIBs that use inexpensive iron phosphate as the cathode material instead of the more expensive cobalt and nickel, and their products are already being used in EVs. Chinese companies also lead the world in the development and manufacturing of sodium ion batteries that use sodium instead of lithium, given the limitations of lithium resources and the rising price of lithium. Indian companies lagging in the development and

manufacturing of batteries are incorporating the technological know-how of Chinese and Israeli companies that possess such advanced technologies, and are rushing to initiate manufacturing operations in India. As for Japanese companies, the Aomori-based startup Forte Co., Ltd. is providing technological know-how to a company preparing to produce LIBs in India and it is attracting attention for its efforts to support production in the country. There are many components that can be produced in India[12], such as BMS (excluding cells), battery pack cases, and vibration pads, which are the elemental technologies for battery manufacturing, so it is also possible to create unique added value by combining them with technologies introduced from overseas.

4. CHALLENGES AND FUTURE PROSPECTS

The FAME II policy has led to a certain degree of progress in EV adoption in India, but EV demand in India remains weak compared to that in Europe, the US, China, and other countries. What is required of the Indian government in particular are policies that will make EVs more cost competitive compared to existing vehicles. In addition to the installation of charging stations on roads, it is necessary to take measures to promote the installation of chargers in housing complexes, which pose challenges in terms of installation locations and power supply.

Globally, demand for LIBs and their raw material, lithium, has surged in recent years as major automakers have entered the EV market in rapid succession. Over the past two years, the price of lithium has jumped 12-fold, with prices for LIBs that use cobalt and nickel materials for the cathode rising about 12% and those that use inexpensive iron phosphate for the cathode rising about 27%. If lithium prices remain high in the future, it will be a major bottleneck to the market uptake of EVs[13]. In addition to lithium raw materials, a stable supply of cathode materials such as cobalt and nickel is also important to promote domestic production of batteries. Chinese companies lead the way in the production of LIBs using iron phosphate for the cathode, and if the technologies to replace lithium with sodium are advanced in the long term, this could be a solution to many of the problems hindering the widespread adoption of EVs.

In addition, in order for India to become cost competitive in battery manufacturing, the key issue is not only to acquire technological know-how in cell manufacturing, which is indispensable for LIB production, but also to create a supply chain for managing downstream materials, such as LIB components, as well as upstream materials, such as electrode materials and lithium resources, in cooperation with Japan, South Korea, Europe, and the US. Furthermore, immediate steps must be taken to ensure supply-side capacity, such as guaranteeing preferential tariff treatment on imports of cells and parts, until domestic cell manufacturing becomes feasible.

[12] Other components include temperature sensors, protection circuit modules (PCMs), signal wires, battery connectors, cathode materials (nickel, cobalt, manganese) and anode materials (graphite, lithium titanate), electrolytes (lithium salts, ethylene carbonate, etc.), and separator materials (polyethylene, polypropylene).

[13] It is said that the battery accounts for approximately 40% of the cost of an EV.