

India: Electric Vehicle Sector



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Manufacturers & Traders

FOREWORD

India stands on the cusp of a ground-breaking revolution in electric mobility. With growing investment from domestic and foreign companies, and supportive government policies, annual electric vehicle (EV) sales are predicted to be around 10 million per year by 2030, which will make India one of the world's largest EV markets, accounting for nearly one in every ten EVs sold globally.

This report is designed to help UK companies understand the developing EV sector in India, in order to inform their strategy and approach to the market. It looks at the strategy of India's automotive manufacturers, profiling domestic players, foreign investors and two-wheel producers as they transition to electrified propulsion. Key recent developments in India's EV ecosystem, including charging infrastructure and battery swapping are also discussed along with the national policy landscape.

India and the UK have a long and close history of co-operation in automotive and electrification opens up significant new opportunities for UK firms, and this report highlights several areas of opportunity.

SMMT has long supported UK firms to explore new business in India's vibrant automotive sector and we look forward to working with you in the months and years to come.

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Abbreviations/ Acronyms

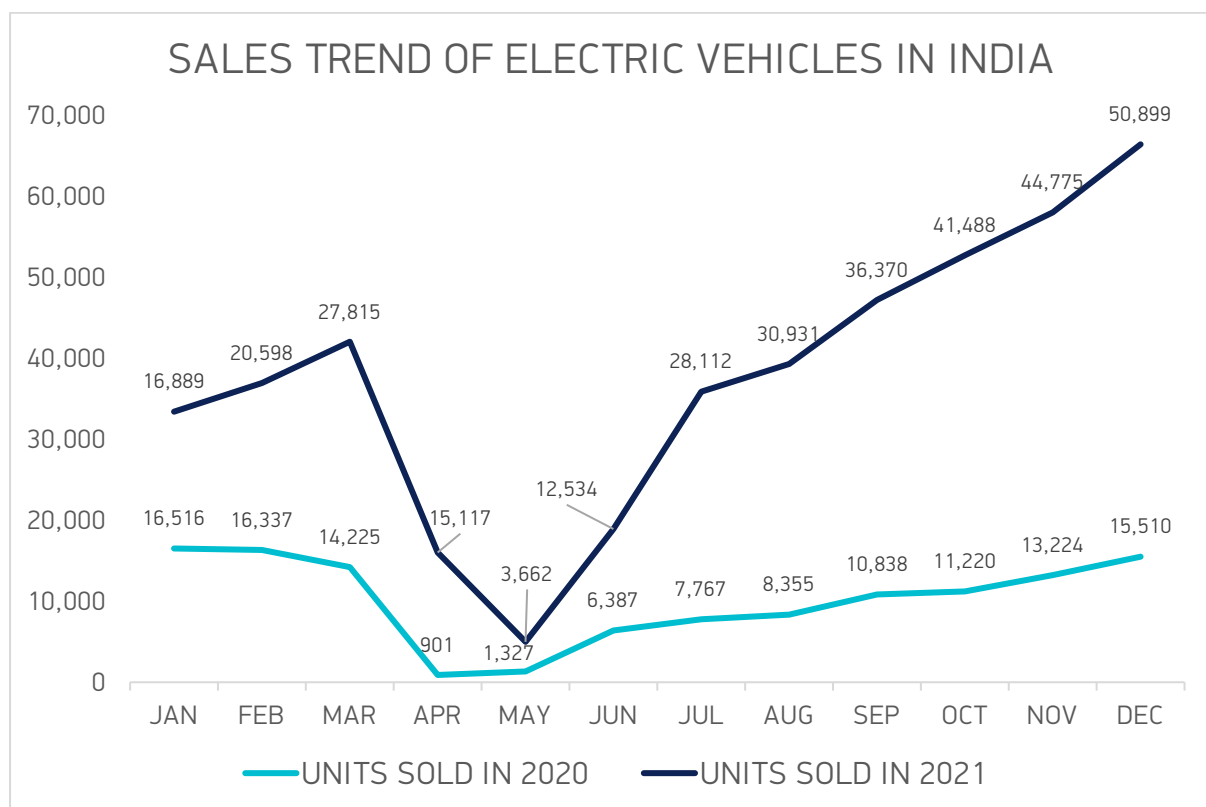
ACC	Advanced Chemistry Cell
ADAS	Advanced Driver Assistance Systems
ADL	Arthur D' Little
AI	Artificial Intelligence
ATF	Aviation Turbine Fuel
B2B	Business to Business
BaaS	Battery as a Service
BIS	Bureau of Indian Standards
BMU	BML Munjal University
BWMR	Battery Waste Management Rule
CaaS	Car-as-a-Platform
CAGR	Compound Annual Growth Rate
CESL	Convergence Energy Solutions Limited
C-MET	Centre for Materials for Electronics Technology
COP	Conference of Parties
CSIR-CECRI	Central Electrochemical Research Institute
CUV	Crossover Utility Vehicle
DSIR	Dholera Special Investment Region
DST	Department of Science and Technology
e-AMRIT	Accelerated e-Mobility Revolution for India's Transportation
EESL	Energy Efficiency Services Ltd
e-LCV	Electric Light Commercial Vehicle
ESG	Environmental, Social and Governance
ETP	Enhanced Trade Partnership
EV	ElectricVehicle
FAME	Faster Adoption and Manufacturing of Electric Vehicles
FDI	Foreign Domestic Investment
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GEMRIX	Global Electric Mobility Readiness Index
GoI	Government of India
GWh	Gigawatt Hours
HMSI	Honda Motorcycle & Scooter India
HPCL	Hindustan Petroleum Corporation Limited

ICE	Internal Combustion Engines
IIT	Indian Institute of Technology
IMF	International Monetary Fund
ISRO	Indian Space Research Organisation
JV	Joint Venture
LFP	Lithium Iron Phosphate
LiBs	Lithium-Ion batteries
LiP	Li-ion polymer
M&A	Merger and Acquisition
MaaS	Mobility as a Service
MEB	Modular Electric Drive Matrix
MGDP	MG Developer Program
MHI	Ministry of Heavy Industries
MIRA	Motor Industry Research Association
MoU	Memorandum of Understanding
NCCRD	National Centre for Combustion Research and Development
NEMMP	National Electric Mobility Mission Plan
NIIF	National Investment and Infrastructure Fund
NITI Aayog	National Institution for Transforming India
OEM	Original Equipment Manufacturers
PIDG	The Private Infrastructure Development Group
PLI	Production Linked Incentive
R & D	Research and Development
SIDBI	Small Industries Development Bank of India
SUV	Sports Utility Vehicle
TPEML	Tata Passenger Electric Mobility Limited
TPG	Texas Pacific Group
UK PACT	UK Partnering for Accelerated Climate Transitions
UKRI	UK Research and Innovation
ZEV	Zero-Emission Vehicle
ZEVTC	Zero-Emission Vehicle Transition Council

OVERVIEW OF THE INDIAN ELECTRIC VEHICLES SECTOR

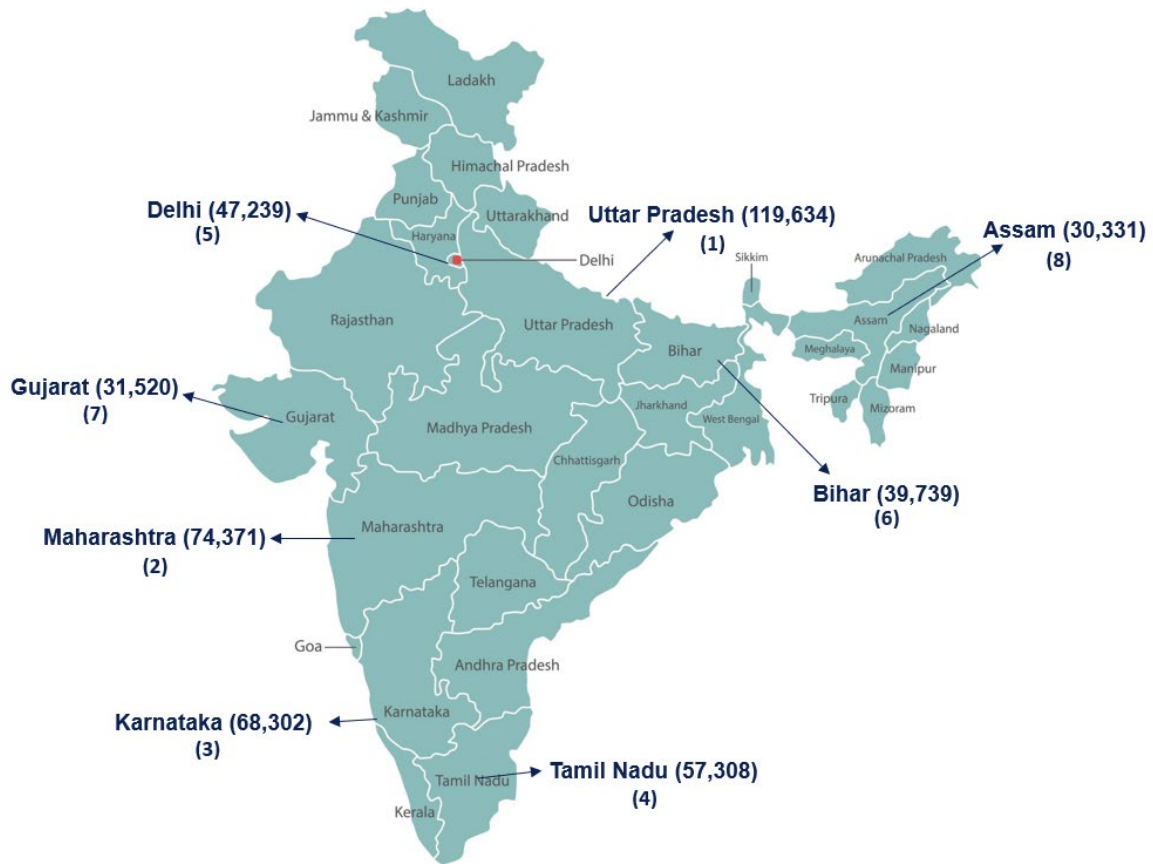
The Indian automotive sector ranks fifth globally and is expected to become the third largest in the world by 2030. India is the world's largest producer of two and three-wheelers and the second-largest manufacturer of buses. The automotive industry currently accounts for 7.1 per cent of India's Gross Domestic Product (GDP) and 49 per cent of its manufacturing GDP.¹

India stands at the cusp of a ground-breaking revolution in electric mobility and has one of the largest electric vehicles (EV) markets in Asia, behind only China and ahead of Japan. India is one of the partners of the global EV30@30 campaignⁱ, which targets to have at least 30 per cent of new vehicle sales be electric by 2030 and is currently 11th among 15 countries ranked in terms of market readiness for EV adoption, according to ADL's Global Electric Mobility Readiness Index called GEMRIX.² There are currently more than 1.3 million EVs on Indian roads³. In 2021, 330,000 units of EVs were registered in India, registering a growth of 168 per cent as compared to 2020. The surge in demand and sales are led by electric two-wheelers and electric three-wheelers which accounted for 48 per cent and 47 per cent of total sales respectively, followed by passenger vehicles contributing to about 4 per cent of the national sales.



ⁱ The EV30@30 campaign is the ambition of the Clean Energy Ministerial' Electric Vehicles Initiative (EVI), setting the objective to reach a 30% sales share for EVs by 2030. Clean Energy Ministerial (CEM) is a high-level global forum to promote policies and programmes that advance clean energy technology. <https://www.cleanenergyministerial.org/initiatives-campaigns/ev3030-campaign/>

Amongst the Indian States, Uttar Pradesh, Maharashtra, Karnataka, Bihar, and Delhi were the top EV selling states between FY2014 and FY2022, collectively accounting for more than 60 per cent of the market share, mostly driven by the large volume of sales of electric three-wheelers and electric two-wheelers in these States. In terms of share of the sales in the Indian States in FY2022, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, and Delhi were the top EV selling States.



EV Sales in key Indian States (2021)

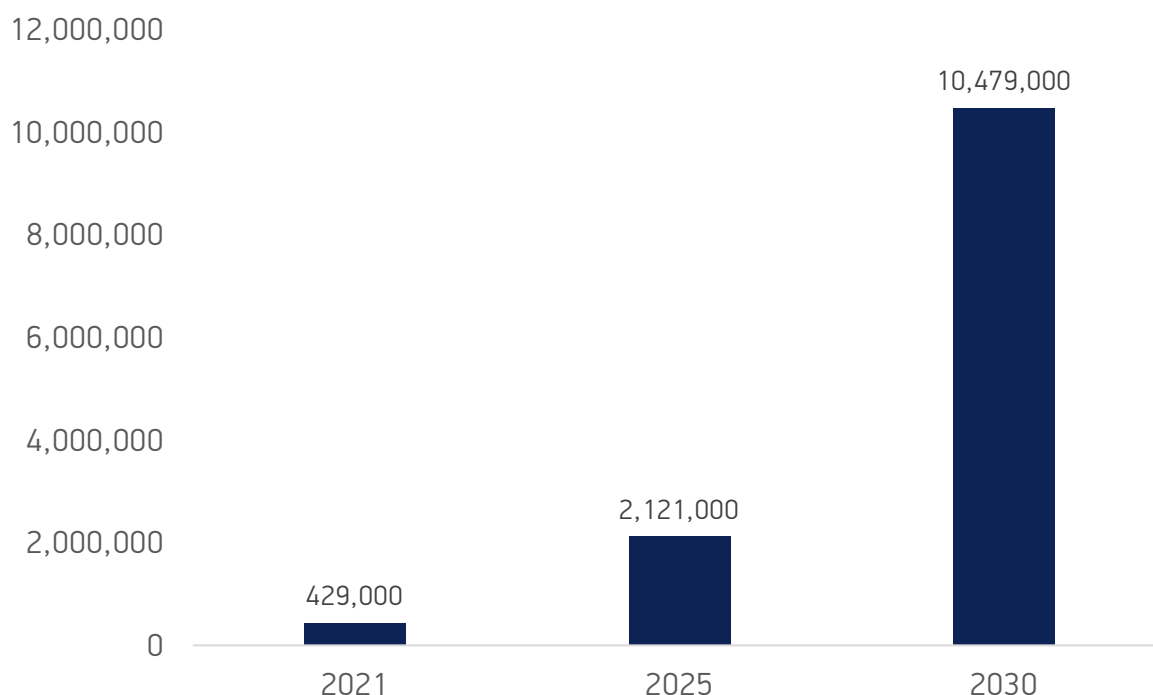
Buoyed by a growing flow of investment from domestic and foreign investors and supportive policies from the government of India (GoI) and the State Governments to boost demand and faster adoption of EVs, the EV sector in India is poised for major growth in the coming years. This sector was one of the quickest to recover from the slowdown during the COVID-19 pandemic period and is witnessing a large number of collaborations, partnerships, mergers and acquisitions (M&A) deals, the emergence of some very promising start-ups, and large projects announced by existing automotive majors and new entrants. Several overseas players too are entering the Indian market by investing in own facilities or joint ventures.

With its flagship Faster Adoption and Manufacturing of Electric Vehicles (FAME) policy, GoI has set an ambitious target of 30 per cent EV penetration for passenger cars, 70 per cent for commercial vehicles, and 80 per cent for two- and three-wheelers by 2030. Many industry experts feel that India's vision and policy support to build a clean and green electric mobility future and a flurry of recent investments in the EV industry have led the Indian automotive industry to an inflection point and India will have one of the largest EV industries globally by 2030.

The EV sector is expected to grow at a Compound Annual Growth Rate (CAGR) of 49 per cent between 2022 and 2030 to an annual sale of about 10 million units. This growth will help the EV industry have about 45 million – 50 million EVs on Indian roads by 2030. India will be among the top 10 EV markets

globally by 2030 and nearly one in every 10 EVs sold worldwide by 2030 will be sold in India. According to an independent study by CEEW Centre for Energy Finance (CEEW-CEF), the EV market in India will grow to US\$206 billion (£173 billion) opportunity by 2030 if India sustains its progress to meet the ambitious 2030 targets. This projected growth would require a cumulative investment of over US\$180 billion (£151 billion) in vehicle production and charging infrastructure.⁴

ANNUAL EV SALES FORECAST 2021-2030



Role of the EV Sector in India

One of the main drivers behind India's recent measures to accelerate the transition to e-mobility is the high import bill for oil (US\$ 119 billion (£100 billion) in 2021-22), rising pollution, and poor air quality in key Indian cities, especially during the winter months, and India's commitment to battle global climate change.

India depends on imports for approximately 85 per cent of its domestic oil consumption and spends a third of its total import values on crude oil alone. If electric vehicles account for 30 per cent share in new vehicle sales by 2030, India's oil import bills could reduce by 15 per cent by around INR 110 billion (£11 billion) in 2030 alone. A higher public transport modal transition along with fleet electrification can double the savings to INR 220 billion (£22 billion) in 2030.⁵

As announced at the COP26 event, held in Glasgow in 2021, India stands committed to reducing the Emissions Intensity of its GDP by 45 percent by 2030, from the 2005 level and achieving about 50 per cent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030. These commitments are a step towards having a sustainable decarbonisation pathway and achieving India's long-term goal of reaching Net Zero by 2070.⁶ Thirty-five Indian cities are amongst the world's top 50 polluted cities in terms of air quality index⁷ and widespread adoption of EVs can yield enhanced air quality eliminating tailpipe emissions. Thus, the advantages of a faster adoption of EVs include improved energy efficiency and air quality and a substantially reduced import bill, along with longer-term climate change mitigation benefits.

Apart from being a sustainable, clean, and green mobility solution, EVs can also play an important role in the economy in many ways including boosting foreign direct investment (FDI) into India, supporting

research and innovation to accelerate towards efficient transport and mobility solutions, and creating jobs. India is already benefitting from an increasing flow of foreign direct investment (FDI) and the emergence of a vibrant start-up ecosystem in the EV and battery technologies. GoI's Ministry of Skill Development and Entrepreneurship has estimated that the EV industry has the potential to create about 10 million direct jobs by 2030 and 50 million indirect jobs in the sector.⁸

India is currently the fifth largest economy in the world after the US, China, Japan, and Germany. Despite the economic slowdown during the COVID-19 pandemic and some threats of recessionary trends in the global economy, India's medium-to-long-term growth potential looks stable. Global rating agency S&P Global Ratings has projected India's economic growth to be at 7.3 per cent for FY 2022-23 and 6.5 per cent for the next fiscal.⁹ The economic growth potential, rapid urbanisation, and favourable demographics (55 per cent of the population is below 30 and there is a large aspirational Indian middle class with a population of about 350 million out of India's total population of 1.4 billion) are likely to support the demand growth for EVs. Mobility is critical to a country's long-term economic prosperity and EVs can fill in gaps in the sustainable public transportation network and last-mile connectivity.

POLICY LANDSCAPE

India introduced the National Electric Mobility Mission Plan (NEMMP) in August 2012 with an aim to help India emerge as a leader in the hybrid and electric vehicles in the two-wheeler and four-wheeler markets in the world. NEMMP set an ambitious target of sales of 6-7 million units by 2020 to enable the Indian automotive industry to achieve global leadership in EVs and contribute towards national fuel security.¹⁰ As a part of this initiative, GoI's Ministry of Heavy Industries (MHI) introduced the first phase of the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme in the year 2015 to promote the manufacturing of electric and hybrid vehicle technology and to ensure sustainable growth of the same. Originally launched for two years, the first phase of FAME had four focus areas (i) Demand Creation, (ii) Technology Platform, (iii) Pilot Project, and (iv) Charging Infrastructure. The Phase-II of the scheme for the period April 2019 – March 2022 (now extended till March 2024) has an outlay of INR 100 billion (£1 billion) to encourage faster adoption of electric and hybrid vehicles by way of offering an upfront incentive for the purchase of electric vehicles and also by establishing the necessary charging infrastructure for electric vehicles. The second phase of FAME aimed to generate demand for 7,000 e-Buses, 500,000 electric three-wheelers, 55,000 EV passenger cars (including Strong Hybrid), and one million electric two-wheelers, and support the setting up of 2,700 charging stations across 62 Indian cities.¹¹ According to MHI's [FAME-II dashboard](#), the FAME Scheme has so far supported sales of 933,000 EVs, 6,740 EV buses, and the setting up of 4,973 EV charging stations till 1 October 2022.

In line with GoI's 'Make in India' and 'AtmaNirbhar Bharat' (Self-reliant India) initiatives, MHI also introduced the Production Linked Incentive (PLI) Schemes for enhancing domestic manufacturing capabilities for Advanced Automotive Technology (AAT) Products with a budgetary outlay of INR 259 billion (£2.59 billion), and for Advanced Chemistry Cell (ACC) Battery Storage with an outlay of INR 181 billion (£1.81 billion).^{12,13}

In the Union Budget for 2021-2022, GoI announced India's Vehicle Scrappage Policy focussing on phasing out old and unfit vehicles. It aims to de-register private cars over 20 years old and commercial vehicles over 15 years old. India's Union Budget for 2022-23 announced that considering space constraints in urban areas for setting up charging stations at scale, a battery swapping policy will be brought out and inter-operability standards will be formulated.

GoI has reduced the Good and Services Tax for EVs and import duties for some of the components. GoI also had plans to order ride-hailing firms such as Uber and Ola, which operate hundreds of thousands of cars in India, to convert 40 per cent of their fleets to electric by April 2026.¹⁴

The State Governments in India have introduced a range of incentives on both the supply and demand sides in the EV sector. Till now, 16 Indian States have announced their EV policies. The policies offer investment subsidies to EV producers and aim at incentivising the purchase and use of EVs through a range of benefits such as waiver of road taxes for EV, interest subventions on loans for the purchase of EVs, and incentives for scrapping old vehicles. Though the State-level policies differ in terms of the areas and nature of interventions, amount of incentives, and the level of support to be extended to EV manufacturers and EV charging infrastructure companies, these are helping India develop a much-needed wider supportive ecosystem for the EV sector.

Gol and State Governments are encouraging government departments to switch to EV cars from ICE vehicles. Indian Railways has introduced a policy to replace its fleet of vehicles running on traditional fuels with electric vehicles by 2025.¹⁵ The Indian Railways are also planning to install EV charging stations at all major railway stations in the country in the next three years under a new policy to promote e-mobility.¹⁶

UK-INDIA COOPERATION IN THE EV SECTOR

One of the key focus areas of the 2030 Roadmap for India-UK Future Relations¹⁷ is to take forward collaboration and share best practice and low-cost climate appropriate technologies in areas including: clean energy, clean transport & e-mobility, sustainable finance, green businesses, and industrial decarbonisation. Under this Roadmap, India and the UK will work with businesses to minimise their carbon emissions while generating sustainable inclusive green jobs and growth by switching to renewables, new tech, electric mobility, and improved efficiency. At COP26, India signed up to the Zero Emission Vehicles Declaration to work together for the faster adoption of electric vehicles globally. India was among 42 leaders to back and sign up to the UK's Glasgow Breakthroughs, launched at COP26. The UK Government has been working closely with NITI Aayog, Gol's Think Tank on public policies, and some Indian States in many areas, including the following:

- Roadmaps on how to scale up electric mobility for three of India's nine global EV 'lighthouse' cities: Ahmedabad, Bangalore, and Hyderabad.
- Opportunities for Advanced Chemistry Battery reuse and recycling – including sharing knowledge from the UK's expertise in this field.
- Knowledge Sharing Partnerships and pairing initiatives between Ahmedabad–Birmingham, Hyderabad–Coventry, and Bengaluru–Transport for London to share learnings and best practices on electric mobility, as a part of The UK-India Electric Mobility Accelerator Awareness Campaign.
- EV awareness web portals in the Indian States of Karnataka, Gujarat, and Telangana.
- Electric Vehicles Business Models Roadmap for Indian Cities, developed by the UK's Connected Places Catapult, under the UK Research & Innovation (UKRI) funding.

Under UK PACTⁱⁱ, there are initiatives to offer knowledge exchange and technical assistance on the following:

- Electrification of Intermediate Public Transport projects in Mehsana and Ahmedabad in the State of Gujarat.¹⁸
- Introduction and deployment of electric buses and electric three-wheelers and upskilling EV workforces in Kakinada in the State of Andhra Pradesh.¹⁹

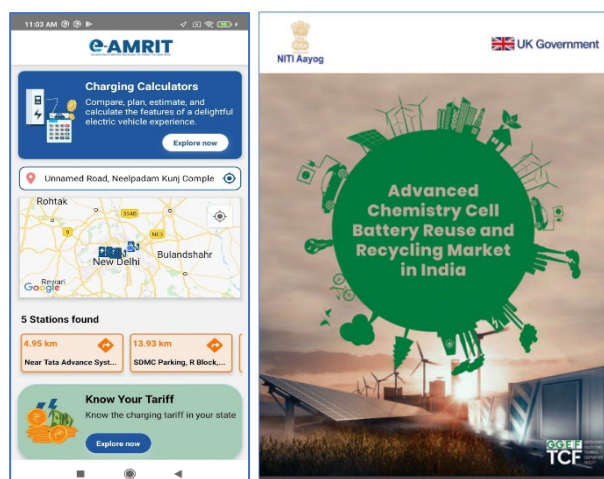
The UK and India have also been working on EV finance. GuarantCo, part of PIDGⁱⁱⁱ, a development finance institution in which the UK is the majority donor, has signed a guarantee to India's Axis Bank to

ⁱⁱ UK PACT (Partnering for Accelerated Climate Transitions) is a flagship programme under the UK's International Climate Finance (ICF) portfolio. The programme is jointly governed and funded by the Foreign, Commonwealth and Development Office (FCDO) and the Department for Business, Energy and Industrial Strategy (BEIS). The UK is committed to tackling climate change and is investing £11.6bn via ICF over the five years to March 2026.

ⁱⁱⁱ The Private Infrastructure Development Group (PIDG) (www.pidg.org) is an innovative finance organisation funded by the governments of the UK, the Netherlands, Switzerland, Australia, Sweden, Germany and the IFC.

accelerate India's transition to Electric Vehicles. The guarantee will enable Axis Bank to lend to EV projects across the EV ecosystem which could range from EV charging points to vehicle production, distribution, and battery servicing. In addition, Macquarie is leading the development of a new blended finance platform, with the UN's Green Climate Fund (GCF), supported by the UK to drive the adoption of EVs across India. This platform aims to deliver US\$ 1.5 billion (£1.26 billion) over the investment term to accelerate India's transition towards higher levels of EVs.²⁰

During the visit of the COP26 President, Alok Sharma to India in July 2022, he launched the mobile app version of India's EV awareness portal www.e-AMRIT.niti.gov.in. The e-AMRIT mobile application offers unique consumer engagement tools that enable users to assess the benefits of electric vehicles, determine savings and receive information on developments in the Indian electric vehicle market and industry. As an accelerator of change, the e-AMRIT application will influence various stakeholders, including millions of users, to adopt electric vehicles, drawing more investments into the sector. The UK Government



has also supported a report on the advanced chemistry cell battery reuse and recycling market in India. Commissioned by NITI Aayog, the report focuses on the recycling potential of current and evolving battery technologies and highlights the crucial role of energy storage in accomplishing India's COP26 goals. The report has been supported by the UK Government's Green Growth Equity Fund Technical Cooperation Facility which aims to catalyse private investments into Indian green infrastructure projects.²¹

UK-India: Trade and Investment in the EV Sector

The automotive industries of the UK and India have been working closely for many years and new partnerships, M&A activities, and cross-border investments have started to happen in the EV sector between the two countries.

Some notable investments from the UK to India include British International Investment's recent partnership with Mahindra to jointly invest US\$ 500 million (£420 million) in the electric SUV project; MG Motors' unit in Gujarat which is producing 'ZS EV' for the Indian market; and Leeds based Switch Mobility's investment of INR 10 billion (£100 million) in a dedicated EV plant in South India with a capacity to produce 30,000 units of E-LCVs and 10,000 units of electric buses annually. Reliance BP Mobility Limited, a JV between Reliance and BP operating under the brand name Jio-BP is setting up large-scale EV charging infrastructure in India.

Several Indian companies and their group companies or subsidiaries have business and R&D presence in the UK. Switch Mobility had plans to set up a New Technical Centre to be opened in Warwick, UK. Bharat Forge, India's leading metal-forging company opened its Electric Mobility Research and Development Centre at MIRA Technology Park and announced a strategic investment of £10 million in June 2018 in Tevva Motors, a company engaged in the electric trucks, EV software, and batteries in the UK.²² India's Ola Electric has announced an investment of £100 million over the next five years to set up the 'Future Foundry' - a global centre for advanced engineering and vehicle design in Coventry, UK. TVS Motors' subsidiary, Norton Motorcycles in the UK is developing an electric superbike and has received significant investment from the UK Government's Advanced Propulsion Centre program. TVS Motors announced a fresh investment of £100 million in Norton Motorcycles in April 2022. Spread over a few years, this investment is being made towards electrification, new technologies and manufacturing,

sustainability, and the future of mobility.²³ Tata-owned, Jaguar and Land Rover are planning to become an all-electric luxury brand from 2025 and aim to achieve net zero carbon emissions across their supply chain, products, and operations by 2039.

UK-India: Roadmap 2030 & Discussions on Free Trade Agreement

The Enhanced Trade Partnership (ETP), launched by the Prime Ministers of India and the UK in May 2021 aims to double the bilateral trade, currently at about £23 billion by 2030, and address various trade barriers to unlock the full trade potential between the two countries. The 'Roadmap 2030' will pave the way for a deeper and stronger engagement between India and the UK over the next ten years in the key areas of people-to-people contact, trade and economy, defence and security, climate action, and health. The ETP declared India and the UK's shared intent to begin a comprehensive Free Trade Agreement (FTA).

India and the UK launched the negotiations on the proposed FTA in January 2022 and concluded the fifth round of discussions in July 2020. For this round of negotiations, technical experts from both sides came together for detailed draft treaty text discussions in 85 separate sessions covering 15 policy areas. While a comprehensive and balanced FTA was expected to be signed by the UK and India by the end of October 2022, senior level changes in the UK Government might have caused some delay and there is hope that under the new leadership in the UK, the discussions will be concluded soon paving the way to a historic trade deal between the UK and India. Once the FTA is announced, it will be interesting to assess how the FTA could boost the bi-lateral trade and investment in the automotive sector, especially in the electric vehicles segment.

LEADING EV PRODUCERS: GROWTH STRATEGIES

All leading Indian automotive producers have developed EV strategies and investment plans comprising a mix of greenfield facilities and brownfield expansions, and inorganic growth through mergers and acquisitions. Many of them are tying up with technology and joint venture partners to accelerate their EV journey by gaining access to technology, funds, and new markets. Aside from the Indian EV producers, foreign automotive majors already present in the Indian market are building an EV portfolio and a few new global OEMs are considering market entry or launch of EVs in India. EV strategies of some of the leading producers are discussed below.

Tata Motors

Tata Motors, the largest EV player in the passenger car segment in India with a market share of about 77 per cent has sold 30,500 electric cars till May 2022. About 80 per cent of the sales came in the last 14 months and two popular models, Nexon and Tigor comprised about 62 per cent of the sales.²⁴ Nexon EV, the current best seller in India is currently securing about 3,500 bookings every month. Tata Motors

has recently launched the Tata Tiago EV at an introductory price of INR 849,000 (£ 8,490) as one of the most affordable electric cars in India. The model secured over 10,000 bookings in the first 24 hours of launch.²⁵

Tata Motors is planning to invest INR 150 billion (£1.5 billion) in the EV segment in the next five years and plans to launch two EVs every year till 2025. Tata Motors is looking to have 25 per cent of its sales coming from EVs in the medium to long term, up from 2 per cent at present.²⁶ Jaguar Land Rover (JLR), Tata Motor's subsidiary aims to have 60 per cent of the company's volumes from EVs by 2030.²⁷

In October 2021, San Francisco headquartered, Private Equity group TPG along with ADQ of Abu Dhabi agreed to invest INR 75 billion (£750 million)²⁸ in the EV business into Tata Motor's new subsidiary, Tata Passenger Electric Mobility Limited (TPEML). Tata Motors will invest US\$ 2 billion (£1.68 billion) into this EV subsidiary over the next five years.^{29,30} In May 2022, TPEML and Ford India signed an MoU with the Government of Gujarat for the potential acquisition of Ford's Gujarat-based vehicle manufacturing plant. TPEML plans to hit a sales figure of 100,000 EVs in 2023-24 and have an installed capacity of 300,000 units per annum in the near future.

Six Tata Group companies are working to create an enabling ecosystem for faster introduction and adoption of EVs in India. Tata Motors, Tata Power, Tata Chemicals, Croma, Tata Auto Components, and Tata Motors Finance will work together to give a push to not just the manufacture of EV batteries, cells, and auto parts but also to the adoption of EVs by building charging points.³¹ Tata Motors is working with Tata Power with a plan to reach out to at least 25 cities and install 1,000 charging stations in the coming years.³² When Tata began EV production in 2020, most parts were imported but Tata AutoComp currently produces around 50 per cent of the components in-house.³³ Tata-owned Jaguar Land Rover contributes to EV design while Tata Chemicals Ltd has plans for large battery recycling and recovery of critical minerals from end-of-life batteries.

Ashok Leyland and Switch Mobility

Ashok Leyland is the flagship company of the Hinduja Group, based in the UK and India's leading commercial vehicle producer. Ashok Leyland's EV business will be primarily led by the UK-based Switch Mobility, a combined entity of Ashok Leyland's electric CV business and the erstwhile British bus manufacturer, Optare Plc, acquired by Ashok Leyland in 2013. They aim to be one of the top 10 EV brands globally. The group has plans to invest US\$150-200 million (£126 million-£168 million) in the EV space in the next few years in India and the UK.

Switch Mobility is expected to launch its first electric light commercial vehicle (e-LCV) in India by the end of December 2022 and has reportedly already secured 2,000 orders. These vehicles will be manufactured in India and sold under the Switch brand. In April 2022, Switch Mobility announced technological collaborations with various partners, including Siemens, to deliver a range of e-mobility solutions.^{34,35} In April 2022, Switch Mobility launched India's first 12m electric bus, and on 18 August 2022, they unveiled India's first and unique electric double-decker air-conditioned bus - Switch EiV 22.³⁶ Designed, developed, and manufactured in India and utilising Switch's global electric bus experience, Switch EiV 22 is equipped with the latest technology, ultra-modern design, highest safety and best-in-class comfort features. Switch India has already secured an order of 200 electric double-decker buses in Mumbai. The group is eyeing a business of 5,000 buses or 15,000 small commercial vehicles in the next three to five years, and Switch Mobility will be investing £100 million in a dedicated EV plant in South India with a capacity to produce 30,000 units of E-LCV capacity and 10,000 units of electric buses annually. Switch Mobility had plans to set up a New Technical Centre to be opened in Warwick, UK in June 2022.³⁷

Ashok Leyland and the Indian Institute of Technology Madras (IIT Madras) researchers at the National Centre for Combustion Research and Development (NCCRD) are collaborating to develop and commercialise 'Swirl Mesh Lean Direct Injection (LDI) system' technology for developing a series of hybrid electric vehicles (EVs) using a turbine technology.³⁸

Mahindra Group

Mahindra Group and British International Investment (formerly CDC) have together committed an investment of US\$ 500 million (£420 million) in the electric SUV sector in India.³⁹ As per an agreement between the two partners, the new electric vehicle company is envisaged to have a total capital infusion of around US\$ 1 billion (£840 million) between FY24 and FY27 for the planned product portfolio. Mahindra has plans to launch five electric SUVs for both domestic and international markets and has recently unveiled its first electric SUV XUV 400 which is expected to be launched early next year. Mahindra entered into a partnership with Volkswagen in May 2022 to explore the use of MEB components for Mahindra's new electric car platform 'Born Electric'.⁴⁰ The company, currently, does not have a presence in the electric passenger car segment. It, however, is the leading player in the domestic electric three-wheeler space with over 70 per cent market share.

Maruti Suzuki

India's largest automobile manufacturer, Maruti Suzuki who has a 49 per cent share in the passenger car segment in India is planning to launch its fully electric car in the Indian market in 2025. The EV car will be first introduced in the Indian market, followed by launches in Japan and Europe. Given Maruti's focus on the volume game, there is an expectation in the market that Maruti EVs will be amongst the most affordable EVs on Indian roads. Maruti Suzuki has already launched four models of smart hybrid cars in India and their future plans suggest that every new Maruti Suzuki launched over the next five to seven years would have some form of hybrid technology and there is likely to be no pure petrol powertrain options across the range.⁴¹ Suzuki Motor has recently announced an investment of INR 104 billion (£1.04 billion) to set up manufacturing facilities for new electric cars and batteries in India, of which INR 30 billion (£300 million) will be invested in the EV factory.⁴² Suzuki is also setting up a global electrification R&D hub in India⁴³ and investing about IN 50 billion (£500 million) in a joint venture company, Automotive Electronics Power Pvt. Ltd (AEPPL), held by Suzuki (50 per cent), Toshiba (40 per cent) and Denso (10 per cent) to manufacture 30 million lithium-ion cells per year by 2025, with a production capacity of more than 1GWh. These batteries could be deployed in pure electric vehicles, hybrids, and electric two-wheelers. Suzuki Motor's two-wheeler arm, Suzuki Motorcycle India Pvt. Ltd has been developing a prototype electric scooter for the Indian market.⁴⁴

MG Motor

MG Motor India has already launched ZS EV in India, which is being manufactured at its factory in Halol, Gujarat. The current production capacity of about 300-350 units per month is being enhanced to 500 units per month. The company is set to launch an affordable electric vehicle priced below £15,000 in the Indian market around early 2023⁴⁵ and the second EV model in the second quarter of 2023-24. The company is expecting EVs to generate about one-fourth of the annual revenue from the next year. MG Motors is planning to source batteries for their EVs locally to keep prices competitive and working on creating an ecosystem for electric vehicles to accelerate the shift to clean mobility. The company is collaborating with tech start-ups to innovate on battery chemistry and charging solutions for the local market under the MG Developer Program (MGDP), which eventually can be replicated in MG Motor's arm in the UK and emerging markets globally. So far, 180 start-ups including Koinearth, Electreefi, Voxomos, Redbot Technologies, and Mihup have been identified and mentored by MG Motor and its consortium members to explore and create applications in connected car technology, futuristic technologies, and CaaS (Car-as-a-Platform).⁴⁶

Hyundai

India's second largest car maker and biggest car exporter Hyundai Motor India Ltd has planned an investment of INR 40 billion (£400 million) in India to launch six electric vehicles (a mix of premium, hatchbacks, and SUVs) by 2028. Hyundai is developing a small electric car for the Indian market as a part of this plan.⁴⁷ Hyundai was one of the first overseas auto majors to launch an EV in 2019 when

they introduced KONA SUV to the Indian market under CKD route.⁴⁸ While Hyundai hinted that it might launch the all-electric crossover-utility vehicle (CUV), IONIQ 5 in the Indian market soon, the launch date has not been announced.^{49,50}

Daimler (Mercedes-Benz)

India becomes the first base for Mercedes-Benz to assemble EVs outside Germany. Mercedes-Benz, has recently launched its second electric offering EQS 580 sedan for India and said that its plant in Chakan, Pune is the company's first assembly plant for EVs outside Germany.⁵¹ With this, Mercedes will also be the first and only luxury carmaker to assemble an EV in the country,

Amongst other premium car manufacturers, Audi has an EV portfolio in India that includes five cars, namely the e-tron 50, e-tron 55, e-tron Sportback 55, e-tron GT, and RS e-tron GT, and BMW offers three electric models in the country – BMW iX SUV, BMW i4 sedan and the MINI Cooper SE luxury hatchback.

BYD

Warren Buffet-funded Chinese electric carmaker BYD has now launched its second product, an electric sports utility vehicle 'ATTO 3' for the Indian market. With a presence in over 70 countries, the company eyes a leadership position in the Indian electric passenger vehicle market.⁵² BYD already sells a multi-purpose vehicle E6 in the country and is looking at a 40 per cent market share in India by 2030. They introduced electric buses in the Indian market in 2018 and have so far sold over 800 buses in 11 cities. BYD has invested about US\$ 200 million (£168 million) in India and is planning further investments. With an aim to sell about 15,000 units of BYD-ATTO3 over the next year, the company will start assembling the sports utility vehicle at its Chennai-based plant and would also look at setting up of a manufacturing plant depending upon the market demand.

FISKER

California-based Fisker Inc, which will roll out its first EV model named Ocean SUV in November 2022 is planning a range of operations in India. Fisker has a technology development centre in Hyderabad which has already started delivering software technologies for the Ocean SUV. The engineering base, which specialises in software technology development is being ramped up to become Fisker's bigger of the two tech hubs outside the USA.⁵³ The Ocean SUV is being contract manufactured by Magna International in its plant in Graz, Austria. Fisker plans to import and launch the Ocean SUV in India by the middle of 2023 and is setting up an experience centre, Fisker Lounge, in Delhi-NCR area. Fisker targets manufacturing cars in India by the second half of 2024, starting with its second model, named PEAR, for which they might consider a tripartite venture between Fisker, Foxconn, and an Indian partner, yet to be finalised.

TVS Motor

Chennai-based, TVS Motor Company plans to introduce a full portfolio of electric two-wheelers and three-wheelers in the domestic and international markets. The company entered into an MoU with the State Government of Tamil Nadu to invest INR 12 billion (£120 million) on future technologies and EVs. Launched in January 2020, TVS' smart electric scooter, iQube is currently available in 33 cities across the country. TVS currently has over 6,000 bookings and has already sold more than 5,000 units in FY 2022-2023.⁵⁴ The company has planned a fresh investment of INR 10 billion (£100 million) in the current financial year FY 2022-223. A large part of this investment will be made into the expansion of capacity and electric product portfolio with an aim to have a monthly production capacity of 50,000 units by 2023.

Aside from investing in own manufacturing facility, TVS has planned some strategic investments in global two-wheeler and EV companies as well. An investment of INR 11 billion (£110 million) has been made through TVS Singapore into SEMG and Ego Corporation in Switzerland, and TVS's subsidiary in the UK, Norton Motorcycles. TVS acquired 75 per cent stake in the Swiss e-bike platform, SEMG in

January 2022. SEMG is a Swiss e-bike platform covering B2B and B2C businesses involving the sale of branded e-bikes from leading manufacturers directly to the end consumers and the sale of own branded e-bikes to a portfolio of B2B key accounts. The company operates the e-bike retail chain M-way in Switzerland with close to US\$ 100 million (£84 million) in revenue. SEMG has a network of over 30 retail stores across Switzerland and Germany with plans to expand into other European countries.⁵⁵ TVS' subsidiary, Norton Motorcycles in the UK is developing an electric superbike and has received significant investment from the UK Government's Advanced Propulsion Centre programme.^{56,57} TVS Motors announced a fresh investment of £100 million in April 2022 in Norton Motorcycles towards electrification, new technologies and manufacturing, sustainability, and the future of mobility.⁵⁸ TVS has also invested in Bengaluru-based, high-performance electric motorcycle manufacturer, Ultraviolette Automotive in December 2021⁵⁹ and is working with BMW, its partner since 2013 in the future mobility space with a special focus on EV. This partnership will see the development of exclusive products by both companies on the common platform and both will retail their products globally.⁶⁰

Ather Energy

Headquartered in Bengaluru, Ather Energy is a leading e-scooter manufacturer in India. With the newly-launched 450X Gen 3 electric scooter, the company is expecting to grow its market share from 9 per cent to 30 per cent in 2022-23.⁶¹ With an aim to increase its annual manufacturing capacity from 120,000 to 400,000 units, the company is investing INR 5 billion (£50 million) in its second manufacturing facility in Hosur in Tamil Nadu.⁶² The company is also setting up charging infrastructure across the country and currently has more than 550 charging points in 50 Indian cities. India's largest two-wheeler manufacturer, Hero MotoCorp is an early investor in Ather Energy and has been a part of its growth story since 2016. They have announced a new investment of INR 4.2 billion (£42 million) in Ather Energy in January 2022.⁶³ Earlier this year, Ather Energy has raised US\$ 50 million (£42 million), led by existing backer Caladium Investment. Ather Energy was valued at US\$700-800 million (£582 million -£672 million) after the round which was an extension of its US\$128 million (£108 million) fundraising in May 2022, led by India's sovereign wealth fund National Investment and Infrastructure Fund (NIIF) and Hero MotoCorp.⁶⁴

Bajaj Auto

Bajaj Auto is currently offering the Chetak electric scooter in the Indian market and has plans to increase its production capacity and expand its sales network. Bajaj Auto has recently set up a new company, called Chetak Technologies that will drive the electric products development.⁶⁵ The company is aiming to launch a new electric two-wheeler every year for the next 3-5 years. Bajaj plans to manufacture 2,50,000 units per year at its new EV-dedicated Akurdi facility in Pune, set up with an investment of INR 3 billion (£30 million).⁶⁶ The company has proposed to invest more than INR 1 billion (£10) million in a new unit for electric vehicles, under Gol's PLI scheme.^{67, 68} Since 2007, Bajaj Auto and KTM of Austria are partners in the motorcycle segments and they are planning to enter the electric motorcycle segments. In the three-wheelers space, Bajaj is developing an electric three-wheeler with both cargo and passenger options.

Honda

Honda has introduced the Honda City hybrid in the Indian market.⁶⁹ Globally General Motors and Honda have joined hands to expand their collaboration on electric vehicles and batteries. Honda Motorcycle & Scooter India (HMSI) is planning to launch multiple electric models in India.⁷⁰

Hero MotoCorp

Market leader in India's two-wheeler segment, Hero MotoCorp, has launched an electric scooter, Vida V1 in India. Hero's Vida V1 electric scooters will be produced at the company's plant in the Chittoor district of Andhra Pradesh. Starting with deliveries in three Indian cities (Delhi, Bangalore, and Jaipur), the company will sell the scooter in eight more cities by December 2022. The company plans to begin

exports of Vida V1 to Europe by the first quarter of 2023. Hero MotoCorp has made a large investment in the EV start-up Ather Energy and plans to invest US\$ 60 million (£50 million) in California-based Zero Motorcycles to co-develop e-bikes. Zero Motorcycles is the global leader in electric motorcycles and powertrains. In April 2021, Hero MotoCorp and Taiwan's Gogoro announced their plans to establish a joint venture to introduce Gogoro's industry-leading battery-swapping network in India. Hero MotoCorp invested about US\$285 million (£239 million) in this joint venture to develop a battery-swapping platform.⁷¹ Hero MotoCorp has announced a US\$100-million (£84 million) Global Sustainability Fund which, led by the BML Munjal University (BMU) and Hero MotoCorp will support start-ups in the ESG sector.

Ola Electric

Ola Electric, the EV venture of India's leading ridesharing company, Ola has launched electric scooters and is currently setting up the world's largest electric two-wheeler manufacturing facility in Tamil Nadu. This 'Future Factory' project being set up at an investment of US\$ 2 billion (£1.68 billion) will have facilities for manufacturing electric two-wheelers, passenger cars, and EV batteries. At full scale, this hub will produce one million electric cars over six models and two platforms, 10 million electric two-wheelers, and 100-gigawatt hours of cells every year to create the "world's largest EV eco-system at a single site."⁷² Ola Electric has recently set up its first experience centre in Chennai as part of a plan to set up 200 such facilities across the country by March 2023.⁷³ With a valuation of over US\$5 billion (£4.2 billion), Ola Electric has raised about US\$866 million (£727 million) with the latest being the Series C funding round of US\$200 million (£168 million) in January 2022.⁷⁴

Ola has announced an investment of £100 million over the next five years to set up a global centre for advanced engineering and vehicle design in Coventry, UK. The centre, 'Ola Futurefoundry' will work with the Ola Campus in Bengaluru in the areas of two-wheeler and four-wheeler EV design, advanced high-performance automotive engineering, digital and physical modelling, and cell technologies. The unit will employ 200 automotive designers and engineers.⁷⁵

Hero Electric

Hero Electric is a part of the Hero Eco Group of India, which is a multi-company, multi-product, and multi-location enterprise with diversified interests in EVs, exports, bicycles, healthcare, and real estate. The company is India's largest electric two-wheeler company and a market leader in the Indian electric two-wheeler industry. Hero Electric sold over 50,000 e-bikes in 2021. They are working on an expansion plan to increase the installed capacity to 500,000 units of e-bikes each year and then to one million units every year from 2025. Hero Electric has recently raised afresh capital of INR 2.2 billion (£22 million) and is planning an investment of INR 7 billion (£70 million) for the capacity expansion. They are working with Charzer, a Bengaluru-based EV charging start-up to set up 100,000 charging stations across India. Hero Electric has also partnered with Sun Mobility to develop electric two-wheelers integrated with Sun Mobility's smart-swappable battery technology.⁷⁶ Hero Electric has announced a partnership with Spoctech Green Ventures Pvt Ltd to introduce last-mile delivery solutions in Chennai. With this partnership, Hero Electric has agreed to deploy a fleet of over 5,000 electric vehicles in Chennai over the next two years and work collectively with Spoctech and Parveen Travels Pvt Ltd towards their shared vision of electrification of the last-mile delivery segment.⁷⁷

THE EV ECOSYSTEM IN INDIA

One of the most critical factors contributing to the growth and success of the EV sector is to have a robust and supportive EV ecosystem comprising a reliable and efficient supply chain for components and batteries and a strong EV charging ecosystem. Other key critical success factors include the availability of investment to EV producers, easy finance for consumers, and a strong research and innovation base to develop and adopt emerging EV technologies. The key recent developments in India's emerging EV ecosystem are discussed below.

Battery Manufacturing

To achieve the GoI vision of more than 30 per cent EV adoption by 2030, India will need about 800 GWh of batteries by 2030. Rising demand for Lithium-ion batteries (LiBs) and GoI policies to encourage domestic manufacturing through the PLI Scheme with an outlay of INR 181 billion (£1.81 billion) aimed at developing domestic capabilities for Advanced Chemistry Cell (ACC) Battery Storage has prompted several players to firm up their plans to set up battery and cell manufacturing units in the coming years. The sector is witnessing the entry of foreign battery players such as Suzuki, Denso, Toshiba, Alperex, and Leclanche to India as well as investments by Indian companies in global battery technology companies besides the emergence of a range of domestic companies and start-ups in the energy storage space. Below is a summary of some of the innovations and announcements:

- India's largest lead-acid battery maker, Exide Industries Ltd, has set up Exide Leclanche Energy, a JV with Swiss firm Leclanche, to manufacture lithium-ion batteries in India. Exide plans to greenfield EV battery manufacturing facility near Bengaluru with an investment of INR 60 billion (£600 million).
- India's largest Corporate Group, Reliance Group plans to invest INR 750 billion (£7.5 billion) to set up four Giga factories in India. The plan is to make batteries for EVs, solar photovoltaic modules, advanced energy storage batteries, electrolyzers, and finally, fuel cells in these Giga factories. Reliance New Energy Limited, a wholly-owned subsidiary of Reliance Industries Limited acquired Sheffield-based sodium-ion based battery technology company Faradion in January 2022 at £100 million and planned to further invest £25 million as growth capital to accelerate the commercial rollout. Faradion is the world leader in sodium-ion battery technology that provides low cost, high-performance, safe, and sustainable energy. Its proprietary technology delivers leading-edge, cost-effective solutions for a broad range of applications, including mobility, energy storage, backup power and energy in remote locations. Reliance will use Faradion's technology at its proposed fully integrated energy storage factory at The Dhirubhai Ambani Green Energy Giga Complex in Gujarat. In March 2022, Reliance New Energy Limited acquired Lithium Werks BV for a total transaction value of US\$ 61 million (£51 million) including funding for future growth. Headquartered in the Netherlands, Lithium Werks has offices and R&D and production facilities in the USA, Europe, and China. Lithium Werks is a leading provider of cobalt-free and high-performance Lithium Iron Phosphate (LFP) batteries. With the recent rise in demand for LFP batteries, Lithium Werks with its experience in battery innovation and manufacturing for over 30 years is reportedly uniquely positioned to take advantage of global opportunities through its integrated portfolio of LFP solutions.
- Indian automotive components manufacturer Lucas TVS has signed an MoU with a US-based start-up to establish a semisolid lithium-ion cell manufacturing facility in Chennai. The first phase of the planned 10 GWh facility will start production in the second half of 2023.
- Amara Raja Batteries, one of India's largest automotive battery makers, has opened its lithium-ion cells manufacturing facility in Tirupati, Andhra Pradesh. Amara Raja Batteries invested in Slovakia-based advanced battery manufacturer, InoBat in 2021.⁷⁸ In March 2022, InoBat opened its first office in the UK at Warwick Science Park as a part of its global expansion.⁷⁹
- A joint venture between Suzuki, Denso, and Toshiba is setting up manufacturing facilities to manufacture 30 million lithium-ion cells per year by 2025, with a production capacity of more than 1GWh. These batteries could be deployed in pure electric vehicles, hybrids, and electric two-wheelers.
- Ola Electric has made a strategic investment in Israeli battery technology company, StoreDot.⁸⁰
- Sun Mobility, Log9, Himadri Chemicals, Tirupai Grpahite, Himadri Chemicals, and Godi India are some of the Indian companies that are working on developing advanced cell technologies for the Indian EV sector.

- The Chatterjee Group (TCG) is setting up a battery research laboratory in Kolkata at their Research Institute for Sustainable Energy, being developed by TCG Centre for Research, Education, Science, and Technology (TCG Crest).⁸¹

India does not have reserves for critical battery materials such as lithium, nickel, and cobalt and GoI has recently introduced the Battery Waste Management Rule (BWMR) 2022 to encourage re-use and recycling of used EV batteries. Tata Chemical has established a process of recovering valuable materials from used Lithium-ion batteries. Recycling of spent batteries provides valuable metals in the form of salts of lithium, cobalt, nickel, and manganese along with by-products like graphite, iron, copper, and aluminium. Tata Chemical's InsperiCo™ is the world's first branded recycled cobalt. The recycling technology can be used for lithium-ion batteries, including those based on lithium cobalt oxide, nickel manganese cobalt oxide, and nickel cobalt aluminium oxide.

Aside from battery manufacturing, there are opportunities for efficient battery management software and monitoring battery performance and remaining useful life. Following several recent fire incidents involving EV batteries in India and voluntary recalls by EV producers, there is a growing emphasis on the quality, performance, and safety aspects of EV batteries.

Component Manufacturing

The shift from ICE to EV will need the development of new supply chains comprising a range of electronic items, motors, motor control systems, capacitors, and EV batteries and related items. There will be a requirement for new materials such as glass/carbon fibre composites and fibre-filled engineering thermoplastic, and new aluminium and other alloys. Existing automotive components manufacturers such as Sundaram Fasteners, Tata Autocomp Systems and Bharat Forge are investing in EV technologies. The segment is also witnessing the entry of new players such as Vemocon Technologies, a start-up that provides full-stack electric two-wheeler solutions (such as battery management system, chargers, motor controllers, and vehicle intelligence and fleet management solutions) and has raised US\$ 5.2 million (£4.36 million) from Tiger Global, Blume Ventures and other angel investors.⁸²; Bharat Forge-backed, Tork Motors; and Bengaluru-based motor control electronics and human interface solutions provider, Virtual Forest.

Technology and Software Development

Efficient cost structure and availability of high-quality talents in India have attracted many overseas companies to set up technology and software development centres in India. Here are some recent examples:

Marelli

Global auto component supplier Marelli inaugurated its new technology R&D centre in Bengaluru in September 2022 to boost its innovation capability, particularly in software engineering.⁸³ When fully operational, the new technology R&D centre, together with the company's established engineering centre in Gurugram, will increase Marelli India's R&D capability, boosting its research team to more than 1,600 members. The Bengaluru centre will focus on electronics, automotive lighting, and both internal combustion and electric powertrain. With this new opening, the company's Indian footprint includes 14 production sites and 2 R&D centres.

Stellantis

Stellantis N V, one of the world's leading automakers and a mobility provider, inaugurated a new software centre in Bengaluru in October 2022. It set up its first global digital hub in India in Hyderabad in the past. The new centre in Bengaluru will focus on the development of software and technological innovations crucial to the advancement of automobiles and mobility and will serve as the primary development centre for new technology platforms, AI and ADAS technologies. The company plans to employ 500 staff in the Bengaluru centre and is collaborating with Indian universities to explore the

development of industry-specific curricula. In addition to the software and technology centres, Stellantis offers two iconic automotive brands – Jeep and Citroën in India.⁸⁴

Arrow Electronics

Bengaluru based, Virtual Forest, a leading expert in motor control electronics and human interface technologies, has entered into a three-year collaboration with Arrow Electronics, a global provider of technology products, services, and solutions, to develop, market, and distribute 3 KW to 15 KW motor controllers for electric two and three-wheelers.⁸⁵ Virtual Forest will be responsible for the R&D of the motor controllers, which will be exclusively marketed and distributed by Arrow Electronics.

Magna International

Canadian Tier 1 major Magna International plans to invest over US\$ 120 million (£101 million) to set up a new engineering centre in Bengaluru.⁸⁶ The technology development centre will focus on vehicle electrification and software defined vehicles. The centre will serve as a key base for the company in powertrain electrification, electronics, and software-defined vehicle development. Magna has 12 manufacturing divisions and three product development centres throughout India.

Charging Infrastructure

An adequate number of EV charging stations and easy access to charging facilities are key for the fast adoption of EVs. The EV charging infrastructure market in India is still at a nascent stage. However, with support from GoI and EV manufacturers, this segment of the EV ecosystem is poised to grow rapidly. The Indian standards for affordable power charging points for light EVs and e-cars are being developed by GoI's Department of Science and Technology (DST) and the Bureau of Indian Standards (BIS). NITI Aayog has published a comprehensive handbook on the implementation of EV charging infrastructure in India.

Multiple stakeholders are exploring various business models and planning partnerships to set up EV charging.

- A subsidiary of Energy Efficiency Services Ltd (EESL), Convergence Energy Solutions Limited (CESL) is working on an initiative for setting up 810 electric vehicle charging stations along 16 expressways and National Highways covering 10,275 km across India. CESL will install 590 chargers of 50kW capacity that will be available every 25 kilometers and 220 chargers of higher 100kW capacity, every 100 km.⁸⁷ CESL has also set up a solar-powered charging station for electric vehicles in the Ladakh region.
- Tata Power has partnered with Hyundai Motors to install its range of fast chargers (DC 60 kW) at Hyundai's existing 34 EV dealer locations across 29 cities in India.⁸⁸
- Automovil, the mobility start-up in India for car servicing has partnered with Midgard Electric to set up 500 EV charging stations in 11 cities in India.⁸⁹
- Exicom, one of India's leading power solutions companies with a presence in the telecom, mobility, and stationary energy segment has crossed the milestone of installing over 5,000 EV chargers including AC and DC chargers across 200 cities in India.⁹⁰
- EV charging network provider Statiq has partnered with the auto major Mahindra & Mahindra to provide EV passenger car charging solutions across the country.⁹¹
- Hero Electric has announced a partnership with Charzer, a Bengaluru-based EV charging startup, to build 100,000 charging stations across India.
- UK-based L-Charge has agreed on a long-term collaboration with Mumbai-based Ziptron Gas Technology to enhance the EV charging infrastructure network in India.⁹²
- Reliance BP Mobility Limited, operating under the brand name Jio-BP, is working with multiple demand aggregators, original equipment manufacturers (OEMs), and technology partners with a vision of becoming the leading EV charging infrastructure player in India. BP bought a 49 per cent stake in over 1,400 petrol pumps and 31 aviation turbine fuel (ATF) stations owned by Reliance for

US\$1 billion (£840 million) in 2019. Jio-BP has recently entered into a partnership with Mahindra. Starting with 16 cities, Jio-BP will install DC fast chargers at Mahindra's dealership network and workshops across the country. With these chargers being open to the public, the partnership will benefit all stakeholders in the EV value chain. Jio-BP is also working with BluSmart, the EV ride-hailing service provider in Delhi and the National capital region, who has a fleet of more than 500 electric cars and over 300 charging stations.

- Earlier this year, NTPC Vidyut Vyapar Nigam published an invitation to bid for electric vehicle chargers, and for public charging infrastructure in cities as part of the FAME II scheme. The tender covered the manufacturing, sourcing, inspection, testing, supply, installation, and commissioning of 1,670 electric vehicle chargers at 267 EV charging stations in Karnataka, Telangana, Madhya Pradesh, Andhra Pradesh, and Andaman & Nicobar Islands.

Battery Swapping

Indian government's think-tank, NITI Aayog, has produced a draft [battery swapping policy](#) to promote the adoption of EVs and address the range anxiety of consumers. The policy envisions a new ecosystem with Battery as a Service (BaaS) model where EV users can pay or subscribe to battery service and exchange their discharged batteries with charged ones without owning their own batteries.⁹³ This model has the potential to complement the EV charging infrastructure, especially in remote or densely populated areas (where charging stations cannot be installed or accessed easily). Moreover, under the BaaS model, EV consumers can now purchase a battery-less scooter from OEMs, cutting the initial cost.⁹⁴

Battery Smart, India's largest network of battery swapping stations for electric two and three-wheelers has raised US\$25 million (£21 million) in a funding round led by Tiger Global.⁹⁵ Very recently Honda Power Pack Energy India Private Ltd and Hindustan Petroleum Corporation Limited (HPCL) have started the operation of Honda e:swap services for the e-rickshaws at the HPCL petrol stations in Bengaluru.⁹⁶ Canada's Magna International is investing US\$ 77 million (£65 million) in India's mobility player Yulu in order to expand the e-mobility market and create a battery-swapping service company.⁹⁷ Yulu has already started setting up battery charging and swapping centres.⁹⁸ These stations will be strategically located in areas of high movement density. Hero MotoCorp has tied up with Taiwan-based, Gogoro, the global leader in battery swapping for light EVs to bring their battery-swapping model and technology to India.⁹⁹ Taiwanese contract manufacturer, Foxconn too is planning to enter the EV battery swapping sector in India.¹⁰⁰

Start-Up Ecosystem

The EV Sector has witnessed the entry of many start-ups over the last few years. According to Tracxn, who monitors start-up investments, there are 731 EV start-ups in India. In 2021, investment into EV start-ups reached a record high, rising by about 255 per cent to reach US\$ 444 million (£373 million). Many Indian States are supporting emerging EV start-ups. The State of Karnataka is planning to create an EV industry hub that would house about 1,000 start-ups and will have five centres of excellence to facilitate training, research, development, innovation, and entrepreneurship.

Many leading EV producers are investing in or acquiring EV start-ups in India. Examples of some recent deals include TVS Motor Company's investment in electric bike maker Ultraviolette Automotive; Hero MotoCorp's investment in e-bike manufacturer, Ather Energy; Bajaj Auto's investment in Yulu; and investment of Murugappa Group's Tube Investments in IPL Tech Electric Private Limited, an electric heavy commercial vehicle start-up, and Celestial E-Mobility, a manufacturer of electric tractors; and acquisition of the electric motorcycle producer, Revolt Motors by RattanIndia. MG Motor through its MG Developer Program (MGDP) is working with and mentoring many start-ups in the EV sector.

Consumer Financing

India's EV financing market is expected to be worth INR 4.1 trillion (£41 billion) by 2030.¹⁰¹ Many traditional Indian banks have continued to shy away from financing EV customers as they burnt their fingers losing money on financing e-rickshaws, and other two- and three-wheelers powered with lead-acid batteries in the past. Financing for electric vehicles remains scarce and expensive for two and three-wheelers, in particular for the many users in India with lower credit scores. However, in recent months, several non-bank lenders and digital financiers have taken the lead in financing this segment. Funds focused on sustainability and green financing such as Northern Arc Capital, Delta Corp Holdings, and Incofin Investment Management are buying into Indian fintech firms that specialise in financing to fast-track adoption of two- and three-wheelers using the electric powertrain. Rev Fin, OTO, Mufin Finance, and Three Wheels United are some of the Indian fintech firms that have secured either equity or debt financing from global and local funds supporting green initiatives, such as Northern Arc Capital, Shell Foundation, Delta Corp Holdings, Incofin Investment Management, Matrix Partners India, Prime Venture Partners, 9Unicorns, and Better Capital.

In recent months, digital e-mobility lending platform Revfin raised US\$ 10 million (£8.4 million) in funding in debt, led by Northern Arc, Liquiloans, and Shell Foundation, a UK-registered charity. Revfin will use the funds from this round to expand its geographical footprint to 25 States and capture over 10 per cent market share of financed electric three-wheelers. Having financed over 10,000 electric three-wheelers in 14 Indian States, Revfin has set a target of financing 2 million electric vehicles in the next 5 years.¹⁰²

EV financing and leasing companies are partnering with EV manufacturers to offer financing schemes to un-banked and under-banked sections of the market. ALT Mobility, a market leader in the leasing of electric commercial vehicles, has partnered with One Electric, a Noida-based electric motorcycle manufacturer, to provide high-quality and durable electric motorcycles for its last-mile delivery partners.

India's Small Industries Development Bank of India (SIDBI) and the World Bank have started interacting with financial institutions and manufacturers to understand how to enhance commercial financing availability for electric two and three-wheelers and develop a risk-sharing program for financial institutions interested in this market. This process is facilitated by a Korean grant secured by the World Bank. The NITI Aayog is the facilitating agency for the project, aimed at facilitating faster and easier financing of electric vehicles.¹⁰³ GoI, the World Bank, and the Small Industries Development Bank of India (SIDBI) are reportedly set to launch a US\$1 billion (£840 million) fund to provide guarantees against loan default to lenders financing the purchase of electric two- and three-wheelers. This initiative is expected to boost EV sales by bringing down the cost of financing EVs by 10-12 per cent.

OPPORTUNITIES

The fast emergence of the EV Sector in India is offering an interesting opportunity mix in many areas. There is a range of investment, partnership, and export opportunities for EV and component producers to access one of the most attractive EV markets in the world. Some key opportunities in the sector are outlined below:

- EV motors and motor controls.
- Battery chemistry and battery management, control, and monitoring solutions: India currently does not have adequate EV battery manufacturing capabilities and several companies are currently running R&D programmes. This segment of the EV industry is witnessing the entry of overseas battery players as well as Indian companies tapping into global battery technologies companies through R&D partnerships and acquisitions. Though most of these companies are focusing on Li-ion battery technologies, in the absence of critical mineral reserves (such as lithium, cobalt, and nickel) in India, India will look at some other emerging battery chemistry

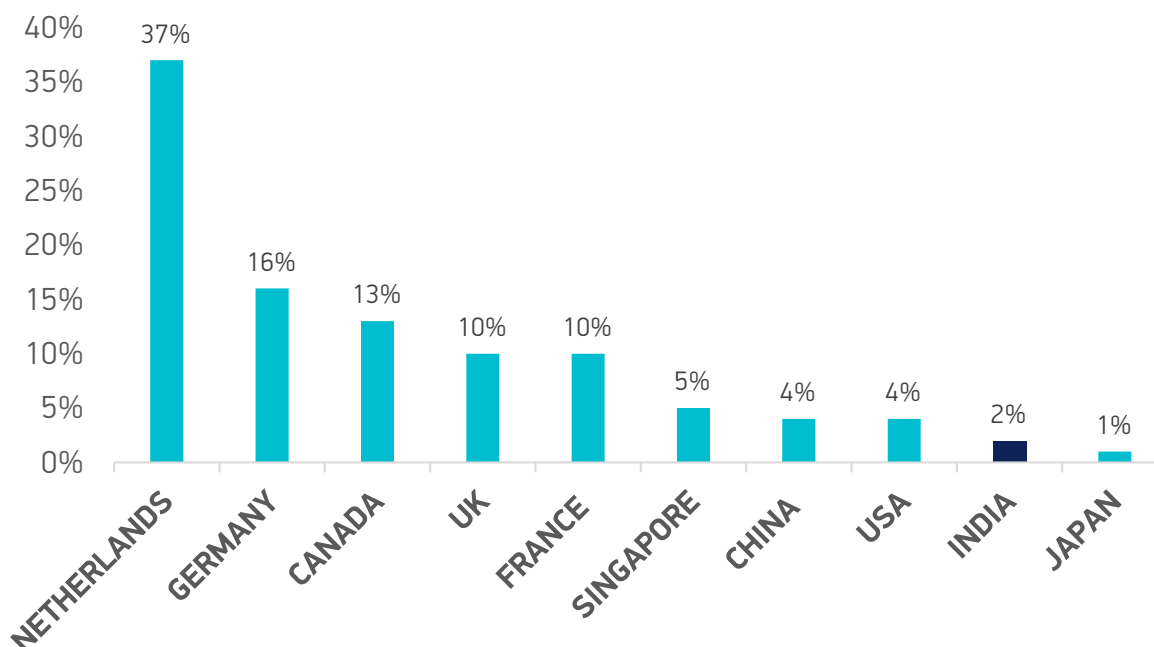
options and efficient technologies for battery recycling and recovery of critical minerals. There are also opportunities in the area of battery management, control, and monitoring.

- **Lightweighting and advanced materials:** EV producers are looking for light-weighting solutions in the form of aluminium alloys, carbon/glass fibre composites, and fibre-filled engineering thermoplastics, and related fabrication technologies such as advanced forming technologies and additive manufacturing.
- **Industry 4.0 solutions for EV-producing facilities in India, especially in the areas of automation, robotics, and IoT-enabled and AI-driven facilities:** Most Indian new manufacturing facilities will deploy the latest digital manufacturing technologies and will be keen to secure these from leading global players – For example, Ola Electric’s Future Factory facility will have more than 3,000 AI-enabled robots and Ola is working with ABB on this project.¹⁰⁴
- **IT and Software:** With a large amount of IT and software-driven monitoring and control systems, EVs are often seen as software-enabled mobility. Aside from battery management systems and motion control solutions in EVs, there will be a need for advanced data engineering and telematics-based solutions for connected cars.
- **Charging/swapping infrastructure:** With an estimated 50 million EVs on Indian roads by 2030, there is a huge opportunity for EV charging infrastructure for both slow and fast charging and battery swapping businesses. Both charging and swapping and Battery as a Service (BaaS) are expected to co-exist and offer investment and partnership opportunities.
- **Aside from electric two and three-wheelers, and passenger cars, the electric bus segment too has strong growth potential.** India is currently the world’s second biggest bus market after China, with over one million registered buses in the country. However, India has only 1.2 buses per 1,000 people, which is lower than that of most developing nations. With India’s urban population expected to grow to 590 million in 2030, there will be a large demand for efficient sustainable public transportation. The EV bus market in India has seen rapid growth in recent years, with FY2021-22 ending at almost 1,200 electric buses, and this growth is expected to become ten times in the next five years. One of the latest initiatives on this front has been Convergence Energy Services Ltd (CESL)’s US\$ 10-billion (£8.4 billion) tender for 50,000 electric buses to drive India’s plans to decarbonise the public transport and help meet its goals for Net Zero emissions.
- **India has a very low car density of 27 per 1,000 citizens mainly on account of limited purchasing power.** It is felt that there is a good potential for shared mobility and offering Mobility as a Service (MaaS), in which consumers do not own vehicles but can access them when the need arises. EV based MaaS platforms will have a good business potential and can ease congestion on roads and reduce pollution levels.
- **Skill development:** The EV industry will need a large number of skilled workforce. It is expected that the EV industry will create about 10 million direct jobs and 50 million indirect jobs by 2030. This will create a large demand for vocational skills and various upskilling and training programmes.

CHALLENGES

Despite the supportive policy from GoI and the State governments, and growing investment in the EV sectors by both established automotive players and new entrants, India has a modest EV adoption rate of 2 per cent and lags behind China and many European countries.

EV ADOPTION RATE (EV SALES AS PERCENTAGE OF TOTAL AUTOMOBILE SALES) 2021



While there is growing optimism about the strong growth of the EV sector in the coming years and that India will emerge as a key global player producing 10 per cent of the world's EV population by 2030, several factors are hindering India's fast adoption of EV. These include i) consumer concerns over price, range of EVs, performance and safety, serviceability, limited choice of vehicles, and inadequacy of the charging infrastructure and lack of battery swapping facilities ii) High dependency of Indian manufacturers on imports of some key items including batteries iii) unfavourable macroeconomic trends such as the threat of global recession and global shortage of semiconductor chips.

- EVs are currently priced at a premium compared to conventional ICE variants. For example, while the price of the ICE version of Tata Nexon ranges from INR 770,000 (£7,700) to INR 1,488,000 (£14,880), the price of its EV version ranges from INR 1,499,000 (£14,990) to 1,750,000 (£17,500). The high price of the Li-ion battery for EVs accounts mainly for the cost difference and it is expected that with the commencement of domestic manufacturing and the advancement of technology, the price will fall in the coming years.
- Many consumers have concerns about the range of EVs. With the long time required for charging, the inadequate density of EV charging stations, and the absence of widely available battery swapping services, consumers are reluctant to use EVs for long routes and inter-city travels.
- Following some recent fire incidents involving EVs, voluntary recalls by OEMs, and penalties imposed by the government, consumers have developed concerns over the safety and performance of EVs, especially electric two-wheelers.
- Though there are launches of multiple EV models almost every month and several new players have entered the EV sector, consumers do not have a wide choice of models yet compared to the large range of ICE models.

- Consumers also have concerns about a lack of service infrastructure especially roadside assistance and lack of skilled service personnel and the high cost of replacement of batteries and other key components.
- Though several EV battery projects are currently being implemented in India and there are ongoing R&D programmes on Li-ion and alternative cell chemistries, India imports most of its requirements of EV batteries. India does not have reserves of critical battery raw materials such as lithium, nickel, and cobalt. So there is currently a high dependency on imports and there is a need to set up end-of-life battery recycling infrastructure.
- As IMF estimates that countries making up one-third of the world economy will see at least two consecutive quarters of economic contraction this or the next year and have downgraded its global growth projections already three times in recent months¹⁰⁵, there are fears that adverse global economic conditions might slow down the flow of investment and make the investors more risk averse. This recessionary trend might affect some of the ongoing and recently announced projects.
- Moreover, automotive OEMs are having supply chain worries with the automotive chip shortage likely to persist through 2023.¹⁰⁶ Chip shortage will force EV producers to cut down on new projects and expansion plans and might delay the rollout plans of new EV models.

END NOTES

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