Grant Thornton

FICCI
Federation of Indian Chambers of Commerce and Industry

India-Germany: Building an integrated and robust e-mobility ecosystem

Contents

Disclaimer: This report is solely based on existing data and material, and the related analysis of the released questionnaire based survey to selected stakeholders. Views expressed in the report highlight aspects that may be considered in relation to fostering the e-mobility ecosystem.

Foreword: Federation of Indian Chambers of Commerce & Industry

'Cars are the cigarettes of the future,' said the Brazilian politician, Jaime Lerner. Thanks to the realisation, e-Mobility has finally gained prominence across the globe. Over the last decade, it has also resorted to greener technologies. Increasing concerns over climate change, unpredictable fuel costs and technological innovations have all contributed towards this paradigm shift.

In Germany, the e-Mobility market continues to expand rapidly. This has been possible mainly due to its progressive policies, expanding vehicle charging infrastructure and major consumer incentives. In India, while key policies do exist, the e-Mobility ecosystem is still developing. Though technological breakthroughs continue to take place at a rapid pace, mass consumer adoption of EVs in India will still take some time. Components such as vehicle pricing, charge time and vehicle range have not yet reached their optimal point.

This study, 'India-Germany: Building an Integrated Robust e-Mobility Ecosystem', is our effort to outline the factors that may help India to integrate the e-Mobility solutions in its economy in a more efficient manner. The report draws from a mix of primary and secondary research and juxtaposes e-Mobility initiatives by the governments in both India and Germany. It presents synergies that exist between the two countries and highlights the remaining aspects that a country like India should further consider in developing a robust e-Mobility ecosystem that is demand and supply driven. Though scheme like the Production Linked Incentive (PLI) is a shot in the arm for EV manufacturers and is a substantial step towards attaining India's vision of an Atmanirbhar Bharat, aspects like developing Component Manufacturing Standards, Battery Management Systems, Battery Recycling, etc., could be more aligned to suit India's needs. Even at the policy level, the focus of offering incentives should not only be for the established players but also for the start-ups.

Germany and India are among the top five economies in the world based on nominal GDP and rank 4th and 5th respectively on automotive production. The two also boast of a flourishing trade and investment relation. Now is the time for the two economies to collaborate more effectively in the e-Mobility sector– Germany with its cutting-edge technologies and India with its economies of scale. This symbiotic relationship has the real potential to cut down costs and help in rapid adoption of EVs, not just in their domestic markets, but across the globe.

With the help of this study, therefore, we hope to steer the discussion towards building on the strengths of the two countries and creating an integrated and robust e-Mobility ecosystem. I hope readers find this report informative and enriching.

FICCI, as the leading industry association of India, is committed towards strengthening the Indo-German economic relationship. Through the FICCI office in Germany, our endeavour has been towards multifaceted efforts, engagements, and initiatives to support the cause of building synergy between the two countries by actively engaging with all the relevant stakeholders.

I would like to thank our partner, Grant Thornton Bharat and Germany, for putting together this study and generously devoting their time and expertise into it.

Dilip Chenoy
Secretary General
FICCI

Foreword: Grant Thornton

2020 would always be remembered as the year that changed the way we need to think. The onset of a pandemic, one that the world was not adequately prepared for, highlights a different dimension. A dimension that requires not only the continuous advancement of innovation and technology, but one that requires appropriate and efficient models to develop and scale up these innovation and technologies. A dimension that further emphasises global inter dependencies and the importance of cooperation. The new world dimensions!

This new world has led to the emergence of a new consumer and world citizen, one that is eager to be healthy, breathe clean air and build a better, more resilient world for the next generation. For the automotive world, this presents a great responsibility and opportunity to fast track the development of electrification and electric vehicles (EV) by utilising the strengths available globally through a collaborated and integrated effort.

Beyond doubt, Germany and India emerge as two nations that could greatly support this development. Germany, the celebrated leader in automotive innovation and technology, and India, the emerging hero in the space with its growing prominence, offer each other a wide array of complementary synergies. The innovation and technological leadership of Germany are optimally complemented by the scalability and cost advantages offered by India. Bringing together the synergies offered by these two prominent automotive nations, could help deliver the entire spectrum of new world essentials and its advantages.

Our report and analysis highlights identifiable short-, medium- and long-term aspects around policy, investment and manufacturing that could present opportunities and areas to Germany and India to collaborate and build a robust and integrated e-mobility ecosystem together.

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About the report

As EV transition gains momentum in India, a concrete pathway for the future of Indian e-mobility, which expounds on priorities and incorporates Indian realities, is the need of the hour. The flourishing EV market in Germany and existence of close diplomatic and economic relationships between India and Germany present potential opportunities and synergies for the countries to together harness this momentum.

With the objective to highlight the potential of joint e-mobility business opportunities between India and Germany and how both countries could build an integrated and robust e-mobility ecosystem, Grant Thornton Bharat, India and Warth & Klein Grant Thornton, Germany, in partnership with the Federation of Indian Chambers of Commerce & Industry (FICCI), have prepared this report. The report highlights areas that both countries could leverage, in view of their strong relations, to forge a new paradigm of economic partnership. Such partnerships would greatly elevate trade and investment as new and innovative technologies accelerate.

With a goal to better understand and closely link the expectations of profitable cooperation in both economies, the report is further substantiated by an analysis done with select stakeholders of the Indian and German automobile industry. The stakeholders participated in an online survey to share their views on certain topics and/or issues triggered by the development of e-mobility in the Indian and German automobile industry. The questionnaire-based survey provided unique, qualitative, and valuable insights, providing important metrics for the two countries to further strengthened e-mobility business trends.

By synthesising the existing data and material, and the related analysis, the report intends to look at how India and Germany can integrate towards the transition to EVs and the impact of electrification on the integrated EV ecosystem. The report highlights inter-country trade between the two countries, specifically in the e-mobility segment of the automotive industry. Both nations are urged to take initiatives in e-mobility leadership and partake in further enriching bilateral relations with diverse and innovative research and extend all possible support in realising the e-mobility vision. With induced commitment and support, India and Germany can together succeed in putting the e-mobility ecosystem on the highest pedestal.

Indo-German trade relations

India and Germany's bilateral relations were founded on common democratic principles and are marked by high level of trust and mutual respect. The relationship between the two countries grew significantly following the Cold War. Over the years, economic and political interaction between the countries has increased and Germany is now one of the most important trading partners for India. The economic and trade relations between the countries are strong, with Germany being India's largest trading partner in Continental Europe.

The two countries have resolved to intensify bilateral and multilateral cooperation. There is focus on strategic cooperation in the fields on new and advanced technology with higher exchange of information and intelligence. In terms of trade, innovation, investment and knowledge, the economic relations between the two countries have increased, but could be intensified further.

Key economic statistics for auto industry

India

- **#4 in sales and #5** in production globally
- **7.5%** contribution to GDP
- **~35 million** workers

- **USD 10.85 billion** in imports from Germany in April 2020 -January 2021 (drop from **USD 13.69 billion** in 2019-20)
- **USD 0.10 billion** estimated revenue for 2020
- **USD 31 billion** engineering and R&D spend (**40% of total**)
- **USD 118 billion** turnover. Under Atmanirbhar Bharat Abhiyaan (Self Reliant India) special economic and comprehensive package of USD 307.65 billion (i.e., 10% of India's GDP) allocated towards promoting manufacturing

Germany

- **#5** in sales and **#4** in production globally
- **5%** contribution to GDP
- **~0.83 million** workers

- **USD 6.47 billion** in imports from India in April-January 2021 (drop from USD 8.29 billion in 2019-20)
- **USD ~480.43 billion** (Euro 398.8 billion) estimated revenue for 2020; **67.6%** to be generated by manufacturing of motor vehicles
- **1/3** of the global automotive R&D spend done by German OEMs
- **Sixth** most important trading partner of India worldwide and the **seventh-largest** foreign investor in India
- **USD ~599.94 billion** (Euro 498 billion) turnover
- **18** of the world's **100 top** automotive suppliers are German companies

Opportunity areas

- Increase in e-mobility in both countries' sale and production volumes
- Higher bilateral trade in electric machinery and auto components
- Surge in German original equipment manufacturer (OEMs) entering the Indian electric vehicle market
- Manifold increase in revenues with e-mobility uptick in both countries

India imports and exports with Germany

While Germany is the fourth-largest economy in the world, India is the fifth and fastest-growing economy.

USD 6.47 billion

worth of exports from India to Germany during April 2020-January 2021

3.56%

of the total imports by India from Germany

Despite this, India's overall contribution to Germany's auto component market is marginal.

To grow trade, India could benefit from a targeted exports expansion and imports substitution programme. The country has the potential to expand its share in global auto components trade to 4-5% by 2026, riding on the exports growth and import substitution initiatives being taken by the industry as part of the Atmanirbar initiative. As supply chain shifts, India will be able to increase its share in the global auto components trade.

Survey find

Imports for India are set to go higher, due to the increased use of electronics and enhanced design and engineering in vehicles and components. According to the survey, **automotive electronics** may be considered as the prioritised segment of the value chain, followed by light-weight materials, machinery and moulds and dies.

Comparitive analysis

Raw material used in EV production	German exports to India (USD million)			Indian exports to Germany (USD million)		
Commodity	2019-2020	2020-21 (April-January)	Trend	2019-2020	2020-2021 (April-January)	Trend
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and re-producers, and parts	1,524.80	973.46	↓	617.42	663.27	↑
Articles of iron or steel	255.74	177.98	↓	377.75	259.91	↓
Iron and steel	252.71	170.46	↓	135.90	91.50	↓
Copper and articles thereof	138.27	122.06	↓	25.79	17.36	↓
Aluminium and articles thereof	106.36	96.54	↓	58.10	58.64	↑
Nickel and articles thereof	29.07	25.68	↓	2.08	1.01	↓
Lead and articles thereof	6.52	2.63	↓	0.00	0.02	↑
Zinc and articles thereof	7.23	3.89	↓	0.33	0.44	↑
Total % share	**2.88%**	**3.56%**	↑	**2.64%**	**2.83%**	↑

Source: Ministry of Commerce & Industry, Government of India
Note: Major Indian imports from Germany are chemicals, auto components, measurement and control equipment, machinery, electro technology, metal and metal products, plastics, pharmaceuticals, paper and printing materials, and medical technology.
Major Indian exports to Germany include food and beverages, machinery, pharmaceuticals, textiles, metal and metal products, electro technology, leather and leather Goods, gems and jewellery, rubber products, auto components, and chemicals.

Balancing act in e-mobility sector post-COVID-19 crisis

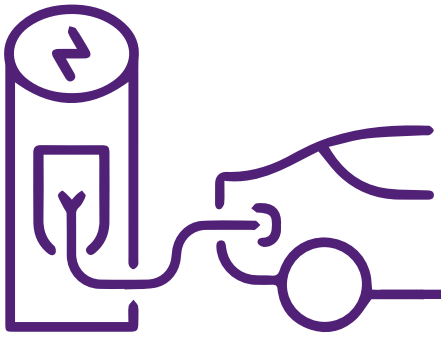
COVID-19 has pushed companies worldwide into a balancing act where, while on one hand they need to manage the immediate effects of the current crisis, on the other hand they also need to build resilience to upcoming shocks.

With the pandemic having influenced economies across the globe, the real GDP in Germany is expected to decline by 5.8% in 2020 and rebound by 4.4% in 2020-21. Germany's business confidence has been hindered due to ongoing trade conflicts between the USA, China and Europe. India's economy too contracted by 7.5% year-on-year (y-o-y) in the September 2020 quarter, pushing the country into a recession. Surprisingly, while India's manufacturing sector witnessed a turnaround, there remain concerns about whether it is sustainable in the wake of weak demand and investment.

One of the first casualties of the economic crisis has been the declining global crude prices. Therefore, the trajectory for transition to EVs would vary across countries and will depend on a country's ability to develop an indigenous supply chain in a time-bound manner. Both, Germany and India, have moved swiftly to counteract the worst effects of the global Covid-19 crisis, implementing far-reaching financial support package for the industry.

However, as an emerging economy dealing with the massive health and economic costs of the pandemic, there is little fiscal room for India to announce new and generous EV incentives – similar to those announced in European markets. Therefor, India needs to be pragmatic about its trade policies.

Challenges and related opportunities



Factors	Challenges	Opportunities
Low oil prices	• Decreasing economic viability of EV adoption vis-à-vis combustion vehicles, especially in countries with limited fiscal incentives for EVs • Relatively higher total cost of ownership for EVs	• Continued push towards innovation in batteries to reduce costs further
Disruptions in supply chain	• Re-shoring production of key components such as batteries • Setting up of trade barriers to ensure localization of production • Delaying EV transition trajectory for existing fleet owners	• With well-planned trade barriers supply chains will be more resilient in the long term • Consolidation of traditional mobility service providers • Increased EV space to mobility service providers • High utilisation of use vehicle cases in logistics and ride hailing

Germany's COVID-19 stimulus package has seen the country doubling its EV incentive. Germany now delivers a USD ~11,420 (Euro 9,480) subsidy for EVs, with USD ~4,192 (Euro 3,480) of that chipped in by OEMs. In November 2020, the German government committed a Euro 4 billion stimulus package to the automotive sector, with funds channeled into the adoption of production lines and incentivization of the purchase of EVs.

This has been further complemented by an effective doubling of cash incentives for EV purchases and significant investment in charging infrastructure as part of a broader Euro 130 billion economic stimulus package to jump-start the German economy. The German government has thus set out COVID-19 recovery plans as a springboard towards a greener economy, with a greater emphasis on electro-mobility.

According to the European Automobile Manufacturers Association (ACEA), registrations of new EVs in Europe doubled in the first quarter of 2020, despite most vehicle dealerships closing in the latter part of the quarter.

In India, however, the EV industry is anticipated to be a strong factor in the revival of the economy. By 2024, the Indian government aims to register 0.5 million new vehicles and plans to provide financial incentives on top of the central government's existing income tax rebates for purchase of EVs. The economic viability of EVs remains intact from a consumer standpoint. To further complement this, in view of rising oil prices, the government has decided to increase taxes on petroleum products to shore up finances. This is likely to induce knock-on effects such as greater investments across the value chain and new vehicle announcements by global vehicle manufacturers.

Indo-German e-mobility roadmap

The need to sustainably grow the mobility ecosystem, both from an economic and environmental perspective, has led to the electrification of powertrain and the introduction of EVs. Due to the challenges posed by climate change and the associated targets, the demand for mobility has changed across the globe, and factors, such as environmental protection, emissions and limited space, are gaining importance.

The global sales of EVs in 2020 increased by 39% y-o-y to 3.1 million units, whereas the total passenger car market declined 14%. EVs are expected to represent nearly half (48%) of all passenger cars sold globally by 2030. This growth is being led by supportive government policies, rising consumer interest in EVs and increasing environmental consciousness.

India is at the cusp of an e-mobility revolution. While it is not a global frontrunner in promoting and developing an e-mobility ecosystem, a range of compelling reasons make this paradigm shift inevitable. Transitioning to e-mobility would potentially reduce oil imports, address air pollution levels and also help meet India's climate commitments by reducing the energy intensity of the GDP.

For India, to have a credible delivery from OEMs in specific and the entire EV supply chain as a whole means "working together".

Keeping this in mind, the Indian government plans to massively increase the share of EVs by 2030, while Germany has outlined its process in the Standardisation Roadmap on Electro Mobility 2020.

Survey find

The stakeholders through the survey responses have primarily sensed that the aim of Government of India to increase sales of EVs to 30% of the new vehicles sales from 2030 onwards is **an increasing ambition for transition to EVs in India.**

India and Germany see the Sustainable Development Goals (SDG) and the Paris Agreement as guiding frameworks in their cooperation for electric mobility. To achieve a successful energy and transport transition in India and Germany, both the countries will have to capitalise on the economic potential of climate protection.

Survey find

India may consider to make continued efforts to improve ease of doing business. However, requirement of **a combination of mandates and incentives, for both demand and supply sides,** is also required.

India and Germany aim to partner by leveraging advantages on each side and intensify cooperation on next-generation technologies, including Internet of Things (IoT). Potential synergies in e-mobility offer immense opportunities for enhancing cooperation and building on comparative advantages. German technology and potential economic investments are likely to complement efforts of the two countries in achieving their e-mobility goals and taking concerted action.

EV ecosystem

	India	Germany
Projected CAGR (2020-27)	44%	32%
EV cars on road	4,000	55,000
Potential to grow by 2025	5%	30%
Number of passenger cars per 1,000 people	~22	~560
EV registrations (2020)	156 thousand (25640 registrations in Feb 2021)	196 thousand (40,000 registrations in February 2021)
EV/total vehicle sales	~0.1%	13.5% Battery-electric vehicles (BEV): 6.7%: plug-in hybrids (PHEV): 6.9% in EU27

Expected EV penetration in India

Segment	Sub-segment	EV penetration % 2025	EV penetration % 2030
2W	Scooters - B2B - B2C Motorcycles Overall	15-25% 40-60% 13-18% 1-2% 7-10%	50-70% 60-80% 40-60% 10-20% 25-35%
3W	Overall	35-45%	65-75%
4W-PV	Personal Commercial	1-3% 5-10%	10-15% 20-30%
Buses	State transport undertakings (STUs)	15-25%	25-40%

e-mobility and Germany

Germany has been witnessing a major increase in EV adoption. With robust push towards electrification, Germany introduced a bonus scheme in 2016 that encouraged German citizens to buy EVs.

22% EV market share in October-November 2020; optimistic in its 2030 goal

Roadmap

2010

National Platform for Electric Mobility (Nationale Plattform Elektromobilität) to deploy one million EVs by 2020. Tasks to push on the **National Development Plan for Electric Mobility (Nationaler Entwicklungsplan Elektromobilität")**

2014

Integrated energy and climate protection programme to phase out nuclear energy by 2022 and ensure at least 80% renewable energy until 2050

2015

E-licence plate for priority parking spaces near charging stations
Electric Mobility Act

2016

Euro 3,000 subsidy for plug in hybrid EVs, Euro 4,000 subsidy for purely battery. EVs 10-year exemption from ownership tax

Free or reduced priced parking

Goal to have 7-10 million plug-in EVs by 2030 and one million charging points by 2030

Purchase bonus scheme approved

EV plug-ins exempt from the annual circulation tax for five years

Realisation that sales are behind the targets

2020

Recovery plan (Euro 8 billion) for EVs, deploying charging infrastructure and mitigate impact of COVID-19

Purchase bonus for Fully EVs (<Euro 40,000) inclusive of new cars, raised from Euro 6,000 to Euro 9,000 and Euro 4,500 to Euro 6,750 for plug-in hybrids (until 2025)

2021

55,000 EV cars on the road

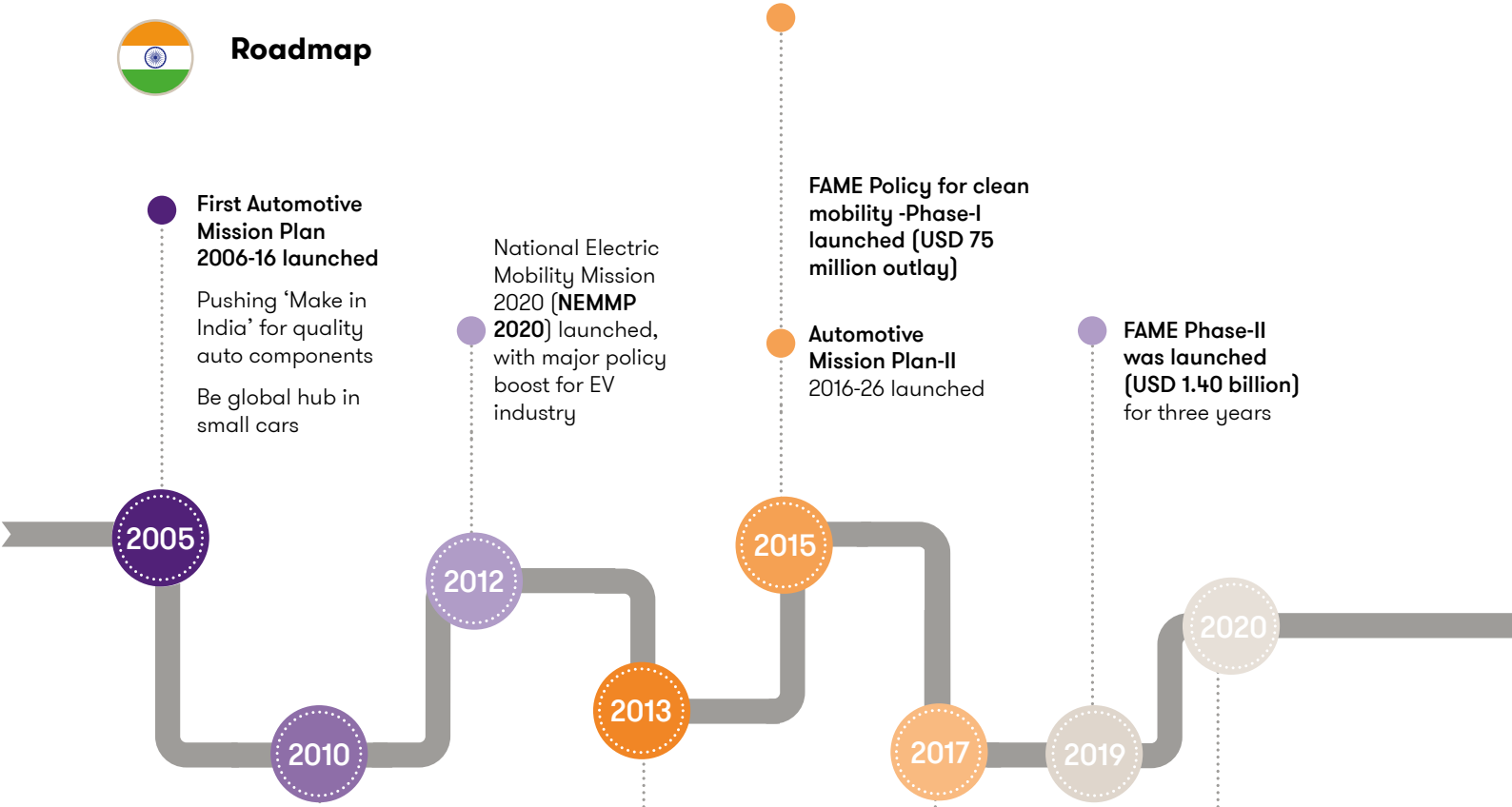
Survey find

To foster EV adoption, providing buyer's premium (as is in Germany) is not considered an efficient strategy that could be replicated in India. Rather, the preference for India is to combine the EV incentives with tax and insurance benefits.

e-mobility and India

In 2018, the Indian automobile market pipped Germany to become the fourth-largest in the world and established stronger trade with India. Germany is strongly advancing towards electrification, but Indian EV industry is a growing industry and move to e-mobility is a priority for Government of India (GOI). In 2012, India unveiled the National Electric Mobility Mission Plan (NEMMP) 2020 to address issues of national energy security, vehicular pollution and growth of domestic manufacturing capabilities.

Roadmap



2005

First Automotive Mission Plan 2006-16 launched

Pushing 'Make in India' for quality auto components

Be global hub in small cars

2010

MNRE incentive scheme for EV withdrawn in March 2012; introduced as NEMMP 2012 (no incentives till FAME introduced)

2012

National Electric Mobility Mission 2020 (**NEMMP 2020**) launched, with major policy boost for EV industry

2013

NEMMP laid out roadmap for EV adoption and domestic manufacturing, launched by MoHIPE

2015

FAME Policy for clean mobility -Phase-I launched (USD 75 million outlay)

Automotive Mission Plan-II 2016-26 launched

2017

NITI Aayog roadmap

Transformative mobility solutions for all

2019

FAME Phase-II was launched (USD 1.40 billion) for three years

2020

35% total input local production for EVs

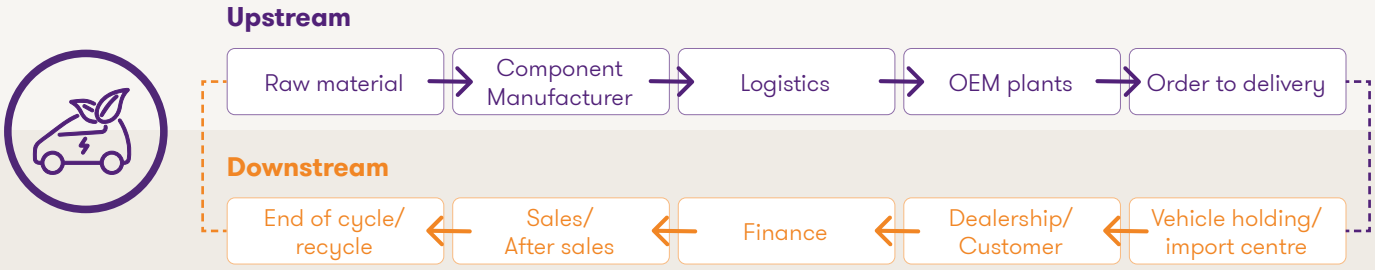
PLI scheme outlay of ~USD 7 billion (INR 51,000 crore) under Aatmanirbhar programme launched

Deduction on interest on EV loans

Tax on Li-ion batteries reduced to 18%

E-mobility ecosystem

e-Mobility Value Chain



For the integration of EV manufacturing, supply chain and infrastructure amongst India and Germany, uncertainty is an overarching theme considering the nascent state of e-mobility uptake in India where the disruptive transitions in Germany and overall at a global level may credibly support towards continued development of India's e-mobility solutions.

Although, the commitment expressed by Indian OEMs and the investment in developing forthcoming EV platforms suggests a strong push by industry towards the development of e-mobility technologies. EV companies in India are determined to be substantial exporters of EVs in the coming years accelerating India's e-mobility movement.

Need to develop industry standards from manufacturing to re-cycling

There are certain EV elements comparable to conventional vehicles such as interior trim and body panelling. However, drive train components, cooling systems, braking and the absence of any systems relating to liquid fuel and exhaust make the supply chain around EV production significantly different.

For EVs, two drive or energy storage concepts will be decisive: battery EVs and fuel cell vehicles with H2 storage. All power sources are primarily battery-driven, which makes it critical to have efficient, smart systems within a vehicle and externally.

Raw materials

As EVs require thousands of cells, countries need more raw materials, skilled talent and machines to extract the raw materials and the factories to process the raw materials into cell components and then the factories to turn those components into cells. The battery manufacturing supply chain has three main parts: cell manufacturing, module manufacturing and pack assembly (figure). Based on recent estimates, about 20% of the total cost of a finished lithium-ion battery pack comes from the cell stage of production.

Survey find

Neutral view on the increased number of jobs in internal combustion engine (ICE) powertrain manufacturing in 2030 with 30% penetration of EVs.

Cell	Module	Pack
• Anode • Cathode • Electrolyte • Separator	• 4 to 444 cells • Case with terminals	• Modules • BMS • Electrical connections

The primary materials in cells are lithium, nickel, cobalt, manganese, aluminum, copper and graphite. The first three are giving possibly the most trouble to the EV manufacturers.

India has no lithium, cobalt, or nickel and as such has 100% import dependence across the raw material value chain. This makes India quite vulnerable and the best option to mitigate supply chain concerns is through recycling.

The most important thing for the EV sector is to have a strong regional battery supply chain

Battery management systems (BMS)

Government of India (GoI) has plans to boost its national battery manufacturing and value-adding capabilities to meet its EV adoption targets. German players have used BMS that monitors each individual cell to achieve a permanently optimised operating condition, making the battery last much longer. The German Association for Electrical, Electronic & Information Technologies (VDE) has recognised this and set up a standards committee.

Meanwhile, India has a National Mission on Transformative Mobility and Battery Storage, to drive clean, connected, shared, sustainable and holistic mobility initiatives. The country has drawn a five-year phased manufacturing programme (PMP) till 2024 to support setting up a few large-scale, export-competitive integrated batteries and cell-manufacturing giga-plants and to localise production across the value chain.

Production of lithium-ion batteries

It is possible that some other battery type that packs more energy per pound will be developed in future, but until then, lithium-ion (Li-ion) batteries will be the most important part of an EV. Thus, Li-ion battery pack prices, which were above USD 1,100 per kilowatt-hour in 2010, have fallen 89% in real terms to USD 137/kWh in 2020. The fall is due to increased EV sales and spread of high energy density cathodes whereas prices have also fallen due to improvements in manufacturing, battery chemistry and tighter supply chain control.

Survey find

Potential opportunity costs for EV transition in India

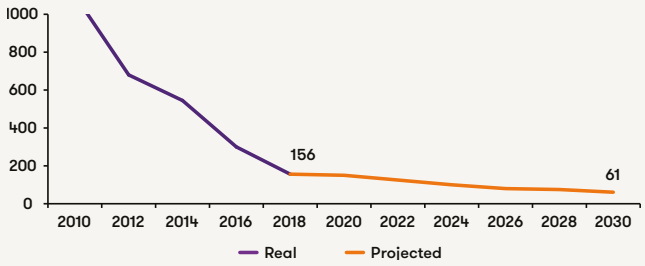
47% Indigenisation of High value add components

33% Increased employment opportunities in EV ecosystem

20% Import substitution towards green mobility

Tumbling costs

Prices of lithium-Ion batteries have fallen about 87% in the past decade, and are forecast to continue to decline



In the Indian context, production of Li-ion batteries has been gaining momentum over the years. Recently, the Indian Space Research Organisation (ISRO) signed an MoU with Bharat Heavy Electricals Limited (BHEL) to produce Li-ion batteries. The plan is to build a 1GWh plant initially and scale up to 30GWh in due course. Although (ISRO) has transferred Li-ion battery technology to 10 firms that have set up plants in the country, India has not been at the forefront of the innovations in battery technology. As cells are more easily imported/ exported longer distances, they are likely to continue to be internationally traded.

So, as vehicle manufacturers venture into making batteries, they could also partner with and initiate investing in battery companies. The move would enable them to secure supply and be strategic investors, further enabling the capital flow.

Alleviate range anxiety

For many car buyers, limited range is a major detriment towards buying an EV. Range anxiety is the fear that a vehicle has insufficient range to reach its destination and would thus strand the vehicle's occupants.

Some methods that can be used to alleviate range anxiety among EV drivers include deployment of extensive charging infrastructure, development of higher battery capacity at a cost-effective price, battery swapping technology, use of range extenders, accurate navigation and range prediction and availability of free loan vehicles for long trips.

However, from EV logistics standpoint, OEMs in India see EVs as a distant prospect due to the current high costs associated with owning one and inadequate charging infrastructure. Thus, expansion of the charging infrastructure is an important part of e-mobility. Consumers tend to worry that an EV with a range of 80 to 250 miles on a single charge would be inconvenient for long trips due to the time it takes to recharge the battery.

Lack of information can be a contributing factor, a good navigation system with knowledge of the battery capacity and remaining distance can minimise the fear.

Light weighting of EVs

For an EV, vehicle being lightweight is crucial in achieving better range and handling. Therefore, the systems within the vehicle need to be optimised to offer integrated functionality and overlook the conventional system. There are innovative concepts that abandons traditional technology altogether for instance in selected surfaces in the vehicle interior to produce sound. With such sound technology, OEMs can reduce the weight of a sound system by up to 75-90%, adding to Light weighting of EVs.

Battery pack assembling

Most countries do not make their own Li-ion cells for the batteries that power their EVs, or energy storage systems and the cells are majorly imported and then assembled into battery packs for various applications.

In India, battery packs are imported for applications in cars, other four wheelers and buses and in case of 2Ws, a fair amount of local assembly of battery packs happens in house.

Also, as India makes the shift from cell-to-pack manufacturing (assembly) plants to full value capture, the domestic cost of the vehicle would also decrease. There is a global consensus that Li-ion battery costs can be reduced further if there are larger volumes. At a scale of 50 GWh manufacturing capacity, the cost of a battery in India is expected to be competitive with global costs.

But where do German manufacturers source their cells from?

Currently, the cells come from China and Samsung in South Korea. These are supplemented by units built in Erfurt, Germany and with Samsung batteries made in Hungary. Germany plans to localise more of the cell production to meet the increasing demand from the assembly plants wherein the battery pack assembly is already handled closer to the vehicle plants at various production locations for German OEMs. Joint ventures are being established.

Battery pack assembly locations used by global OEMs

Manufacturer	Range (miles)	Assembly location	Battery size (kwh)	Battery manufacturer	Battery pack assembly location	Battery cell production location
German motor vehicle manufacturer	126	Germany	35.8	Samsung SDI	Hungary	South Korea
German multinational corporation which produces luxury vehicles and motorcycles	114	Germany	22-23	Samsung SDI	Hungary	South Korea
South Korean multinational automotive manufacture	111	South Korea	27	SK innovation	South Korea	South Korea
American automobile division	238	United States	60	LG Chem	United States	South Korea

However, for India, to encourage local assembling of EVs, the government needs to minimise import duties on relevant EV components, such as electric compressors, brake systems and motor controllers, which are usually imported as pre-assembled sets.

Survey find

Effective cost reduction levers for bringing down EV costs in India

40% Design simplifications

33% Partnership during transition

27% Optimisation of urban mobility

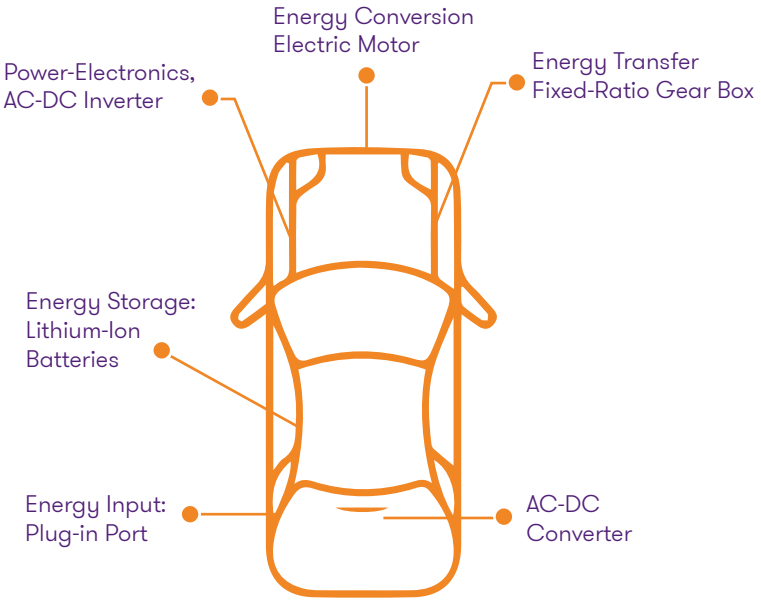
Component manufacturers

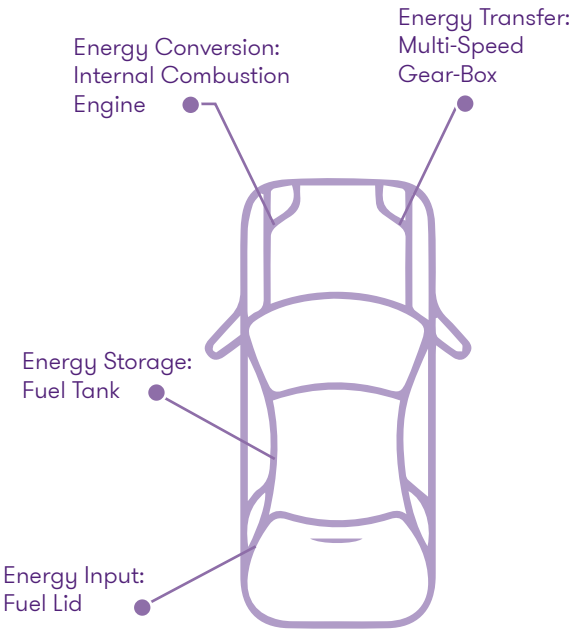
Potential integration in technically advanced and eco-friendly vehicle parts

The advent of EVs means there needs to be a rehaul of the entire ecosystem and architecture of a vehicle and its surrounding environment towards sustainable automotive technologies. While it might take some time to develop vehicles with zero carbon emissions, EVs are certainly one of the greener alternatives with fewer lifecycle emissions.

The industry players along with value chain entities including component and raw material providers have adopted partnership and collaboration strategies to integrate technically advanced and eco-friendly vehicle parts.

The EV supply chain is similar to the ICE passenger vehicle supply chain; however, instead of competing based on the engine and transmission, EVs compete based on their batteries. Further, to give impetus to the EV production, vehicle manufacturers have realised the need to make the batteries, where about 40% of the value of an EV is contained. OEMs in India and Germany have begun making their own.





Electrification beyond Powertrain

Connected, Autonomous, Shared and Electric (CASE) trends

	India	Germany	Bilateral Trade Cooperation	How viable it is for countries to Synergise	
Vehicle to everything (V2X) technology	With IoT and enhanced V2X communications, efforts are made to bring innovations in the new vehicle experience	OEMs deliver V2X-type applications through wide-area cellular connectivity and supporting infrastructure such as appropriately equipped roadwork trailers	Focused approach of OEMs on bringing design and R&D to India	Very high 	Germany to India
Digital Human Machine Interface (HMI)	Increased HMI R&D capability with increased production and development capabilities to meet the growing local demand	Developed intelligent HMI to ease acceptance EV technology	Advanced HMI solutions for EV driving stimulator	Medium 	Both ways
Telematics	Firms offer automotive services as well as a delivery platform that allows embedded telematics to integrate and connect with a vehicle	Mandate use of Telematic systems	Upgradation of products by developers of satellite monitoring platforms	Medium 	Germany to India
Cybersecurity	Cybersecurity can be improved by enhancing the framework conditions for drawing up common minimum standards (code of conduct) with allies and partners	Country enforces international rules of conduct, standards and norms in this domain	strengthening cyber security	Very High 	Germany to India
Tyre pressure monitoring System (TPMS)	Mandatory TPMS standards made effective from Oct 2020 vehicles with tubeless tyres. (Road Transport ministry) Development and promotion of intelligent TPMS based on vehicle networking technology	Implementations towards transmit live tyre pressure data to the cloud with AI predictive analysis of tyre lifetime Alerting drivers and fleet managers about potential issues	Connectivity and artificial intelligence in TPMS	Medium 	India to Germany
Tyres	OEMs producing tyres for new generation electric vehicles	Providing increased load-bearing capacity for the extra weight of a battery pack	Tyre performance and longevity. reduce rolling resistance, increase range	Medium 	Germany to India
Intelligent Battery Sensor (IBS)	Continuously developing new products to expand automotive battery sensor business at the global level	Prominent players in IBS market	In on-board diagnostics	Very high 	India to Germany

Source: Grant Thornton Analysis

Logistics

Scaling up EV charging

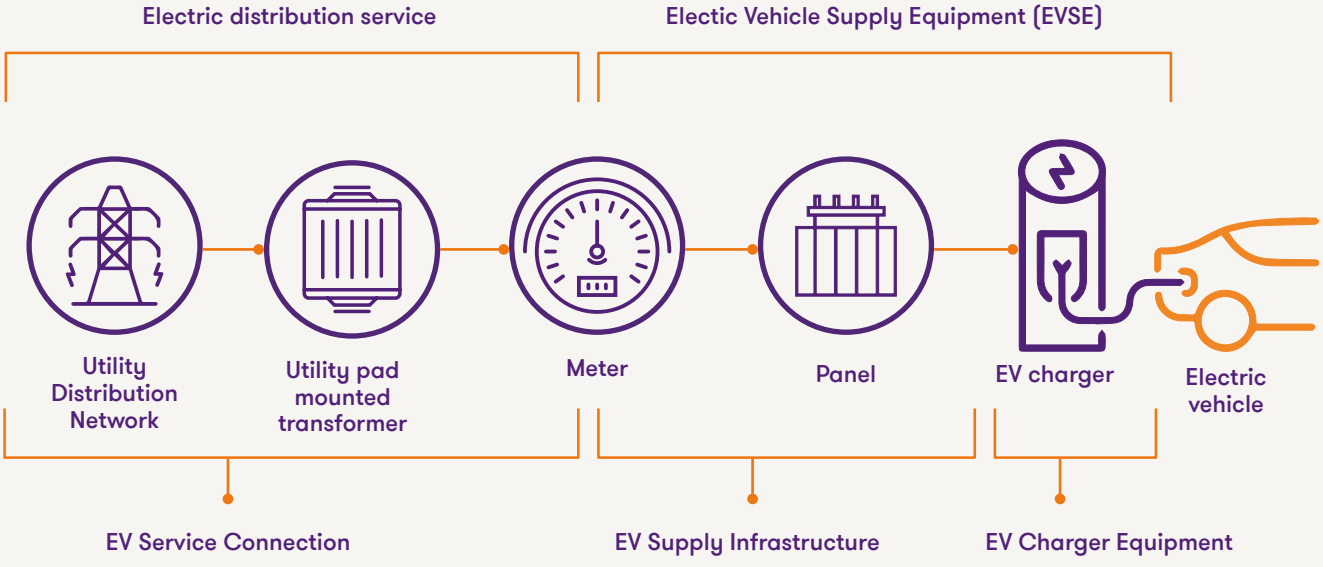
To unleash utility investments, it is critical that state and national policies provide direction to invest in EV programmes. Utilities are seeing the benefits through increasing electricity sales and efficiency of the electrical grid through vehicle-grid integration. EV integration can also allow more renewable energy into the grid, which helps utilities meet renewable purchase targets and generates non-monetary benefits, such as energy security and environmental and social benefits.

The blossoming EV industry in India stares at an unclear future, as OEMs are divided on how the EV sector will eventually emerge out of the present situation: Some have forecast stagnation while others see a possibility of the Indian EV sector becoming a strong contender in the global electric mobility manufacturing space. Policy directives have been issued with a clear intent to transition to EVs.

Survey find

More than half of the stakeholders believe that infrastructure deployment may be considered to be the most followed pursuit for a smooth transition to EV in India.

Electric distribution infrastructure



The EV charging infrastructure supports through EV service connection (owned and operated by the distribution utility), the supply infrastructure and charging stations (owned and/or operated by the EV-owner, EVSE owner, or a third-party service provider, including a utility itself). This highlights the challenge in ownership models and grid integration requirements that are multifarious when different charging station and EV technologies and standards are considered-both for power transfer and information exchange.

Global practices: Flexible EV resource

Many grid integration activities across the world are focused on early-stage demonstration and applications of EVs, as a grid resource using variants of the vehicle grid integration (VGI) services. Due to concerns of battery life and OEM warranty issues, smart charging is commonly practiced wherein depending upon the OEMs choice, the chemical compositions of Li-ion battery technologies vary. Battery chemistry, as a proxy for a grid resource, is assumed negligible. Overall, the EV infrastructure is tightly coupled with the EV and charging station characteristics, battery technologies, and electricity markets.

Survey find

Guidelines laid by the Ministry of Power, on EVSE (electric vehicle supply equipment) requires every charging point to cater to all three (CCS, ChaDeMo, and Bharat AC/DC) standards, and has set certain rules for the location of charging points. This would not reduce market flexibility for charging service providers, however a major push is recommended for easy- to-install, low-cost and compact EV slow chargers to be developed indigenously.

More than half of the stakeholders have recommended involvement of discoms in EVSE deployment and classification of EV charging infrastructure as corporate social responsibility (CSR)

According to EV industry body Society of Manufacturers of Electric Vehicles (SMEV)

1,800 charging stations in India (March 2021) for

~16,200 electric cars, including the fleet segment

Survey find

Key steps to facilitate trade and reduce technical barriers between India and Germany

53% German players supporting 'Make in India' initiative to boost local manufacturing

33% Harmonisation of standards and technical regulations

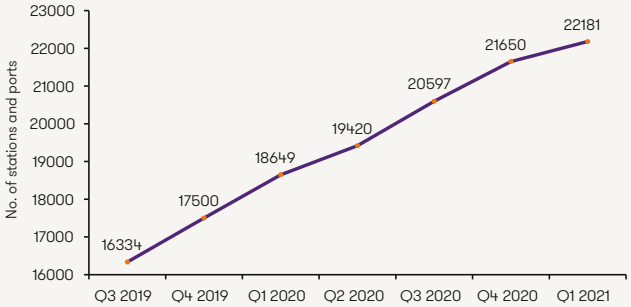
13% Effective operation of Bilateral Working Group on Quality Infrastructure

Global manufacturers have spent millions to improve the availability and efficacy of EV chargers, and as a result the fastest ones today take no more than 15 minutes to recharge a vehicle.

Herein, the cooperation on quality infrastructure demonstrates the strong ties that exist between Germany and India. The policy dialogue with the German Federal Ministry for Economic Affairs would help to reduce technical barriers to trade, enhance product safety and strengthen consumer protection.

Charging stations

Steady increase in charging stations in Germany; over 22,181 stations were active in the first quarter of 2021



India needs about 0.4 million charging stations by 2026 to meet the charging requirement for two million EVs

Based on the strategies deployed globally by countries, a more ambitious and sustained set of policy interventions in India may include:

EV charging infrastructure and EV-"make-ready" investments as part of India's utility reform and smart grid infrastructure investments

Prepare guidelines to improve coordination around EV charging station deployment by establishing processes and communication requirements for cities and states

Improving utilisation of chargers through appropriate siting so that the chargers are used by more EV drivers. Another way to increase utilisation is to build charging stations that support different charging connectors like CCS, CHAdeMO, GB/T

Following in the footsteps of automakers, encourage oil companies to set up EV chargers

Availability of financing options such as accessibility to low interest loans to set up charging stations can help the charger owner-operators during the initial low utilisation years

Improve consumer awareness and education through engagement with non-profit organisations, utilities and state-level funding programmes

Instituting state EV-readiness building code requirements based on the national Model Building Byelaws to ensure that all new buildings are EV-ready

Consumer interface

Understanding consumer adoption of EVs

Global studies focused on the cost of EV, driving distance per charge, time to recharge the battery, availability of charging points and battery cost. Range anxiety and incentives offered-both financial and non-financial-are the other attributes. Thus, most Indian customers could consider buying an EV by 2024 wherein for consumers in India, a price point USD 31,000, a charge time of 35 minutes and a range of 401 kilometres from a single charge are needed to achieve mainstream EV adoption.

	India	Germany	Global average
EV adoption tipping price (USD)	30,572	38,023	35,947
Chare time tipping point (minutes)	35	29	31
Range tipping point (km)	400	392	468
Consumers who believe EVS are more fashionable than ice vehicles (%)	70	40	48

Battery swapping model

The Indian government is also examining the battery swapping option model to overcome the challenges of size and power in EV adoption. Another alternative could be battery leasing that could reduce the ownership cost. However, the easy availability of charging points across different places in a city remains a significant challenge yet unresolved.

Meanwhile, Germany aims to help consumers identify the right recharging option for their battery electric and plug-in hybrid EVs by harmonising labelling across EU, which could be a potential prospective for India as well. Being on charging stations, the labels would also be placed on all newly produced electric cars, vans, trucks, buses, coaches, mopeds, motorcycles, tricycles and quadricycles in a clear and visible manner.

Overall, cross-country and cross-industry stakeholders including automakers, charging station manufacturers, component suppliers, energy providers, grid operators and many others can create partnerships to continue moving towards interoperable charging, where vehicles, chargers and software systems work together and to make the user experience reliable, easy and smooth.

Aftermarket service - are we ready?

The growing global market for EVs, such as ICE-powered equivalents, would require timely, efficient servicing and repair as they age. The aftermarket segment represents an enormous opportunity; but critically only for garages that have invested in the equipment and know how to work safely on these vehicles.

Tires and glass emerge as dominant consumables of the EV era. EVs consume tires at a much higher rate than ICE vehicles. They are heavier and create near-instant torque off the line. While EVs have less of a need to visit a service shop, they'll need tire replacement more often.

This aspect could translate into a service business with labeling its own tires, offerings on a subscription model or offering a guaranteed uptime policy.

Moreover, the core growth drivers of the glass category are similar to tires (increased VMT and vehicle age). This will include all visibility products (windshield glass, wipers, cleaning fluids, headlights and bulbs) as they increasingly tie to on-board technology such as sensors, cameras and as more vehicles add sensors for advanced driver assistance features (ADAS), they won't operate unless they are kept clean. Thus, what used to only mean the windshield and headlights will soon mean dozens of sensors and surfaces that require clear, machine-verified visibility.

EV component recycling

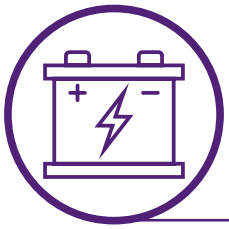
The recycling of Li-ion batteries requires supportive regulations and government enforced laws to ensure smooth collection and recycling of the waste batteries.

Government enforcement and market-based incentives for simplifying the designing process of the battery to facilitate easy disassembling are key in recycling industry. A sound infrastructure to promote collection of dead batteries and innovate technologies for executing the recycling process on a large scale are two essential factors that could escalate the recycling rates of Li-ion batteries.

Germany puts a legal obligation on producers to collect their products from the consumer and deposit them in containers managed by the GRS Batterien Foundation, set up by leading battery manufactures and the German Electrical and Electronics Industry Association in 1998.

Contrary to Germany, India seems to still need adequate legislations that can prevent illegal dumping of spent lithium batteries whereas a cohesive set of rules for the safe disposal of EV batteries is to be included in the most recent legislations. Li-ion batteries need special mention in the framework for end-of-life treatment or recycling, which as of now does not prevails and needs to be brought attention to. Overall, large quantities of EV battery waste in India presents a unique opportunity to nurture a domestic recycling industry, which is currently in its infancy. There are initiatives that can be carried off, such as an Indian Battery Alliance which may be sponsored by the Indian Government and bring together OEMs, battery producers, and battery recyclers to develop partnerships for addressing key sustainability issues.

The efforts by German counterparts thus aim to educate not just producers and active consumers, but also individuals who are future consumers who can be tapped into by Indian OEMs as an ideal of technological progress; however, not at the cost of the environment. The recycling of Li-ion batteries may crucially develop a closed loop system whereby the recovered materials would be reused in the batteries and help in meeting the rising demand for raw materials. Adoption of such measures towards recycling of the batteries would help in reducing the overall emission and energy consumption. In fact, adequate supply of recovered raw materials would help in alleviating the material scarcity and thereby minimise the market price.



The surge in the consumption of Li-ion batteries further emphasises on the disposal of batteries that would or have reached their end-of-life. Most batteries end up in landfill and become a threat to the environment. The global Li-ion battery recycling market is niche when compared with others, such as lead acid batteries. In addition, the lifecycle considerations around battery production, second lives and recycling have important social and environmental consequences that e-mobility programmes in both the countries may seek to address.

German investments in India

Transportation, electrical equipment, metallurgical industries, services, chemicals, construction activity, trading, and automobiles are some of the focused sectors. The top sector attracting investment from German companies is industrial machinery, equipment and tools, followed by chemicals and automotive components, all ranking in the top five across projects, capex and jobs creation.

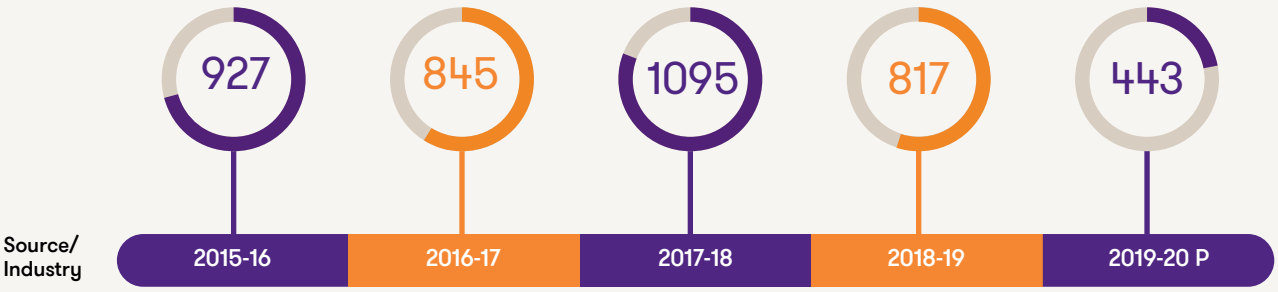
Germany is home to more than 213 Indian subsidiaries, of which about 74 Indian companies, each with an annual turnover of more than Euro 10 million, generates combined annual revenues of approximately Euro 11 billion. Germany has been an integral development cooperation partner of India since 1958. Indian companies operating in Germany, include IT, automotive, pharma and biotech organisations.

More than 1,700 German companies are active in India and over 600 Indo-German joint ventures are in operation.

Growing demand for EVs equipped with smart and automated technologies is driving the electric mobility market in both the countries. Companies are investing in development of vehicles networking, infotainment systems, head-up displays, etc., to enhance vehicle operability.

Germany has persistently been a strong ally to the Indian economy as the sixth most important trading partner of India worldwide.

FDI flows to India from Germany (USD million)



Includes FDI through SIA/FIPB and RBI routes only

Note: The German federal government tightened its Foreign Direct Investment Control Law (draft 17th amendment to the Foreign Trade and Payment Ordinance (AWV). The amendment is expected to include procedural changes to the German government's review process.

Both India and Germany have the potential to generate substantial bilateral trade from lucrative investment affiliations. The new AWV in February 2021, would require a notification if a non-EU acquirer plans to acquire 10% or more of the voting rights in a German company, if it is active in any of the following sectors:

- Goods using artificial intelligence to perform abusive acts
- Autonomous cars or drones or related components
- Industrial robots (including their components)
- Cyber defence IT-products or their components
- Raw materials deemed critical for Germany's economy

Potential bilateral trade

Broader cooperation between India and Germany in technology and R&D

January 2020, a strategic stake acquired in Germany's electric bike maker, HNF Nicolai marked a major step for Hero Cycles, India's largest bicycle producer, aiming to be at the center stage of the European bicycle market.

May 2020, the auto components maker Endurance Technologies Ltd. (one of the leading automotive component manufacturers, with operations both in India and Europe) had fully acquired Italian auto parts manufacturer Grimeca Srl.

July 2020, Precision Camshafts Limited (PRE-CAM), an auto component manufacturer from Solapur, Pune, completed acquisition of its foreign subsidiaries with acquired stakes in the Dutch electric mobility firm, EMOSS Mobile Systems BV and MFT Motoren und Fahrzeugtechnik GmbH, Germany allowed to expand its manufacturing base in the European Market. The acquisition at EMOSS has firmed the stand of PRE-CAM into the EVs.

September 2020, Mahindra & Mahindra Ltd., raised its shareholding in Sampo Rosenlew Oy (a combine harvester company, in the markets of Europe) to 74.97% to provide Sampo with growth opportunities in newer export markets, also enabling to leverage Mahindra's strength in manufacturing, sourcing and distribution.

Hence, with leading multinationals today setting up their R&D centers in India, there is a need for broader and deeper cooperation between India and Germany in technology and R&D. We observe that the German economy is slowly recovering and the government's economic stimulus package worth a total of Euro 130 billion is expected to play a significant role in this development. Moreover, the financial aid and measures have contributed greatly to improving consumer confidence since June 2020.

Going forward, with the Indian government also rapidly simplifying procedures, instituting market reforms and implementing fair, effective and transparent processes to attract foreign investments and cooperation; the investment from Germany would place focused, integrated efforts and initiatives for both. Industries such as industrial automation, robotics and automotives is likely to provide good opportunities for German companies in India.

Focus on start-ups

According to Automotive Component Manufacturers of India (ACMA), automakers need to explore new technologies and focus on start-ups as the industry needs to learn to take risks. Traditional ICE vehicle manufacturers as well as new EV start-ups are investing in setting up new manufacturing lines for EVs and charging equipment and Indian EV start-ups alone have secured USD 601 million in funding during 2014-19.

Case Study: Shared mobility vehicle

A solution for mass electric mobility worldwide has together brought German design and engineering, combined with the quality of a world leading production partner to deliver a reliable and durable electric vehicle at a large scale.

A shared mobility vehicle, created by start-up, builds up on many years of research by a German consortium of leading industry players and institutions, supported by the German Federal Ministry for Economic Affairs and Energy. The research successfully led to six functional research prototypes that received type approval in Germany and have been testing on road since 2017. A series of prototypes have been released that build on industry insights to develop and mass produce a shared mobility vehicle.

The four-wheeled EV is developed from ground up as a light and efficient vehicle. It works with existing 110V/220V electric connections to deliver a range of up to 240 kilometre with 7-8 hours of charging using the standard home plug or just 4-5 hours of charging using the home power plug. Additionally, the vehicle supports rage extender batteries that can add up to 120 kilometre of range with just a manual swap of a set of four batteries, within three minutes.

The organisation learned from a multitude of contributions from taxi, ride-hailing, car-sharing, logistics and even micro-mobility players to arrive at this solution. The solution enables large fleets with low investments, higher utilisation, additional revenue streams and without the limitations of range. It has received declarations of intent from all over the world, covering more than Euro 2 billion in turnover.

Industry speak

Clear and transparent policies. Reduced bureaucracy. More stringent IP laws and building out of smart infrastructure. Additionally, a significant boost to green electricity production is needed in India.

Senior representative, leading OEM

Increased Industry, Academic Institutions and Research institution cooperation for joint product development. Govt. incentives through tax breaks or grants (from both Govts) to facilitate enough cash to research low cost solutions for price sensitive India.

Senior representative, leading component manufacturer

India is a very cost sensitive market. You will have to make sure that the product is affordable to the masses otherwise EV adoption will be very difficult. In addition the charging infrastructure is very important given most people will not have access to recharge in the Vehicles.

A sector expert

Conclusion and key takeaways

Countries at all stages of development may consider to promote the use, adoption and adaptation of technologies, preparing people and firms for what lies ahead. An important requirement is effective national governance. There is a need to create vision, mission and plan for creating as well as shaping the market for inclusive and sustainable innovations.

Looking at the road ahead, India aspires to reach its vision of 100% EVs by 2030. Surely, factors such as increasing government support, decreasing cost of technology, growing interest of the country in EVs, distressing pollution levels, would accelerate India's transition to EVs and enable the government to near its vision. However, there is still a long way to go. India's progress on electric mobility has been commendable, but the transition will certainly take place at a steady pace. What is important is that the right path has been laid and the shift has started to happen.

Moreover, manufacturers and suppliers of the German automotive industry are convinced that there is no long-term alternative to clean and climate-friendly mobility. The objective is to achieve carbon-neutral mobility by 2050, for which the German automotive industry is making its contribution to achieving the climate protection targets globally agreed in Paris.

Key takeaways

Steps to foster EVs	India	Germany
ICE engines to be banned by 2030	✗	✓
Imposition of fines targets for corporate CO2 emissions are exceeded	✗	✓
High import duties	✓	✗
Purchase Incentives/Tax deductions	✓	✓
Sound incentive scheme	✗	✓
Establishing charging infrastructure	✓	✓
State wise and subsidies to OEMs	✓	✓
Economic recovery plan for EVs	✗	✓
Road tax incentive	✓	✗
Bonuses for leasing	✗	✓
Funds to commercial vehicle segment	✗	✓
Fleet exchange program	✗	✓
Funds for battery cell production	✗	✓

GT Analysis

Sustainable innovation between India and Germany

	Shor-term 2025	Medium-term 2030	Long-term 2030
Policies			
 **E-mobility market**	• India-Germany foreign trade agreement focusing e-mobility • Reducing import tariffs	• Policies for EV manufacturing and assembling plants	• Exiting ICE vehicles from the road
 **SME sector**	• Export opportunities for EV components and Li-ion batteries	• Fostered cooperation of KfW with SIDBI to mitigate existing market failures in India	• Executed programmes for energy efficiency and investments in area of green finance
Investment			
 **Charging infrastructure**	• Deeper integration of complete EPC solutions, to multiply EV charging stations • Inducing FAME- Phase II scheme	• Develop new financing instruments for rapid and reliable expansion of quick-charging locations • Develop profitable business models with nationwide network for user acceptance	• Invest in alternative technologies like induction charging • Have charging lane on highways with wireless chargers removing range anxiety
 **Fuel cell technology**	• Cell level manufacturing with collaborations on cutting-edge technologies like LTO batteries from Germany	• Building value chain capabilities from cell, power electronics, motors and boost localisation through SMEs	• Profitable giga battery production with government-industry partnerships
 **Battery**	• Deeper partnership in raw material mining and battery companies	• Alternative sources for supply chain resilience specific to Li-ion • Expanded synergies for GW capacity • Potential battery pack assemblies in India	• To develop a BMS that continuously analyses the battery condition

Investment

Shor-term 2025	Medium-term 2030	Long-term 2030
Smart cities		
• Germany's global development partners to invest in India and find solutions for global challenges such as climate protection*	• Making life in cities of the future more worthwhile with well construed research network and deeper international partnership	• Well-executed, close cooperation in urban infrastructure projects and area-based development

*The 'Sustainable Urban Development Programme – Smart Cities in India' project is supported by the German Federal Ministry for Economic Cooperation and Development (BMZ) and jointly implemented by the Ministry of Housing and Urban Affairs, Government of India and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Start-ups		
• Rise of B2B startups • Fostered exchange within young Indian and German leaders of automotive and EV supply chain • Be a launchpad for start-up-MNC collaboration in skills, research, talent and funding	• Wider participation by local component players. New entrants for rise in domestic EV demand	• Startups' competitive advantage in digital economy. Strengthened Indo-German economic relations in EV startup ecosystem

EV manufacturing

Shor-term 2025	Medium-term 2030	Long-term 2030
AI		
• Develop policy frameworks Ready for AI • Foster joint initiative FAIR forward to strengthen cooperation in AI and digital transformation	• With tech entrepreneurship and 'Make-in India', • innovation experts to have accelerate programs and support AI startups	• Achievement of the sustainable development goals (SDGs) of the UN 2030 Agenda
Digital transformation		
• Focused digital transformation of manufacturing with technological investments, honed skills to drive business value	• Sythesised data to drive digital transformation with effective governance of cloud-based assets and clear visibility into the cost of cloud resources	• Embedding ADP/ Industry 4.0 technologies in manufacturing domain (at shop floor, between supply chain partners and with markets)
R&D		
• Efforts to push the bilateral programs towards funding opportunities	• Deeper international research training groups and research information systems by both nations as per the center's* vision	• Cutting-edge research and technical assistance • Conglomerate and mergers in electronic machinery companies with integrated widespread base

*Indo-German Science & Technology Centre (IGSTC) was established by the Department of Science and Technology (DST), Government of India and the Federal Ministry of Education and Research (BMBF), Germany to foster innovation through Indo-German R&D networking including industrial research partnership in PPP mode

Grant Thornton Analysis

Acronyms

ACEA	European Automobile Manufacturers Association
ADAS	Advanced Driver Assistance
ADP	Advanced Digital Production
AI	Artificial Intelligence
B2B	Business to Business
B2C	Business to Customer
BMS	Battery Management System
CAGR	Compound Annual Growth Rate
CCS	Combined Charging System
CHAdeMO	CHArge de Move
EU	European Union
EV	Electric Vehicle
EPC	Engineering, Procurement And Construction
EVSE	Electric Vehicle Supply Equipment
FAME	Faster Adoption and Manufacturing of (Hybrid &) EVs
FDI	Foreign Direct Investment
FIPB	Foreign Investment Promotion Board
FTA	Foreign Trade Agreement
GB/T	Guojia Biaozhun, meaning "national standard"/T from Chinese language "recommended"
GDP	Gross Domestic Product
GoI	Government of India
HMI	Human Machine Interface
HS codes	Harmonized System Codes
IBS	Intelligent Battery Sensor
ICE	Internal Combustion Engine
IoT	Internet of Things
KfW	Kreditanstalt für Wiederaufbau ("Credit Institute for Reconstruction")
LTO	Lithium Titanium Oxide
MNRE	Ministry of New and Renewable
MoHIPE	Ministry of Heavy Industries and Public Enterprises
NEMMP	National Electric Mobility Mission
NITI Aayog	National Institution for Transforming India
OEM	Original Equipment Manufacturer
PLI	Production Linked Incentive
PMP	Phased Manufacturing Programme
RBI	Reserve Bank of India
R&D	Research and Development
SIA	Secretariat of Industrial Approvals
SIDBI	Small Industries Development Bank of India
SME	Small and Medium Enterprises
SMEV	Society of Manufacturers of Electric Vehicles
STU	State Transport Undertakings
TPMS	Tire Pressure Monitoring System
USD	United States dollar
V2X	Vehicle to Everything
VGI	Vehicle Grid Integration
VMT	Vehicle Miles Travelled

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Economic Times

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Reserve Bank of India

Press Information Bureau India

Ministry of Commerce and Industry in India

Ministry of Heavy Industries & Public Enterprises in India

CEEW - Centre for Energy Finance 2020

Grant Thornton Auto Track Publication

Grant Thornton Deal Tracker

Kraftfahrt-Bundesamt (KBA)

Grant Thornton-FICCI questionnaire based survey on EVs ecosystem in India and Germany (Insights of Industry stakeholders)

Note: The figures in Euros are converted into USD for the purpose of the report. Figures conversion are based on National Stock Exchange (NSE) rate as on April 22, 2021.

Exchange rate (1 Euro = 1.2047104177 United States Dollar).

About Federation of Indian Chambers of Commerce & Industry

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialisation, and its emergence as one of the most rapidly growing global economies.

A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policy makers and civil society, FICCI articulates the views and concerns of industry. It serves its members from the Indian private and public corporate sectors and multinational companies, drawing its strength from diverse regional chambers of commerce and industry across states, reaching out to over 2,50,000 companies.

FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policy makers and the international business community.

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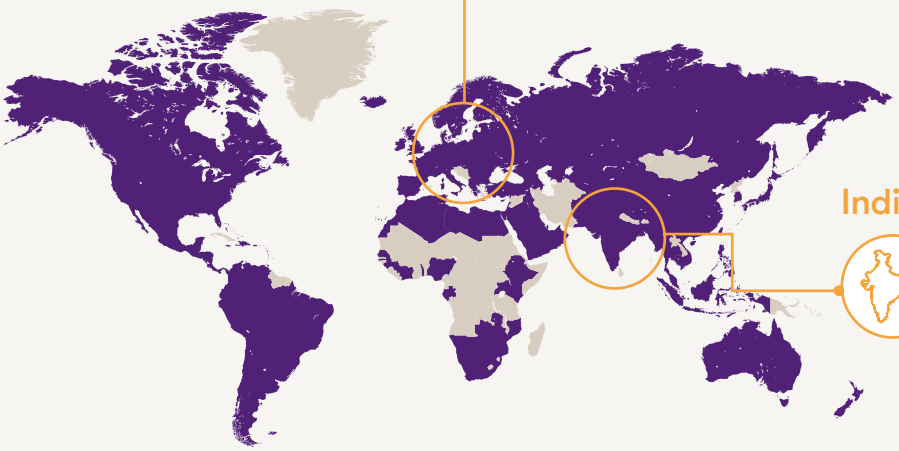
Global snapshot

58,000+
people around the world

130+
countries

USD5.76bn
global revenue (FY2020)

750+
offices globally



Germany

~1,500
people in Germany

11 locations

India

4,500+
people in India

15 offices in **13** locations