Grant Thornton

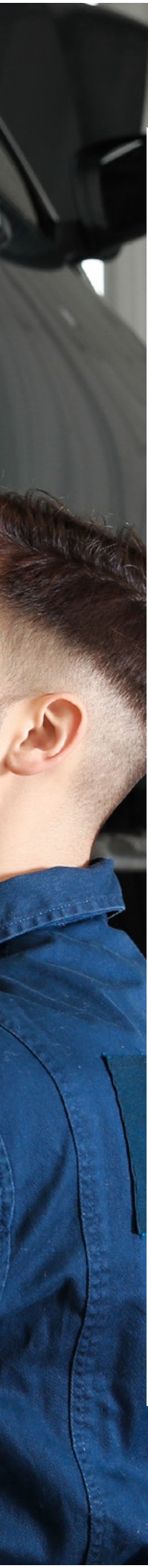
Centre of Excellence for Competitiveness for SMEs

Confederation of Indian Industry

# Sustainable automotive technologies: The road ahead for e-mobility

May 2021

# Contents



# Foreword: Confederation of Indian Industry

**New products and technologies especially the EVs are causing a shift in consumer preferences. The interesting thing to watch out is how fast the traditional companies are learning and adopting e-mobility.**

Technological advancements have been reshaping the manufacturing industry, including automotive manufacturing, over the last few years. Vehicle features that we could only imagine a few years ago have now become a reality.

The Indian automotive industry is one of the fastest-growing markets of the world, accounting for a large share in the Indian economy. The complete manufacturing ecosystem is undergoing a phenomenal shift with technological advancements happening at a fast pace. Understanding and adopting advanced manufacturing techniques to promote e-mobility are the need of the hour.

India's potential to create a new mobility paradigm that is shared, electric and connected could have a significant impact domestically and globally.

Disruptions, new product development and globalisation are changing the landscape of the auto industry. New products and technologies especially the EVs are causing a shift in consumer preferences. The interesting thing to watch out is how fast the traditional companies are learning and adopting e-mobility. The key to survive in the current age of disruption will be to develop new capabilities, adapt to changing customer needs and collaborate across the ecosystem to save environment.

This conference on Sustainable Automotive Technologies - The Road Ahead for E-Mobility will be an ideal platform where all stakeholders from industry will get a common platform for discussion. Industry experts who will be addressing the participants will give insights into the related aspects, and relevant discussions will help get a better understanding of the changes happening in the overall e-mobility industry.

**Naveen Munjal**
Conference Chairman
Managing Director
Hero Electric Vehicles Pvt. Ltd.

# Foreword: Grant Thornton Bharat

**EVs are finally showing implementation in India to a marked extent. There are many positive signals from the government and industry as it strongly pushes the automobile industry towards e-mobility.**

The primary objective behind the government's set-up of at least one e-charging station at each of the fuel pumps across the country is a required boost to electric vehicle (EV) uptake. The number of EVs on the road in India has also started to increase and this has necessitated attention from all stakeholders - original equipment manufacturers, suppliers, dealers and utility players. The shift is incomplete without the deployment of futuristic technologies that would deliver disruptive breakthroughs towards an all-electric future.

After striving to turn the pandemic-induced crisis into an opportunity, the Indian government has pushed for massive penetration of EVs towards green fuel and electricity. Overall, the government is focusing on various measures, including increasing domestic production, promoting the use of alternate fuel options, energy conservation measures, technology advancement to reduce dependence on imported crude oil. Towards demand for clean mobility, the adoption of large-scale technology has accelerated, especially in the wake of the pandemic, where people want to have enhanced air quality and a clean environment.

Moreover, to align the sustainable development goals (SDGs), aggressive targets are set for rolling out EVs and new commitments are being announced regularly, related to policy, technology, finance and partnerships. One of the key enablers for the rapid uptake of EVs is the development of widespread charging infrastructure. While India focuses on achieving its commitments, the key stakeholders in the charging infrastructure landscape need to be prepared to undertake several interventions to address the various technological challenges and gaps that currently exist.

Overall, there is a need for the industry stakeholders to come together and lay the groundwork to increase the adoption of technology and establish a smooth, effective infrastructure for a truly smart and e-mobilised country in the future.


**Saket Mehra**

Partner, Automotive Sector leader
Grant Thornton Bharat


# Overview

The Indian automotive industry is witnessing a profound change with the exponential growth of the e-mobility market. When the COVID-19 pandemic hit the economy, it triggered a decrease in consumer purchasing power and disrupted supply chains, leading to an overall economic slowdown, which wreaked havoc in the industry. While the diesel and petrol segments were the worst hit, one sector showed surprising resilience to the pandemic - EVs.

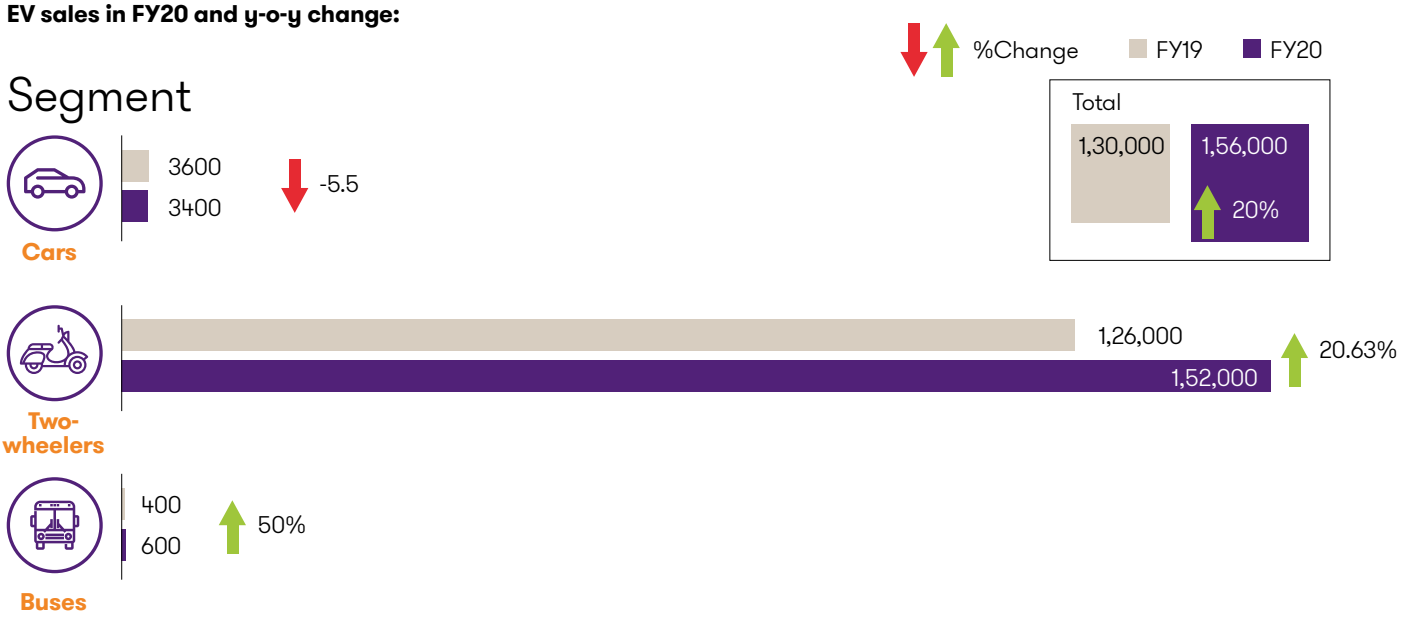
# The state of electric mobility

## CAGR projections by 2026

36%
**Indian EV market**

30%
**EV battery market**

**EV sales in FY20 and y-o-y change:**




**INR 8 trillion**
India's imports of crude oil

**80%**
expected growth in the country's power demand in the next 10 years, with the share of demand from EVs to be less than 0.5%

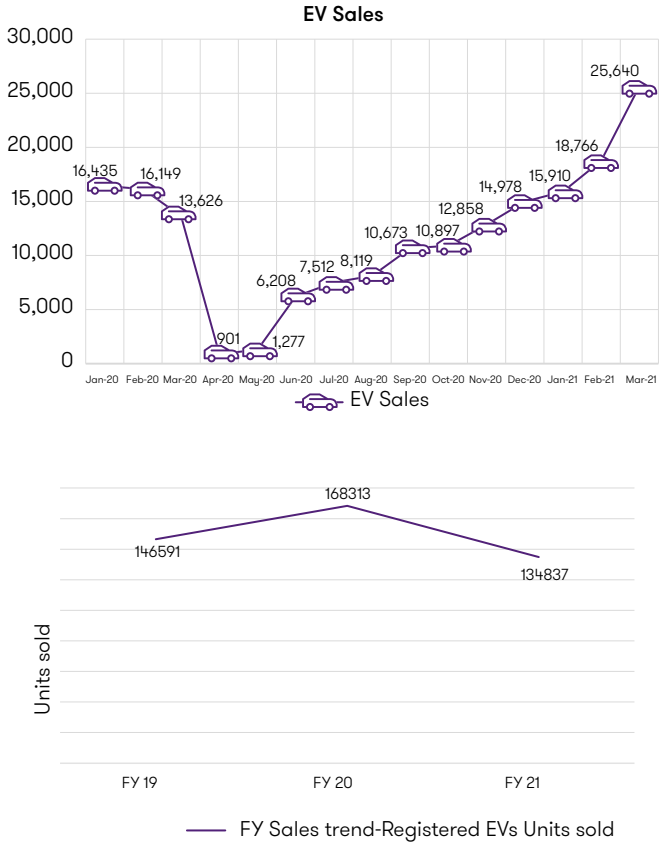
**450 GW**
the target for renewable energy installation by 2030

**22.2%**
projected CAGR of the Indian connected car market, to reach USD 32.5 billion by 2025 from about USD 9.8 billion in 2019

**100%**
foreign direct investment is allowed under the automatic route

**INR 500 billion**
opportunity worth for Indian EV by 2025

**Registered EV sales in India (Jan 2020 – Mar 2021)**




Despite an average 94% q-o-q growth from Q1 to Q4 of FY21, the sales during the corresponding fiscal year declined below that of FY20. The figures even failed to cross the FY19 sales level; where the FY sales record of 1,68,313 units of FY20 witnessed a steep decline by 20%.

# EV sales trends

**25,640 units**
registered EV sales in March 2021

**34.2%**
m-o-m increase

**88.2%**
y-o-y increase of

**1,34,000+**
units registered EVs sales in FY21

**<1%**
EV share in total vehicle sales

# State's role

By making the shift towards EVs, India stands to benefit on many fronts. It has a relative abundance of renewable energy resources and availability of skilled manpower in the technology and manufacturing sectors.

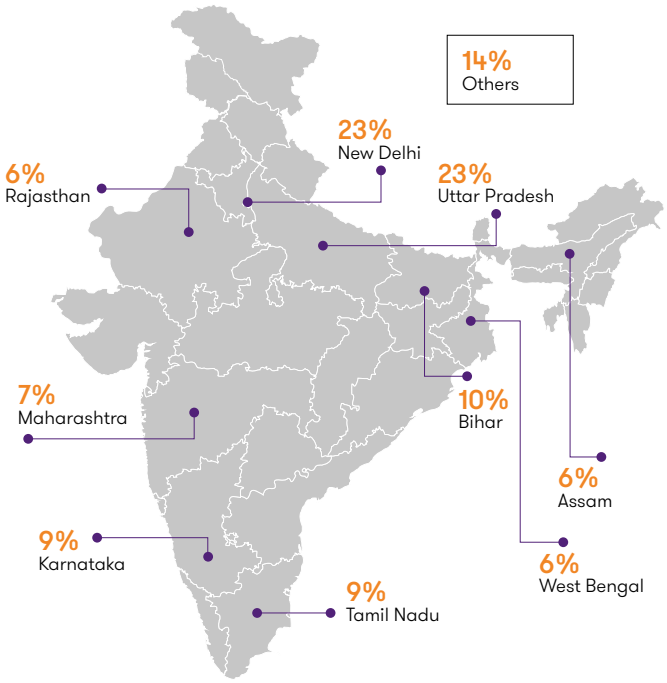
There have also been positive developments in the expansion of charging infrastructure across the country – states such as Andhra Pradesh, Uttar Pradesh, Bihar and Telangana are setting impressive targets for the deployment of public charging infrastructure to increase uptake of EVs in the country.

Nevertheless, while growth in the EV industry is on an upward trend, it has much ground to cover to be able to realise the government's ambitious 2030 target. The COVID-19 pandemic has not only slowed the industry's progress but also dampened the overall market demand. Thus, for total EV sales, after suffering an initial setback in 2020, sales appear to be picking up slowly. In January 2021, 15,910 units of EVs were sold in India, of those, the maximum were sold in Uttar Pradesh, followed by Bihar and Delhi.

With a 23% share, Uttar Pradesh led in the registered EV sales in FY21 among all states/UTs.

Bihar and Karnataka held the second spot with a 10% share. Tamil Nadu (9%) has the third-highest sales for the year.

**State/UT region wise registered EV sales FY 21**




Note: Figures represent EVs registered across 1,286 RTOs in 33 states/ UTs

## Takeaway

Nearly all the state EV policies prioritise 2Ws and 3Ws, public transportation and job creation. However, the policies differ in terms of targets, supply (manufacturing) and demand-side incentives (consumer and charging infrastructure investments). Thus, investing in e-mobility at the national and state level, as part of the economic recovery, would help achieve India's goals to create jobs and combat climate change.

# EV policies

**10 states in India have policies on EVs**

| Policy focus | Demand | Supply | R&D | Charging ecosystem | Technology |
|---|---|---|---|---|---|
| **EV policy highlights** | Conditional demand incentives based on segments, vehicles, and time periods | Lower tarrif on production, subsidies, and tax benefits | Grants and venture funds to research organizations, incubators and startups | Supporting public infrastructure by providing land, subsidy and other support | Financial support for growth of newer technologies in vehicle and charging space |
| **Andhra Pradesh** | | ✓ | ✓ | ✓ | ✓ |
| **Bihar** | ✓ | | ✓ | ✓ | |
| **Delhi** | ✓ | | ✓ | ✓ | ✓ |
| **Karnataka** | | ✓ | ✓ | ✓ | |
| **Kerala** | ✓ | ✓ | ✓ | ✓ | |
| **Maharashtra** | ✓ | ✓ | ✓ | | |
| **Uttarakhand** | ✓ | ✓ | ✓ | ✓ | |
| **Uttar Pradesh** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Tamil Nadu** | ✓ | ✓ | ✓ | ✓ | |
| **Telangana** | | | ✓ | ✓ | |


Electric Vehicle
By Charging Infrastructure
Charging Infrastructure
Super Charger
Slow Charger
Fast Charger
Wireless Charger
By Vehicle Type
Passenger Cars
LCV
Buses & Trucks
Electric Motor
Series
Brushless
Brushed
Shunt
Synchronous
Induction
By EV Components
Fuel Call Stack
Battery
Lead acid battery
Lithium Battery
Nickel-Metal Hydride Batteries
Ultracapacitors
DC/DC Converter
Motor Controller
Automatic
Manual
Microcontroller
By EV Propulsion Type
FCEV
Components
Fuel Tank
Power Conditioner
Battery Pack
Fuel Cell Stack
HEV
BEV
Plug-in Hybrid
Full Hybrid
Mild Hybrid
Micro Hybrid

# I. Development of EV technologies

EVs are propelled by one or more electric motors, drawing power from an onboard source of electricity, typically batteries, as they are environment-friendly and diversify energy sources from petroleum. In an Indian context, the deployment of the EV ecosystem is at its nascent stage, and they are less than 1% of the total vehicle population. On the other hand, countries across the globe took a head-start driven by incentives and strong mandates to reduce greenhouse gas (GHG) emissions.

Overall, India's national missions to advance renewables, smart grid demand flexibility, EVs provide pathways for sustainable development. The Indian central and state governments' policies — National Solar Mission (NSM), National Electric Mobility Mission (NEMM), National Smart Grid Mission (NSGM) and others are in the process of implementation. Within these distributed energy resources (DERs), EV and their demand management play a key role in economics and reliability in reducing carbon emissions. Thus, enabling a more sustainable future through the e-mobility ecosystem requires an automotive engineering paradigm shift.

## Accelerating EV market growth

**Charging infrastructure**

**Renewable energy and smart grid**

**Connected car and mobile phone applications**

## EV energy service goals

**Supply EV with renewable $CO^2$-free energy**

**Protect customer from undesired actions of third parties while charging**

**Maintain complete control of communication to the vehicle and access to batteries**

**Explore sustainable business models with technical solutions that can be deployed worldwide**

## Key challenges

A few technologies can disrupt the automotive industry in the next few years. However, they would pose some challenges that will require innovative solutions:

### Power devices

New test methods are needed to produce reliable and repeatable measurements of new wide band gap semiconductors used in EVs

### Power conversion

One of the most noticeable changes in vehicle electrification is the addition of high-voltage, high-power batteries to a platform

### Cells and batteries

While much progress has been made to extend the mileage range of EVs, mass adoption of the e-mobility ecosystem will require cells and batteries with even better range performance while meeting the high safety requirements and maintaining affordable margins

### EV-to-grid communication

Charging stations, home energy management systems, microgrids and smart grids all play a vital role in this ecosystem and require new approaches to support the mass adoption of an e-mobility future

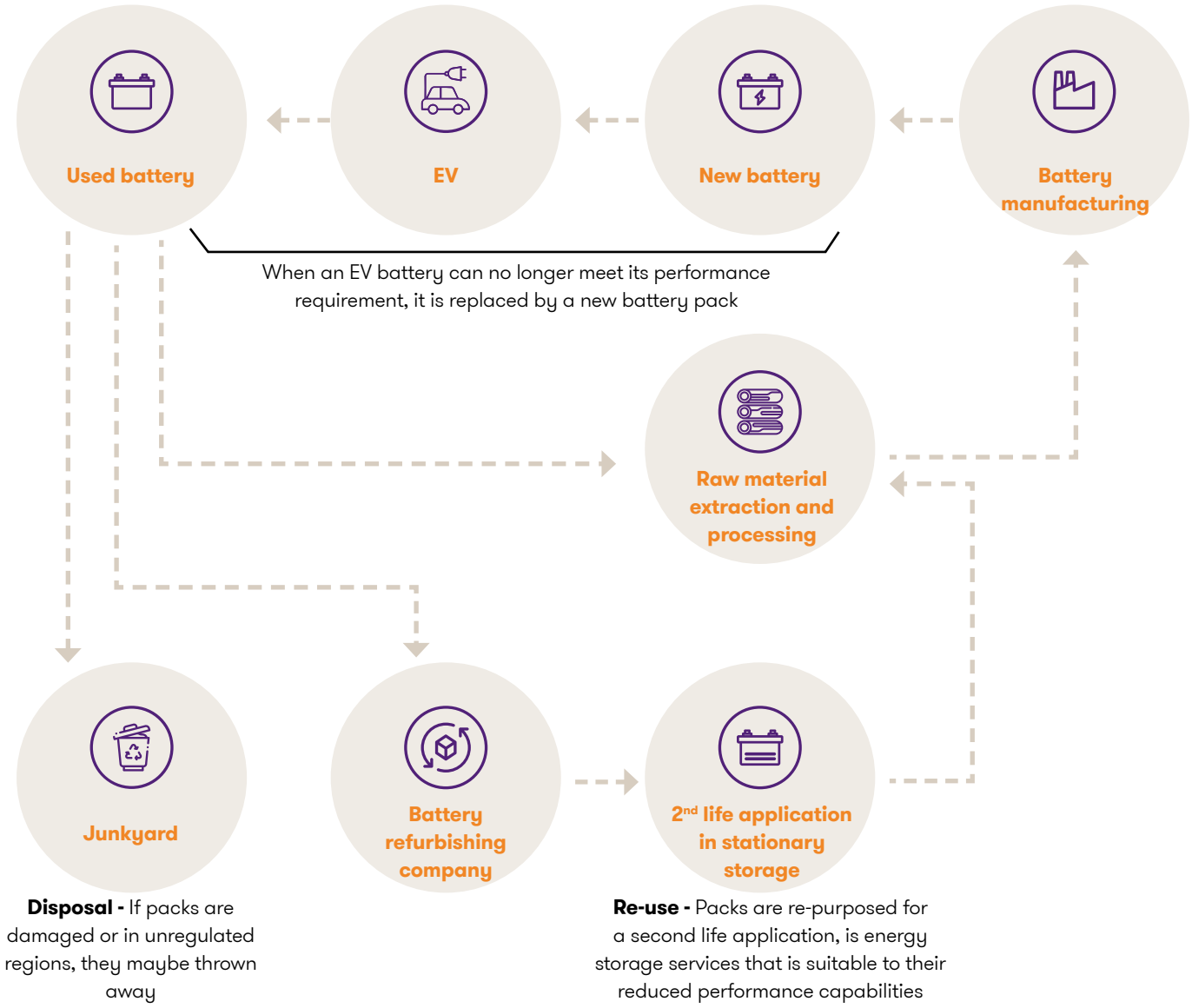
Newer and better electric drivetrains are likely to satisfy consumer demands and fulfill the incentive criteria offered by governments, such as fuel economy and longer ranges. As a result, the coming years are likely to see exciting innovations in better power devices, cells, batteries and a larger charging infrastructure, including better ways to harness natural energy sources to fuel automobile technologies.

## Setting up battery recycling capabilities

India needs to step up its battery recycling capabilities. Although the government has updated its e-waste management policies in 2018, the rules do not cover lithium batteries. The policy's recycling guidelines only apply to lead-acid batteries. The enforcement of these rules is difficult due to poor e-waste generation rates and informal reclamation.

The country is underprepared for the volume of EV battery waste expected in the coming decade. Most of the e-waste in India is dumped in landfills. Further, there is a need for adequate legislation that can prevent illegal dumping of spent lithium batteries. The most recent legislations — the E-waste (Management and Handling) Rules, 2011, E-waste (Management and Handling) Rules, 2016 and E-waste (Management) Amendment Rules, 2018 — evolved considerably in terms of the range of materials. They need to include a cohesive set of rules for the safe disposal of EV batteries.

**EV battery life cycle**




**The Indian battery manufacturers and start-ups may have to step up and collaborate to solve this issue as the end life of batteries tends to impact sustainability and the value chain of materials. The electricity demand is increasing in India, which will increase the operational costs of EVs in the coming years. India may control rising electric energy costs by recycling battery materials and reusing batteries.**

City planners, municipal bodies, local administrative bodies, electricity companies, government and automotive companies need to build a comprehensive policy document to meet future demands of EVs.

## Battery swapping technology

Despite the fact that the FAME-II policy gives importance to charging stations, the government and automakers may also provide serious consideration to invest in battery swapping technology. From a user perspective, battery-swapping stations may function like fuel stations. They would change batteries when charge is low and offer greater flexibility for EVs in general. At the swapping stations, EVs would have different levels of degradation of batteries, and it may be difficult for operators to gauge and monitor these levels for a swap.

However, there are several practical challenges associated with setting up this system. Batteries may be standardised and made interoperable with all EVs for easy removal and reattachment. This may constrain manufacturers when it comes to design and innovations.

Further, the ownership of the battery may shift to the swapping station operator and the prices and the cost of a battery in such a scenario might be comparable to petrol or other fossil fuels. This might discourage users to buy EVs in general and opt for the more familiar internal combustion (IC) vehicles, defeating the larger mandate of cutting carbon emissions.

## Sensors collecting data

Modern EVs are phones/tablets mounted on a chassis with a giant battery, a motor, some wheels and many sensors that collect data. EV manufacturers would become digitech companies than traditional automakers. They would constantly collect data about battery charge, discharge, temperature, power, acceleration, top speed, passenger weight and additional loads through sensors to feed into their battery management software.

A leading electric scooter company said  their product has 46 sensors generating data on various components to assess riding behaviour and patterns. The data collected through these sensors are crucial to monitor a battery's performance and provide accurate information to the riders about the range. Modern EVs are equipped with GPS for maps services and eSIMs to transmit vehicle data and update various software controlling the vehicle. With such features, it extends the surveillance capabilities of companies and the state dramatically. Cybersecurity concerns will also be amplified. However, data collected from these vehicles would prove valuable for the companies and they would use it to make the product better and build new functionalities and open businesses.

## Data linking: A crucial monitoring aspect

The data and driving patterns collected from vehicles may also be linked to motor vehicle insurance. In India, a leading self-driving car rental company equips its vehicles with camera and driver assistance systems and has partnered with an insurance company. It is unclear whether the data collected will be used to adjust insurance premiums but the ethics of the practice may be questionable and may lead to increased algorithm biases.

Moreover, state surveillance capabilities are also enhanced with the proliferation of EVs with the use of eSIMs. More EVs on Indian roads would be beneficial for telecom companies with the issue of eSIMs and would open new use cases for the expensive 5G technology infrastructure. However, they are subject to regulations from the Telecom Regulatory Authority of India (TRAI).

Thus, in the current environment, it isn't hard to imagine a scenario where the government may mandate telecom companies to build backdoors into EVs to fulfill the security and lawful interception and monitoring conditions of their licence agreements. India also has the ignominious distinction of having the most number of Internet shutdowns in the world. If these shutdowns are extended to eSIMs on EVs, it would impinge on the fundamental right to movement. Hence, a comprehensive personal data protection law is needed to mitigate such concerns and allow companies to collect data that is only necessary. The state needs to balance the security requirements for EVs to ensure that the fundamental rights of users are protected.

## Boost to EV R&D in India

### Boost to EV R&D in India

The government needs to create an alternative to generate electricity for fueling EVs since electricity for vehicles is only as clean as the fuel that is used to produce it. The **USA produces 66% of the electricity from fossil fuel, Germany 50%, and India almost 60%**. We cannot use thermal or fossil fuel to produce electricity to power EVs. It can cause more damage to the environment. Thus, electricity for EVs needs to be generated using renewable sources such as biogas, solar power. The government may consider taking initiatives for creating more renewable energy sources across the country. In India, the R&D of EVs is quite low because of fewer resources with knowledge on EV concepts. The governments of various states in India may also create additional sources for awareness and research on EVs. These resources will be used for R&D in manufacturing units, which would further boost EV R&D in India.

**The ISRO recently designed highly efficient batteries. The government has decided to use its technology to manufacture batteries for the EV sector under licensed production.**

# II. Stimulating demand for EVs in India

To stimulate the demand for EVs in India, it is vital to develop a better understanding of key adoption factors, which significantly influence the market segment in the economy. There is a need to systematically analyse the leading factors for induced adoption and use of EVs in the country.

## Induce e-mobility in differentiated vehicle segments

Globally, original equipment manufacturers (OEMs) have been leading the charge for EV adoption. In the Indian context, with a large population comfortable to use 2Ws for daily commuting, focus on the production of electric two-wheelers (e2Ws) is important.

Three-wheelers are also an essential part of public transport in India. Most e2Ws and e3Ws have a range of around 80–100 km per charge and the economics of EVs is expected to fit into this scenario. For primary inducement, there is a need for advanced battery technology to handle the passenger load. Also, with buses, range tends to decrease with more passengers and weight.

Reading this trend, majorly e2Ws and e3Ws companies applied for the FAME-II scheme. Marquee 2W manufacturers in India have released their e2W products in the market and now compete with newer companies. For incumbents, these new products might also see success in Southeast Asian countries, which also have a thriving 2W and 3W culture and contribute significantly to the nation's exports.

However, hurdles still exist for e4Ws. In India, the product's design is quite relevant. With additional battery packs, these will need to be charged often, which will make it difficult for such vehicles to be able to find use beyond city boundaries.

## Invest in research for battery technology and materials sciences

There is a need for significant investments in material science research towards manufacturing and processing technology. With new battery chemistries, the energy storage would be enhanced at the individual and grid levels and it would further enable higher renewable energy utilisation.

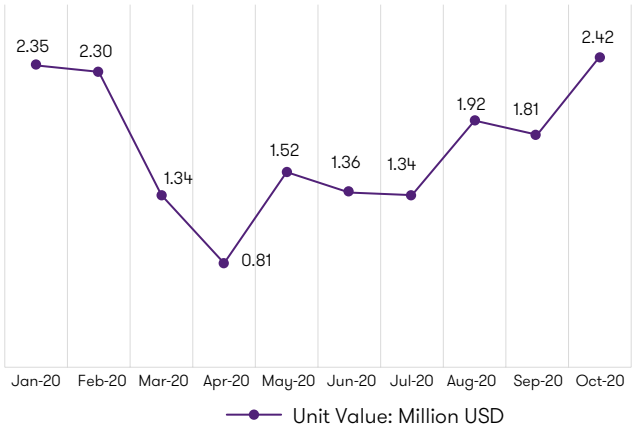
Improving battery technology involves innovation in the current standard lithium-ion and other future components like metal-air, metal-ion and solid-state batteries. Hydrogen and solid-oxide fuel cells are also quite promising to replace conventional internal combustion engine-based transport. Apart from these new modes, lightweight design also necessitates innovation in hybrid materials, composites and alloys.

### The market for lithium-ion batteries in India is expected to grow at a CAGR of 12.47% during 2021-2026

For India, all its lithium needs are imported where all commercial EVs run on lithium-based batteries. Lithium discovery is a crucial step to making India self-reliant in the renewable sector and achieves our energy goals. Although 14,000 tonnes of lithium reserves have been found in Mandya, Karnataka, we need sufficient reserves to keep up with the future demand. However, lithium extraction is very intensive and harmful to the environment as it seeps into water sources and damage natural ecology. Further exploration for lithium reserves in the country will be expensive, as lithium is a rare earth metal found with other radioactive elements beryllium, niobium and tantalum.

**As of January 2021, the Department of Atomic Energy has discovered 1600 kg Lithium in Mandla district of Karnataka**

**Importation of lithium batteries in India from the world**




At 2.10 crore tonnes, Bolivia has the largest reserves of lithium in the world, followed by Argentina, which has 1.70 crore tonnes of lithium. While India and Bolivia are in talks for a joint manufacturing base for the batteries, both Chile and Argentina are in talks for exploration and exports of lithium. It is, therefore, important from a strategic perspective to stop depending on global players for these elements. India has a long way to go in terms of research and study of potential deposits.

**Automotive giants and start-ups are playing a major role in the development of indigenous lithium-Ion batteries under the Make in India scheme to lower the initial cost of EVs in India.**

## Investment in alternative battery technologies

### Is aluminium an alternative?

India is the fourth-largest producer of aluminium. It is also cheaper than lithium and cuts the costs of EVs. Aluminium batteries have shown they have more energy density than lithium ones, which translates into a longer range for EVs.

This is primarily due to aluminium's valency of +3 compared to lithium's +1, which makes ion exchange more efficient. There are mainly two types of batteries with this metal- aluminium ion (which are rechargeable) and aluminium air (which are non-rechargeable). Both have challenges with shelf life and more research in materials sciences is needed for better designs.

Charging EVs takes several hours. However, primary, non-rechargeable batteries like aluminium-air offers much higher ranges and capacity, giving them a distinct advantage.

**Thus, the industry, academia and government need to come forward with an extensive policy to promote alternative batteries for sustainable EVs.**

# Readiness to switch over to EVs

The demand for e-mobility is rising due to its ability to augment itself and interconnect with other technologies. This is likely to drive new customer relationships and service opportunities. Mainstreaming of EVs could transform Indian commutes. So the focus should be last-mile connectivity and public transportation to bring EVs to the mainstream.

The authorities need to consider lowering import/export taxes on EVs and charging infrastructure. The relaxation of the requirements under FAME II policy, combined with offsetting incentives associated with non-EV vehicles could be beneficial in lowering prices for consumers. This will allow the necessary equipment manufactured outside India to enter the market.

The light mobility segments of two/three-wheelers and commercial vehicle will be leading EV penetration in India by 2030.

Though India is still at its nascent stage in terms of EV penetration, a range of policies, guidelines, and regulatory orders have been initiated to address some of these requirements.

## EV penetration India

Several gaps in the four-wheeler EV market, such as a limited number of products, high prices, insufficient battery promise, low performance and an underdeveloped charging ecosystem, are yet to be filled. Given these impediments, the growth of EV four-wheelers is expected to lag behind other segments. Sales are expected to pick up once these gaps are plugged.

By adopting EVs, India can save up to INR 8 trillion on oil imports by 2035.

87% of the country's automotive fuel is imported from other countries.

**Segment-wise analysis – EV penetration in India**

| Segment | | EV penetration % | |
|---|---|---|---|
| | | 2025 | 2030 |
| **2W** | | 7-10% | 25-35% |
| **3W** | | 35-45% | 65-75% |
| **4W-PV** | Personal | 1-3% | 10-15% |
| | Commercial | 5-10% | 20-30% |
| **Buses** | State Transport Undertakings (STUs) | 15-25% | 25-40% |

**The following factors together make a strong case for EV adoption in India**

| | Current scenario | Futuristic scenario |
|---|---|---|
| **Value/price premium** | India's auto market shows high sensitivity toward cost | This is shaping consumers' preference for cost-effective mobility options |
| **Awareness** | A conscious move toward cleaner mobility with growing awareness and greater focus across the world | Efforts are under way to upgrade traditional internal combustion engine (ICE) vehicles and their fuels, and EVs are a strong replacement |
| **Mass transit** | Public transport coverage, though currently limited, is growing fast — generating a need for last-mile connectivity and creating new customer segments | High potential for EVs in the form of last-mile transport needs, including electric two-wheelers and three-wheelers, quadricycles, and feeder buses |
| **Driving range** | Safety concern with battery technology | A well-established charging network would increase EV adoption, relieve range anxiety of consumers, and reduce the inconveniences associated with charging |
| **Congestion** | Population growth and urbanisation have fueled the demand for mobility and added to congestion | Promoting shared utilisation of the asset to improve the EV proposition |
| **Comfort** | There is strong demand for comfort and convenience during a commute. Even for public transport, people prefer metro services or comfortable low-floor buses to older fleets | Manufacturers would align their products with consumers' shifting preferences and needs |

## Few regulatory and fiscal measures to underpin the deployment of EVs

**The Union government is also focusing on other alternative technologies, such as hydrogen fuel cell-driven EVs, besides announcing a scrappage scheme to help boost manufacturing of EVs for exports**

**FAME-II scheme aims to bring 7,000 electric buses on the road**

**E-commerce companies to shift their goods delivery fleet to electric**

**Tax deductions: A deduction for interest payments up to INR 1,50,000 is available under Section 80EEB of the Income-tax Act**

**Vehicle scrappage policy: Paving the way for the higher adoption of EVs**

**Allocation of INR 80 billion in Union Budget 2021 to procure 20000 buses to strengthen public transport is encouraging for the industry. The scheme could strengthen the EV industry if more number of e-buses could be supported through the scheme**

**Possible reduction of goods and services tax on EVs to 5%**

# III. Strengthen the charging infrastructure

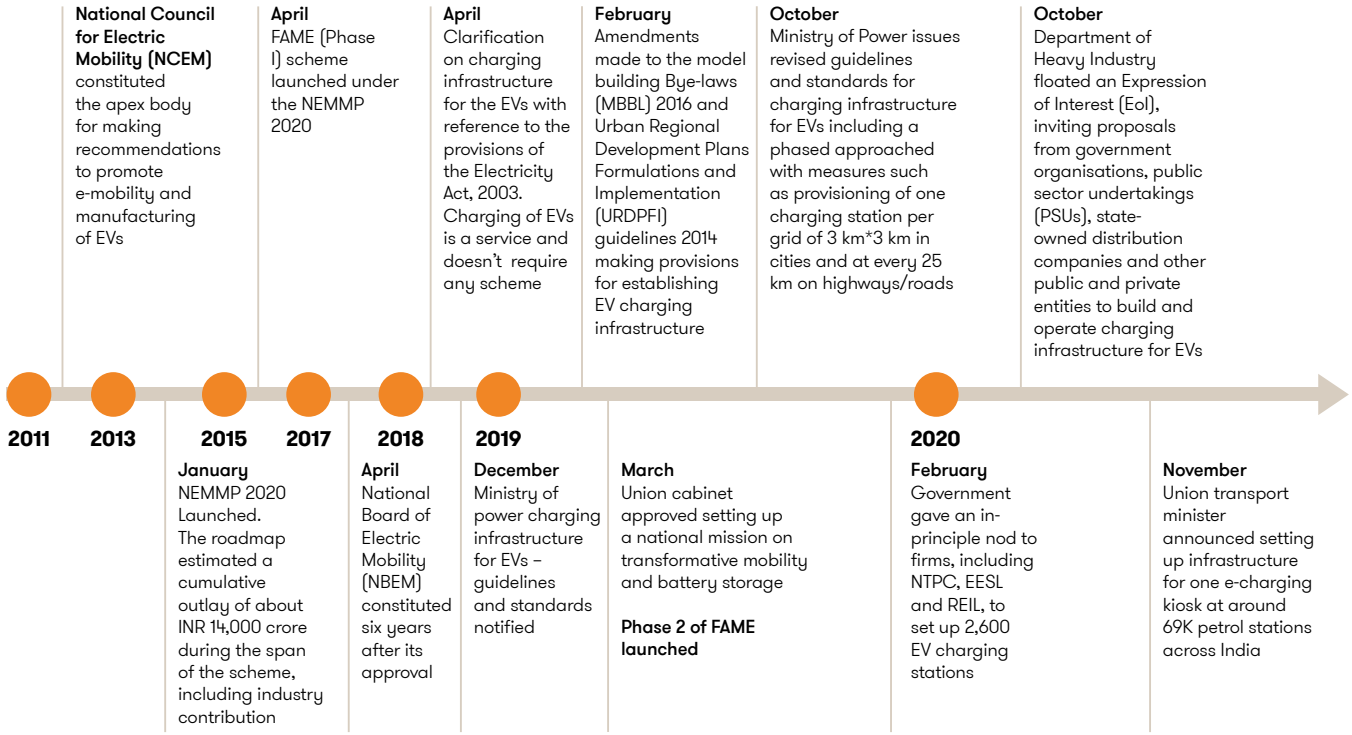
In India, the limited availability of charging infrastructure seems to be a major impediment to the increased adoption of EVs. The role of charging infrastructure is to accelerate the shift from conventional to electric transport. The deployment of charging infrastructure is essential to facilitate the uptake of hybrid EVs (xEVs) and the sustainable development of the EV industry. Thus, there is a need to support local governments, public infrastructure providers and OEMs in search for the right charging infrastructure to fulfill their project needs for mass adoption across the country. While a supportive framework is being put in place, utilities in India would have to prepare for meeting the challenges in managing EVSE integration in distribution networks.

The government has pushed for the deployment of EV charging stations by providing capital subsidy through Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) in India, Electric Vehicle Supply Equipment (EVSE) India Scheme Phase II and state-level initiatives. Further, the government has delicenced the activity of setting up EV charging stations to increase private sector investments and facilitate market adoption. Thus, in the coming years, there will be sufficient availability of public charging stations (PCS) for EV owners.

## Powering up

| Charging stations installed during |
|---|
| FAME I - 314 |
| FAME II - 2,867 |
| Up 900% |

**Policy roadmap for EV charging infrastructure in India**




1. Source: DHI, MoP, MoP, MoHUA, Niti Aayog

## Standards for charging equipment

As per the government's notification*, public charging stations shall install both European Combined Charging System (CCS) and Japanese CHAdeMO charging platforms in addition to the Indian Bharat Standard (BS). Of the three standards, BS utilises low voltage charging technology (72 volts–100 volts). Whereas CCS and CHAdeMO Standards utilise high voltage technology (200 volts and above).

* Notification vide No. 12/2/2018-EV dated 14 December 2018.

Globally, the world of electric vehicle charging standards has been fragmented, but over time, some leading standards are emerging. CCS is primarily being driven by European and North American auto manufacturers. China, which has developed its own standard known as GB/T, is now collaborating with Japanese CHAdeMO to develop a next-gen ultra-fast EV charging standard.

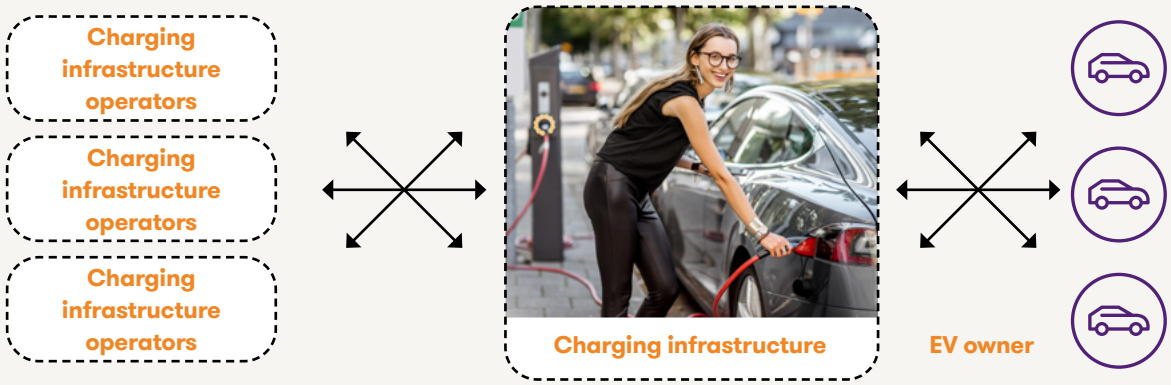
## Presence of EVs in distribution grids

Globally, and even more so in India, there is a dearth in understanding the grid impacts caused by EVs. Though EVs may have a manageable impact on the power grid as a whole, the locational and temporal coincident demand impacts can be significant. At the distribution system level, simultaneous charging of many EVs under a distribution transformer (DT) circuit can overload if the DT does not have the capacity for aggregated charging. The high-density energy storage charging of EVs requires low- to high-level electricity, which can affect the DT and the low voltage distribution system. The EV fleet across DTs when charged simultaneously can demand a significant proportion of the daily load from the distribution grid. Some EV-specific charging challenges to the grid are:

1 Excess distribution system demand
2 Increase in location and temporal system peaks
3 Demand forecasting barriers from variable demand
4 Increased variability from distributed generation

**Leveraging the EVs as a DER grid asset can alleviate the causality from these challenges. Their adoption must consider charging infrastructure integration to ensure grid impacts and interoperability needs are factored.**

**Interoperability among EV Infrastructure and ownership models**



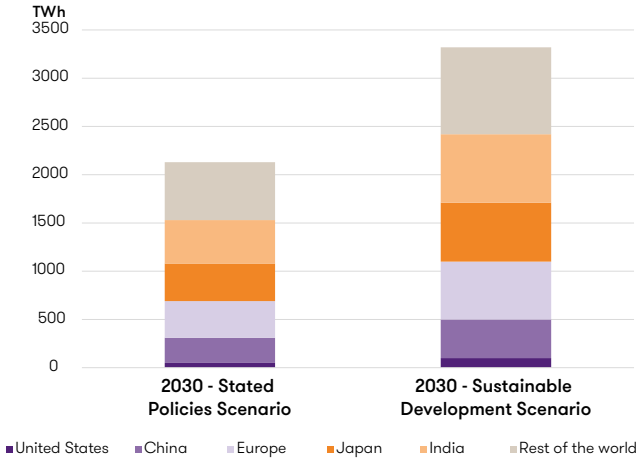
Specific to India, the state of charging infrastructure needs to be reviewed to understand the integration with the grid and flexibility service capabilities. Considering the EV charging infrastructure, demand response (DR) may play an important role in balancing the grid and providing better renewable integration opportunities. For example, stopping and starting EV charging as needed through smart charging mechanisms and advanced communication and actuation technologies.

A smart grid solution that integrates EV load management with other DR load controls is likely to allow a utility to fully optimise the demand side of the electricity equation to manage supply requirements. An EV aggregator may be able to support utility to manage thousands of vehicles, tapering off charging when the grid operator signals that demand is high, and paying customers for the right to manage their charging — while guaranteeing that vehicles are adequately charged when needed.

With a cumulative projected demand of 265 GW and annual energy use of 290 TWh by 2030, a combination of dynamic utility rate tariffs and advanced technologies will play a significant role in demand management and sustainable EV growth. **Policy interventions on the use of retired batteries for grid services must be considered in the EV costs so that the buyers of second-hand batteries can underwrite the partial cost of EV batteries that will reduce the first cost of EVs.**

## EVs increase electricity demand but reduce oil demand and well-to-wheel GHG emissions

**Electricity demand from the electric vehicle fleet by country and region, 2030**




In 2030, in the Stated Policies Scenario, global electricity demand from EVs (including 2/3Ws) is likely to reach 550 TWh, about a six-fold rise from 2019 levels.

The share of demand due to EVs in total electricity consumption at a national/regional level is growing as high as 4% in Europe. In the sustainable development scenario, with demand rising nearly eleven-fold relative to 2019, to almost 1 000 TWh, the share of total demand ranges from 2% in Japan to 6% in Europe.

As the leading automotive nations drive e-mobility forward, the world would witness the overall demand for EVs, including battery cells rise. The market negotiating power of the leading producers would also see a huge surge. As a result, OEMs will need the right and sustainable automotive technologies and strategies.

# Conclusion

The regulations and incentives introduced by the central and state governments, clearly establish India's intention to promote EVs and develop India into a manufacturing hub for EVs. This will organically open many opportunities for private players to get into the EV space, both for manufacturing and charging of EVs (including strategic technology collaborations). Thus, support from the state government and local transport authorities will be critical for creating and implementing a robust EV ecosystem in India.

For the adoption of EVs, both the central and state governments need to collaborate further and align their policies towards making e-mobility affordable and quicker to charge, with an extended battery range for consumers. The government should seek ways to take these measures by highlighting the importance of importing high-quality manufacturing and charging equipment into India.

Overall, a balance would need to be struck, which would not only catalyse a homegrown EV ecosystem but also lead the way towards sustainable growth and development.

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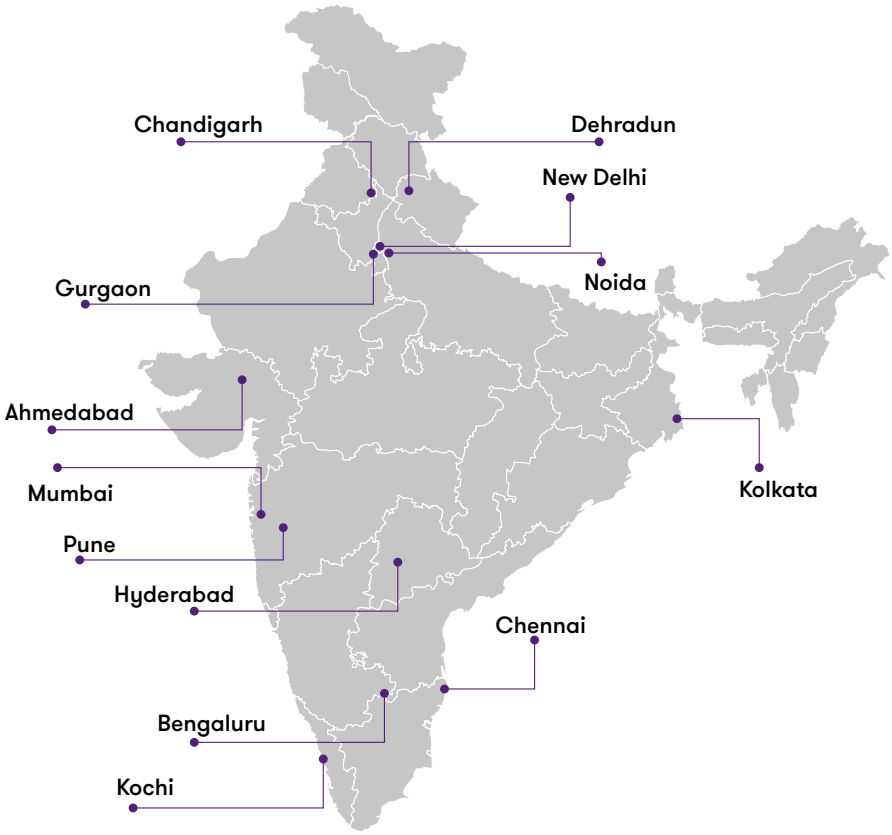

# About CII

Confederation of Indian Industry

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government and civil society, through advisory and consultative processes. For 125 years, CII has been working on shaping India's development journey and, this year, more than ever before, it will continue to proactively transform Indian industry's engagement in national development.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, with about 9100 members from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 300,000 enterprises from 288 national and regional sectoral industry bodies.

CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

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With the Theme for 2020-21 as Building India for a New World: Lives, Livelihood, Growth, CII will work with Government and industry to bring back growth to the economy and mitigate the enormous human cost of the pandemic by protecting jobs and livelihoods.

With 68 offices, including 10 Centres of Excellence, in India, and 8 overseas offices in Australia, Egypt, Germany, Indonesia, Singapore, UAE, UK, and USA, as well as institutional partnerships with 394 counterpart organizations in 133 countries, CII serves as a reference point for Indian industry and the international business community.

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Established in 2004, today Chandigarh based CII- Centre of Excellence for Competitiveness for SMEs is a single point of reference for meeting the needs of small and medium enterprises for enhancing SME competitiveness. With a pan India approach, the Centre plays role of a guide and mentor for SMEs by its 'Cluster Approach', which enables SMEs to learn through sharing of knowledge with other Cluster companies. Best Practices and a detailed road map for enhancing productivity and efficiency of Cluster companies is charted and implemented by the seasoned counselors of the Centre. The Centre works exclusively to enhance the competitiveness of MSMEs, Technology adoption , Zero Defect Manufacturing, Energy Excellence , Build profitability and Growth , inculcating culture of improvement , Corrosion prevention services etc. . Our Pro-active International Engagements ensure that we are in tune with the cutting edge of global Competitiveness in order to transmit the same to the Indian SMEs. More than 300+. Training programmes have been held in the last 5 years, benefitting more than 10000+ delegates.

Services Offered:w Service delivery is through a co-ordinated and participative approach. The Centre works closely with industry via training, counseling, sharing best practices, study missions through class room learning and shop floor approach. The major services offered by Centre are:

— Manufacturing Excellence via Cluster Approach on Lean, Basic, Advance, ZED, Digitech and LCA

— HR Management via improving Total Employee involvement & inculcate improvement culture

— Energy Audits and Management via Energy Audit & Training

— Corrosion Management via Corrosion training, workshop and Audit

# Glossary

| | |
|---|---|
| BEV | Battery electric vehicle |
| BS | Bharat Standard |
| CAGR | Compound Annual Growth Rate |
| CCS | Combined Charging System |
| CHAdeMO | CHArge de MOve, equivalent to move using charge |
| DC | Direct current |
| DER | Distributed energy resources |
| DR | Demand response |
| DT | Distribution transformer |
| EV | Electric vehicle |
| ICE | Internal combustion engine |
| e2Ws | electric two-wheelers |
| e3Ws | electric three-wheelers |
| e4Ws | electric four-wheelers |
| eSIMs | embedded-SIM |
| EVSE | Electric Vehicle Supply Equipment |
| FAME | Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles India |
| FCEV | Fuel Cell Electric Vehicles |
| GB/T | Guobiao standards (GB), (T from Chinese language; tuījiàn; 'recommended'). |
| GHG | Greenhouse gas |
| GoI | Government of India |
| GPS | Global positioning system |
| HEV | Hybrid Electric Vehicles |
| ISRO | Indian Space Research Organisation |
| LCV | Light Commercial Vehicle |
| MBBL | Model Building Bye Laws |
| NEMMP | National Electric Mobility Mission Plan |
| OEMs | Original equipment manufacturers |
| PCS | Public Charging Stations |
| PHEV | Plug-in hybrid electric vehicles |
| R&D | Research and Development |
| SDGs | Sustainable Development Goals |
| STU | State Transport Undertakings |
| TRAI | Telecom Regulatory Authority of India |
| URDPFI | Urban Regional Development Plans Formulations and Implementation |

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CEEW Centre for Energy Finance (CEEW-CEF)
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