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Current Indian Car Market and EV Adaptation

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I. INTRODUCTION

Indian automotive industry is one of the largest automotive industries in the world. It accounts for 7.1% of the country's total Gross Domestic Product (GDP). India is a flourishing automobile exporter to its neighboring countries such as Africa, Bangladesh and Sri Lanka among others and has string export progression prospects for the nearby future. India automotive industry is also anticipated to undergo major changes in the form of electric vehicles (EVs), shared mobility, Bharat Stage-VI emission and new safety norms which will majorly influence the development of automobile industry in the country.

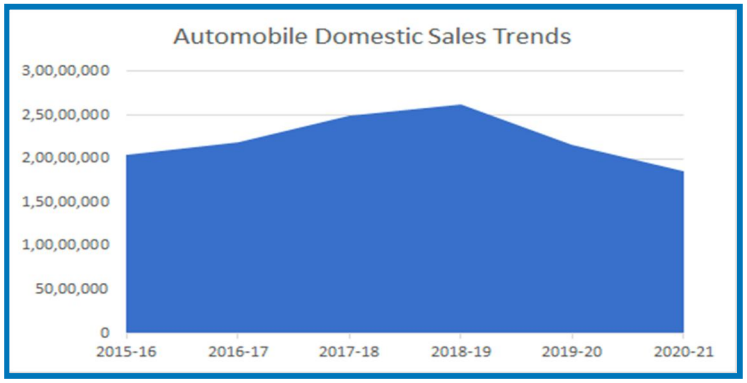
India passenger car market can be broadly divided based on segment type, by fuel type, by Car transmission type and by company/brand.

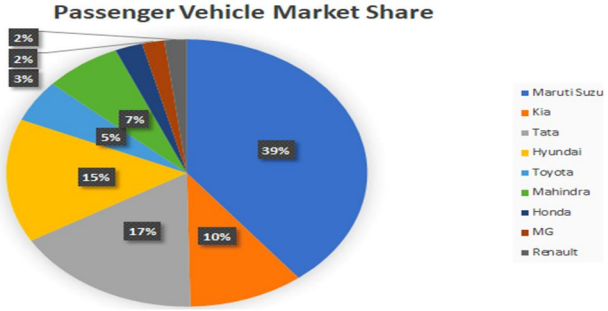
In terms of segment type, the market is segmented into Sedan, Hatchback, Sports Utility Vehicle (SUV) and Multi-Purpose Vehicle (MUV). In FY2020, the Hatchback category had the majority market share, followed by SUV, Sedan and MPV categories. Over the next decade, the Hatchback category is expected to assert its dominance in the country's entire passenger car market.

Due to the Indian government's implementation of various environmental norms and Corporate Average Fuel Efficiency Norms, Diesel fuel-based engine variants are less likely to be the bought by consumers in future.

In terms of car transmission type, market is divided into Automatic and Manual segments. Though Manual transmission vehicles continues to rule the market with their cheaper cost, while the Automatic transmission-based vehicles are anticipated to grow at faster rate of adoption in India over the coming years.

II. CURRENT INDIAN CAR MARKET





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Rank	CAR	TYPE	Name	Sep'21	Sep'20	Y-o-Y
1	Maruti Suzuki	Hatchback	Alto	12,143	18,246	-33%
2	Maruti Suzuki	MUV	Ertiga	11,308	9,982	13%
3	Kia	SUV	SELTOS	9,583	9,079	6%
4	Tata	SUV	NEXON	9,211	6,007	53%
5	Hyundai	SUV	Creta	8,193	12,325	-34%
6	Maruti Suzuki	Hatchback	Baleno	8,077	19,433	-58%
7	Hyundai	SUV	Venue	7,924	8,469	-6%
8	Maruti Suzuki	Van	Eeco	7,844	11,220	-30%
9	Maruti Suzuki	Hatchback	Wagon R	7,632	17,581	-57%
10	Tata	Hatchback	Altroz	5,772	5,952	-3%
11	Hyundai	Hatchback	I20 Elite	5,153	9,852	-48%
12	Tata	Hatchback	Tiago	5,121	6,080	-16%
13	Toyota	MUV	Innova Crysta	4,724	4,087	16%
14	KIA	Hatchback	Sonet	4,454	9,266	-52%
15	Hyundai	Hatchback	i10 Grand	4,168	10,385	-60%
16	Maruti Suzuki	MUV	XL6	3,748	2,087	80%
17	Mahindra	SUV	XUV300	3,693	3,700	0%
18	Honda	Sedan	City	3,348	2,709	24%
19	Mahindra	SUV	Thar	3,134	0	-
20	Hyundai	Sedan	Xcent/Aura	2,862	3,882	-26%
21	Tata	SUV	Harrier	2,821	1,755	61%
22	Maruti Suzuki	Hatchback	S Presso	2,793	9,000	-69%
23	MG	SUV	Hector	2,722	2,410	13%
24	Renault	Hatchback	KWID	2,710	4,513	-40%
25	Mahindra	SUV	Scorpio	2,588	3,527	-27%

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III. FACTORS AFFECTING INDIAN CAR MARKET

A. Cost

This is without a doubt the main concern for each car buyer. There is a sure spending plan for everything as-is for purchasing a vehicle. Everybody will ensure that they get the best out of their vehicle at the most ideal cost. Also, this is the explanation that carmakers were battling to change to the BS6 discharge standards since that prompted an expansion in cost. Organizations need to remember their client's purchasing limits while presenting a vehicle.

B. Brand Value

We Indians are extremely specific with regards to brands while purchasing anything. As is the situation with the vehicles, Indians have certain specific options. This is the explanation that Maruti Suzuki has stayed at the highest-rated spot since the time it began activities. Also, by brand, I mean trust. A few brands like Maruti Suzuki and Hyundai have had the option to construct this trust because of their solid organization of deals and administrations spread the nation over.

C. Eco-friendliness/Mileage

An inquiry that everybody knows about! On the off chance that you ask a normal Indian vehicle purchaser, he will let you know that mileage is the highest level of need with regards to vehicles. There have been vehicles ever, that was amazing and stacked with best-in-portion highlights but then flopped wretchedly because of the low eco-friendliness. Low kilometers per liter is a straight warning for Indian customers.

D. Administration/Maintenance Cost

It's not just the underlying expense of the vehicle that a purchaser remembers. The customary help costs do add to financial plan arranging. In this way, the vehicle needs to stay low on use a short time later as well. This is an explanation that brands like Skoda are not ideally the best option due to their high help costs

E. Looks and Design

Vehicles are yet a thing of extravagance for some Indians. What's more, Indians simply love to display their possessions. In this way, if a vehicle looks revolting, it won't sell at all be the force specs or the elements. An individual won't spend his/her cash on a vehicle consistently. In this way, it is fundamental that the cash is spent well and there is no lament thereafter. Even though there are numerous inclinations as far as looks, some like it straightforward and rich while some like their vehicles are more extravagant and bulkier. In this way, so, looks do matter. Sorry Fellas!

F. Infotainment System

This was not an exceptionally well-known thing until last year when every one of the makers began outfitting their vehicles with the infotainment framework. At first, there used to be a tape player or a radio for seemingly forever. However, when the web costs fell (Thanks to Jio!) and versatile clients began expanding, Indians needed their vehicles to be exceptional as well. Thus, the infotainment frameworks picked speed, and presently, it has become one of the first concerns of vehicle purchasers the nation over.

G. Lodge/Cargo Space

One thing is without a doubt, Indian families are not little. And keeping in mind that purchasing a vehicle, a purchaser needs to remember that it ought to have the option to fit more individuals. Thus, lodge space is a genuine need for individuals in India. Also, the equivalent goes for the freight. Indians love to gather gigantic packs while going out traveling to remain prepared for any eventuality. Also, their vehicle should have the option to oblige those things. Or there will be consequences, the vehicle is excessively little!

H. Motor and Performance

Indians do ensure that their vehicles are adequately quick albeit the exhibition is not the first concern for most vehicle purchasers. Lately, turbocharged motors have turned over acquiring ubiquity, since individuals are adoring the force specs of such motors. mHawks from Mahindra and Dicor from Tata have been well known in India because of their presentation.

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I. Transmission Option | The less, The Merrier

In the realm of confusion, individuals need their vehicles to be less chaotic to drive. Also, that is the reason the sort of transmission is a need for vehicle purchasers in India. Some lean toward it manual as they love the excitement of changing the gears while some like it programmed which calms them from the consistent stuff moving. Our shifters are additionally turning into a frenzy in India now with numerous turbocharged motors combined with a programmed transmission with paddle shifters.

J. Traveler Safety

You will experience it each day. Unfortunately, security is of least concern with regards to focusing on the need of great importance. Street mishaps are a significant reason for death in India. This is because of the explanation that vehicles are not worked to withstand such huge maltreatment. Also, the ones that are constructed are not selling enough. We continue to ask the carmakers to construct quality vehicles, however, need everything to lie on a similar spending plan as in the past. We need to comprehend that adding security will require an increment in the costs of vehicles. Furthermore, India is in critical need of tough standards and guidelines. BNVSAP should get this going, however evidently, this is by all accounts at a much slower speed than required. Taking off Insurance costs

As indicated by the changed collision protection standards from September 2018, an obligatory three-year outsider protection cover for new vehicles is to be outfitted by all broad insurance agencies. Subsequently, with heightened on-street vehicle costs, purchasers are re-examining whether to purchase their fantasy vehicle.

K. Climate Consciousness Lessening Demand for Diesel Cars

The green mindfulness prompting the execution of new BS-VI outflow guidelines has influenced the monetary practicality of diesel adversely. Likewise, many business sectors in the nation have limited diesel vehicle enrolment when contrasted with their petroleum partners. What's more, an examination of vehicle and fuel costs has driven planned buyers to reconsider purchasing.

L. Changing Policies and Change in Government

Auto approaches straightforwardly sway purchasers' opinions. As of now, notwithstanding standard inquiries on credit revenue, GST rates, value control, storm forecast, and so on the additional vulnerability of a political race year worked to the impairment of the portion. Execution of the most recent wellbeing guidelines began in April this year in stages. All vehicles ready to move are presently needed to have ABS, safety belt admonitions, speed alerts, invert leaving sensors by July 2019. New vehicles likewise need to confront Bharat NCAP crash test wellbeing standards by October this year and BS-IV emanation standards by July 2020. That is the reason most vehicle makers are either occupied with remodeling their items or arranging various dispatches satisfying all guidelines. This has additionally assumed a part in potential purchasers delaying their buy choices, hanging tight for spic and span models.

Factor	2012 (%)	2011 (%)
PRICE	65	65
BRAND VALUE	57	57
FUEL EFFICIENCY	51	51
SERVICE COST	49	47
DESIGN/STYLE	29	28
PERFORMANCE	24	25
SAFETY	18	17

A list of priorities of an average car buyer. The list goes from the most important to the least important.

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IV. NEED FOR ELECTRIC VEHICLES IN INDIA

A. Low Maintenance Costs

The most important reason for buying an EV is its maintenance cost. If you buy a car with an ICE based vehicle, it will have more parts and therefore will have more complexities in maintenance. EVs are simple and less costly to maintain due to their simple structure and operations.

B. EVs have NO sound of their own!

Another advantage that an EV can deliver over your already existing car is its quiet functioning. As there is no engine under the hood, The electric motor it has is so silently that you can even hear a clock tick. Considering the practical side, no matter how quiet the engine car is, the EV can always give you a comfortable ride because of its completely quiet operation. Some EVs are so quiet that manufacturers must add false sounds in order to make it safe for pedestrians

C. Low Running Costs

Another major benefit of EVs over conventional ICE cars is the running cost. For instance, the Hyundai Kona delivers approximately 450kms of range in a single charge and therefore the running costs come down to even less than a single rupee per kilometer.

D. No more fuel price hikes!

Do varying fuel prices trouble you? Well, if you buy an EV, you will no longer have to worry about the daily rise of petrol and diesel prices. While the government changes the fuel prices depending on the global prices, you will no longer have to worry because you will no longer be dependent on fuel.

E. Convenient Charging at Home!

EVs have a major advantage in this case because one can simply plug in your vehicle at your home for 4-5 hours and you are ready to drive again. EVs nowadays also come with fast charging capabilities which allows them to charge within 60 mins!

F. Easy to Drive

Electric vehicles have no gears, starting right from an electric scooter and going all the way up to an electric bus. Yes, EVs are an absolute pleasure to drive because you don't have to use gears. You only must use a set of buttons or pedals which will make you increase or decrease the speed and that's all! An automatic petrol/diesel car can never get you the same comfort of driving.

G. Environment Friendly

Buying an EV can reduce your carbon footprint because there are no carbon emissions. EVs are one of the most "nature first" modes of transport available right now in the market.

H. Comfortable Cabin and More Storage Options

Since there is no engine and its surrounding components, and motors and batteries don't take much space; EV provides more space to utilize that a same sized ICE vehicle. We get a better legroom, front storage space, the rear section of the cabin gets you a flat space.

I. Various Government Incentives

There are multiple benefits of buying an EV that are not limited to car itself. For example, Government of Delhi recently released a new electric vehicle policy under which you can get additional benefits of up to ₹1.5 Lakhs.

J. EVs are Future Proof!

We have exhausted most of our fossil fuels sources. From Petroleum to Natural gas to Coal, everything is about to finish. Our electricity is also generated from fossil fuels. We are transiting towards renewable sources of energy. We have learnt to harness solar energy and wind energy which are renewable and do not cause pollution. EVs are the future, and we should get used to it in the present too!

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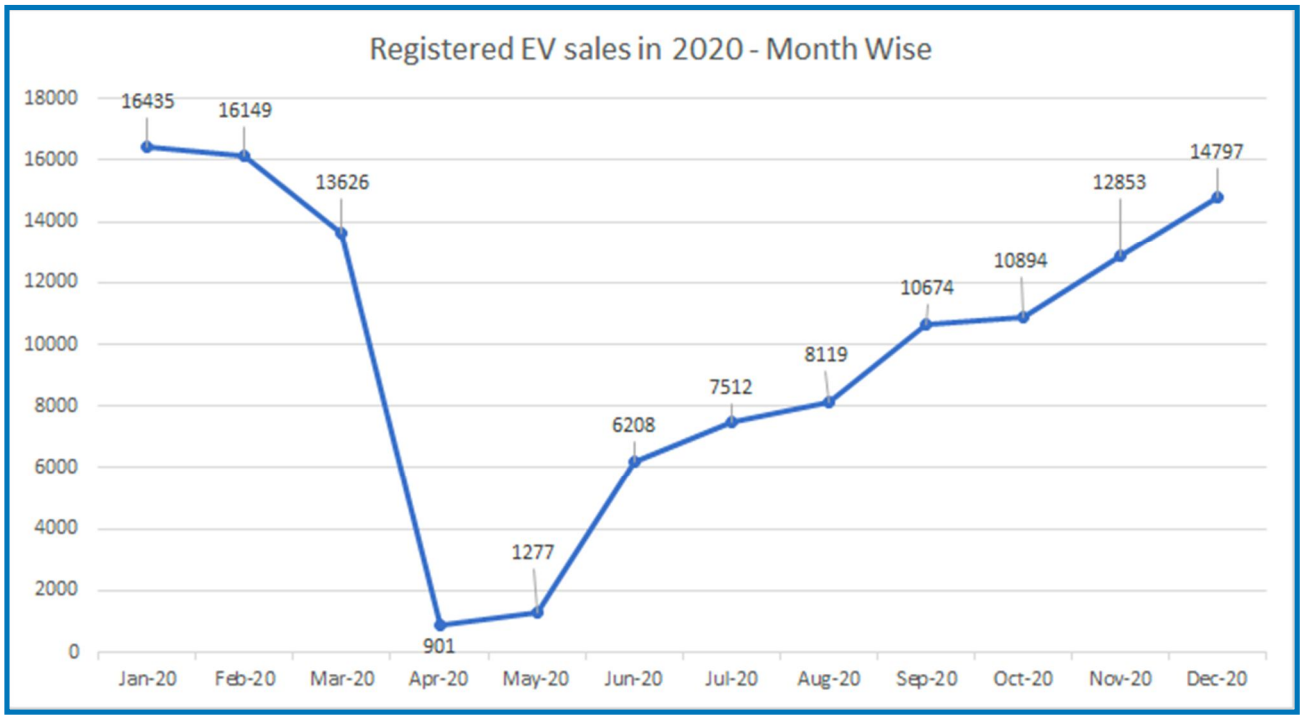
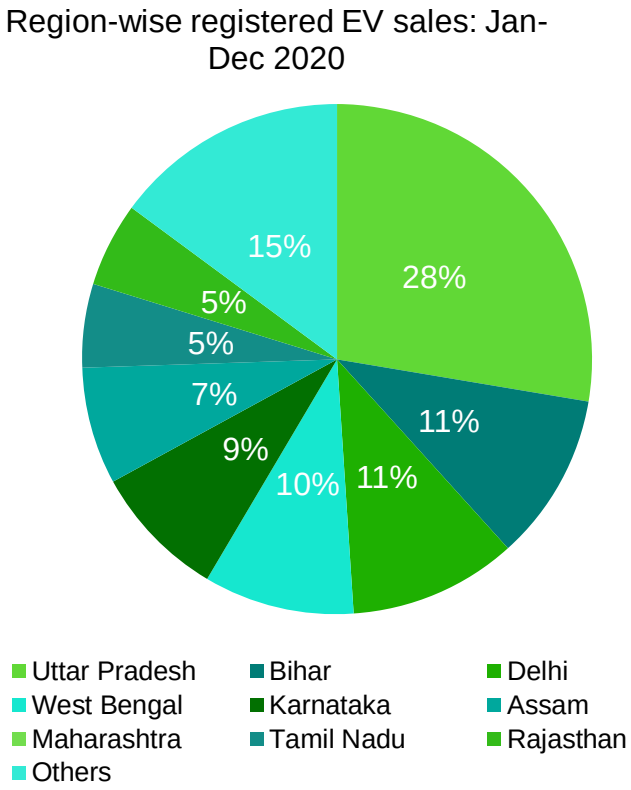


V. CURRENT INDIAN EV MARKET

Even after the devastating effect from COVID - 19, there is gigantic demand and potential for EV in India. But to enable and sustain this growth, we need a very efficient and robust charging Infrastructure.



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VI. ELECTRIC VEHICLE CHARGING INFRASTRUCTURE IMPLEMENTATION

A. AN Overview of EV Charging Infrastructure

Specifications and standards for EV chargers, also known as electric vehicle supply equipment (EVSE), are designed for currently available EV models in the market and the characteristics of the present electricity grid.

1) Characteristics of EV Supply Equipment

Electric vehicle supply equipment (EVSE) is the elemental unit of EV charging infrastructure. It harnesses power from the local electricity supply and uses a control system and wired connection to safely and securely charge EVs. It allows for various functions such as user authentication, permission for charging, recording, and saving data and data privacy and security. Plug-in (wired) (conductive charging) charging is the common charging technology method in use. Factors on which it depends on are:

Battery Specifications of Different EV segments
Charging Methods and Power Ratings
Power Ratings
Battery Swapping

	Power level	Current type	Compatible EV segments
Normal power charging	P ≤ 7kW	AC & DC	E-2Ws, e-3Ws, e-cars, other LCVs (up to 1 ton)
	7kW < P ≤ 22kW	AC & DC	
High power charging	22kW < P ≤ 50kW	DC	E-cars, LCVs and MCVs (1-6 tons)
	50kW < P < 200kW	DC	

2) EV Charging Standards in India

Indian standards for AC CHARGING: IS 17017 is the key EV charging standard in India
Indian standards for DC CHARGING: IS-17017-Part-23 describes the requirements for DC charging stations

3) Charging Stations

Charging stations refer to high-power EVSE
Charging points refer to normal power EVSE that can be accessed by a portable charging cable.
Points to be noted while designing the charging infrastructure
Ease of access to EV Charging
Use of Normal Power Charging Points
Cost-efficiency of Charging Infrastructure
Financial Viability of EV Charging

B. Multi-Stakeholder Governance of EV Charging

The EV charging ecosystem comprises of multiple components and processes that have to be followed diligently in a correct order – the provision of land, supply of electricity for EV charging, specification and installation of EV charging equipment, day-to-day operations and maintenance of EV charging facilities, and services allowing EV owners to use charging facilities without any hassle.

1) Classification OF EV Charging Infrastructure

Private Charging: Dedicated charging for personal EV or EV fleet owned by one entity
Semi-public Charging: Shared charging for a restricted set of EV users
Public Charging: Open for all EV users

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2) Roles and Responsibilities of Government Stakeholders

Government bodies at the center, state, and local levels are responsible for good governance of EV charging. The roles played by these bodies can be categorized as:

3) Policy-Making And Regulatory Authorities

Government bodies are responsible for creating policies, making new regulations, and establishing efficient standards and specifications for EV charging infrastructure.

Government Authorities Involved: Ministry of Power (MoP), Central Electricity Authority (CEA), Ministry of Housing and Urban Affairs (MoHUA), Urban Development Departments, Urban development authorities (UDAs), Apart from land and electricity supply, EV charging standards are defined by the Bureau of Indian Standards (BIS)

4) Executive Or Implementing Authorities

Government bodies who executive roles and are responsible for the everyday governance of EV charging infrastructure

Government Bodies Involved: Bureau of Energy Efficiency (BEE), Department of Heavy Industry (DHI), State nodal agencies (SNAs), DISCOMs, Unified metropolitan transport authorities (UMTAs), State and regional transport authorities (RTAs)

5) Working Group

Multiple state and local government bodies are responsible for the successful utilization of public charging infrastructure. At present, it does not exist, but it's ideal version would support the necessary coordination between different government agencies. Their functions would include:

a) To take a holistic view of opportunities and challenges for rollout of EV charging infrastructure and recommend efficient strategies to accelerate progress
b) To identify and solve coordination issues amongst various departments
c) Take care of any other policy or coordination issues that hamper the acceleration to rollout the EV charging infrastructure

6) Charge Point Operators

Charge point operators (CPOs) and e-mobility service providers (e-MSPs) manage and enable day-to-day operations.

The main responsibilities of CPO are:

a) Planning And Permission
b) Installation & Commissioning
c) Operation and Billing

The CPO can be a public utility or a private entity.

C. Assessing Charging Demand and Setting Targets

In planning a robust EV charging infrastructure, stakeholders must consider potential charging demand as well as major constraints of land and power supply.

1) Setting Targets For EV Charging Infrastructure Assessing Ev Charging Demand

An EV charging demand assessment can be seen from different aspects of charging infrastructure planning. It can be used as input data to set targets for the number of public EV chargers

2) EV Projections for Horizon Years, By Segment.

VEHICLE SEGMENTS	Annual growth rate	EV penetration rate - 2025	Total number of EVs - 2025	EV penetration rate - 2030	Total number of EVs - 2030
E-2W	5.88%	10%	1,00,477	30%	6,12,353
E-3W (passenger/cargo)	5.57%	40%	30,376	70%	1,15,804
E-car (personal)	3%	3%	4,519	15%	42,561
E-car (commercial)	15.80%	10%	4,775	30%	41,992

3) Charging Demand by Vehicle Segment

VEHICLE SEGMENTS	Daily kms driven	Battery capacity in kWh	Driving range in km/full charge	Daily charging demand in kWh	Total daily charging demand in kWh - 2025	Total daily charging demand in kWh - 2030
E-2W	40	2.5	80	1.25	1,25,596	7,65,442
E-3W (passenger / cargo)	120	7	100	8.4	2,55,162	9,72,757
E-car (personal)	40	30.2	312	4	17,498	1,64,786
E-car (commercial)	100	21.2	181	12	55,931	4,91,838

4) Type And Number Of Public Chargers (25% Utilization)

VEHICLE SEGMENTS	Share of public charging	Charger Types	Number of chargers - 2025	Number of chargers - 2030
E-2W	10%	Single phase 15A charger	634	3,866
E-3W (passenger / cargo)	20%	Single phase 15A charger	2,557	9,826
E-car (personal)	10%	Type-2 AC (70%) 50kW DC charger (30%)	32	306
E-car (commercial)	25%	Type-2 AC (60%) 50kW DC charger (40%)	262	2,303

D. Location Planning and Land Allocation

EV charging requires space to set up an EVSE and to park the vehicle for the charging duration. Private and semi- public charging can utilize spaces that allocated in the parking areas of independent houses, apartment buildings, or commercial and institutional establishments. But for public charging, it is necessary to plan for a network of chargers that are conveniently and well located and well-distributed across a region.

1) Principles Of Location Planning For Public EV Charging

Maximize: Accessibility, Utilization and Cost

The Steps for the same are:

a) Geospatial Analysis And Site Selection
b) Understanding the Space Requirements for Charging Facilities
c) Site Planning for EV Charging
d) Understanding the Space requirements for Upstream Electrical Infrastructure

Estimated load	Recommended DT set-up	Minimum area requirement
100 kW to 300 kW	Installation of one 11 kV pole or plinth mounted DT	4 m x 4 m (pole) 8 m x 5 m (plinth)
300 kW to 700 kW	Installation of one 11 kV plinth mounted DT	9mx5m
700 kW to 1,500 kW	Installation of two 11 kV plinth mounted DTs	10 m x 8 m

2) Land Allocation For Public Charging Infrastructure

A distributed approach to public charging infrastructure is aimed to achieve a dense network of normal power charging points, integrated with public parking for maximum utilization of space. They can be accommodated even at a single parking spot, or at multiple parking spots in a larger area. Therefore, the space required at each location may be small, but a vast number of locations are needed for an effective network.

Few problems for the same are:

- Lack of Clarity on the land Ownership
- Poor Planning and Maintenance of Parking
- High Cost of Urban Land

Few Methods of Solutions:

- Support Low-Cost Charging Point Implementation at Public Parking Locations
- Implement Comprehensive Urban Parking Policies
- Planning for cost effective Public EV Charging in Urban areas

E. Connecting EVs to The Electricity Grid

Accessible, reliable, and affordable electricity is a prerequisite for a good charging infrastructure provision. For a rapidly scalable and promising EV charging network, the ubiquitous low-tension (LT) electricity distribution infrastructure should be utilized wherever feasible to provide electricity connections for EV charging. A distributed approach to charging infrastructure, consisting primarily of normal power charging points, ensures that most charging points can be connected to the LT electricity network.

1) Central Technical Regulations And Guidelines

Technical Standard for Connectivity of the distributed generation Resources (Amendment) Regulation, 2019.
Measure Relating to Safety and Electric Supply (Amendment) Regulation, 2019.

2) State Regulations

With electricity distribution and supply being a state subject as per the Indian Constitution, regulations at the state level determine the rules around connection and supply of electricity.
This regulatory framework differs from one state to another, and appropriate state regulations should be considered when planning or installing charging facilities. Among the provisions of the state supply code, the following issues especially impact electricity connections for EV charging.

3) Role Of Discoms In Providing Power Connections

DISCOMs are responsible for providing electricity connections for charging infrastructure. They enforce and execute the electricity supply rules and regulations on-ground.

4) Arranging For Electricity Supply For Charging

CPOs or EV owners should select the optimal option based on their requirements.

a) Draw electricity from an existing power connection.
b) Arrange for a new electricity connection.
c) Powering by adaptive Renewable Energy Generation.

F. Achieving Effective Ev-Grid Integration

The total electricity demand for EVs,by 2030, is projected to be 37 TWh (as per a 2018 Brookings India report). This constitutes less than 2% of the total electricity demand across the country by 2030. Therefore, meeting the overall energy demand for EVs is not expected to be a major challenge in India.
But to ensure the same we need to constantly work on:
Improving the utilization of the electricity Grid & Integrating EV Charging in Grid Planning

G. Models of EV Charging Implementation

The EV charging infrastructure market in India is young, with fewer than 2,000 charging stations established across the country as of March 2021. And the market is expected to scale up rapidly in the next few years, companies from various sectors are entering at different points in the value chain to benefit from this transition.

1) Typical Roles In Charging Infrastructure Implementation

This involves multiple roles, which may be executed by one stakeholder or accomplished through partnerships between multiple stakeholders. Apart from setting up the charging infrastructure, other roles would include provision of land, stable electricity supply, EVSE supply, charging software solutions, and various associated customer services.

2) Models Of Implementation

There are three major implementation models for charging infrastructure:
Government Driven Model, Consumer Driven Model, Service Driven Model

3) EV Tariffs in Different States

State	EV TARIFF		
	ENERGY CHARGE(in ₹)	DEMAND CHARGE	
		Low tension (in ₹ per month)	High tension (in ₹ per month)
Andhra Pradesh	6.7/kWh	-	-
Assam	5.25 to 6.75/kWh	130/kW	160/kVA
Bihar	6.3 to 7.4/kWh	-	-
Chhattisgarh	5/kWh	-	-
Delhi	4.5/kWh	-	-
Gujarat	4 to 4.1/kWh	-	25 to 50 per kVA
Haryana	6.2/kWh	100/kW	-
Himachal Pradesh	4.70 to Rs 5/kWh	-	130/connection to 140/kVA
Jharkhand	6.00 to 6.25/kWh	40 to 150/connection	
Karnataka	5/kWh	60/kW	190/kVA
Kerala	5/kWh	75/kW	250/kVA
Madhya Pradesh	5.9 to Rs 6/kWh	-	100 to 120/kVA of billing demand
Maharashtra	4.05 to 4.24/kWh	-	70/kVA
Meghalaya	10.09/kWh	100 to 230/ connection	
Odisha	4.20 to 5.70/ kWh	200 to 250/kW	200 to 250/kVA
Punjab	5.4/kWh	-	-
Rajasthan	6/kWh	40/HP	135/kVA
Tamil Nadu	5 to 8.05/kWh	70/kW	-
Telangana	6/kWh	-	-
Uttar Pradesh	5.9 to Rs 7.7/kWh	-	-
Uttarakhand	5.5/kWh	-	-

VII. CONCLUSION

It goes without saying that the automotive industry is one of the biggest industries in India. But there are multiple challenges and issues to resolve to make it the best in the world. Overcoming these challenges of manufacturing, switching to EV, and exporting them will enable the Indian automotive industry to become one of the biggest contributors in the global market.

There are multiple things going on for faster adaptation of EV and new policies have been implemented to promote electric vehicle companies and their manufacturers to make a humongous number of electric vehicles in India. Government of India is also claiming to reach all-electric vehicle in India by 2050 and 40% of total fleets by 2030.

India has a lot to gain by transiting from ICE vehicles to Electric vehicles at the earliest. Its oil-import bill would considerably reduce, thereby enabling common people to save lot of money. ICE vehicles are the most significant contributor to pollution in cities, and their replacement with EVs will improve air quality resulting into better lifestyle. There is a possibility that we can become leaders in small and public electric vehicles all over the world.

However, this would require various creative innovations, a solid policy regime that encourages and provides access to the latest technologies. These with lot of effort by the Indian industry will be needed to achieve global domination in EV Industry.

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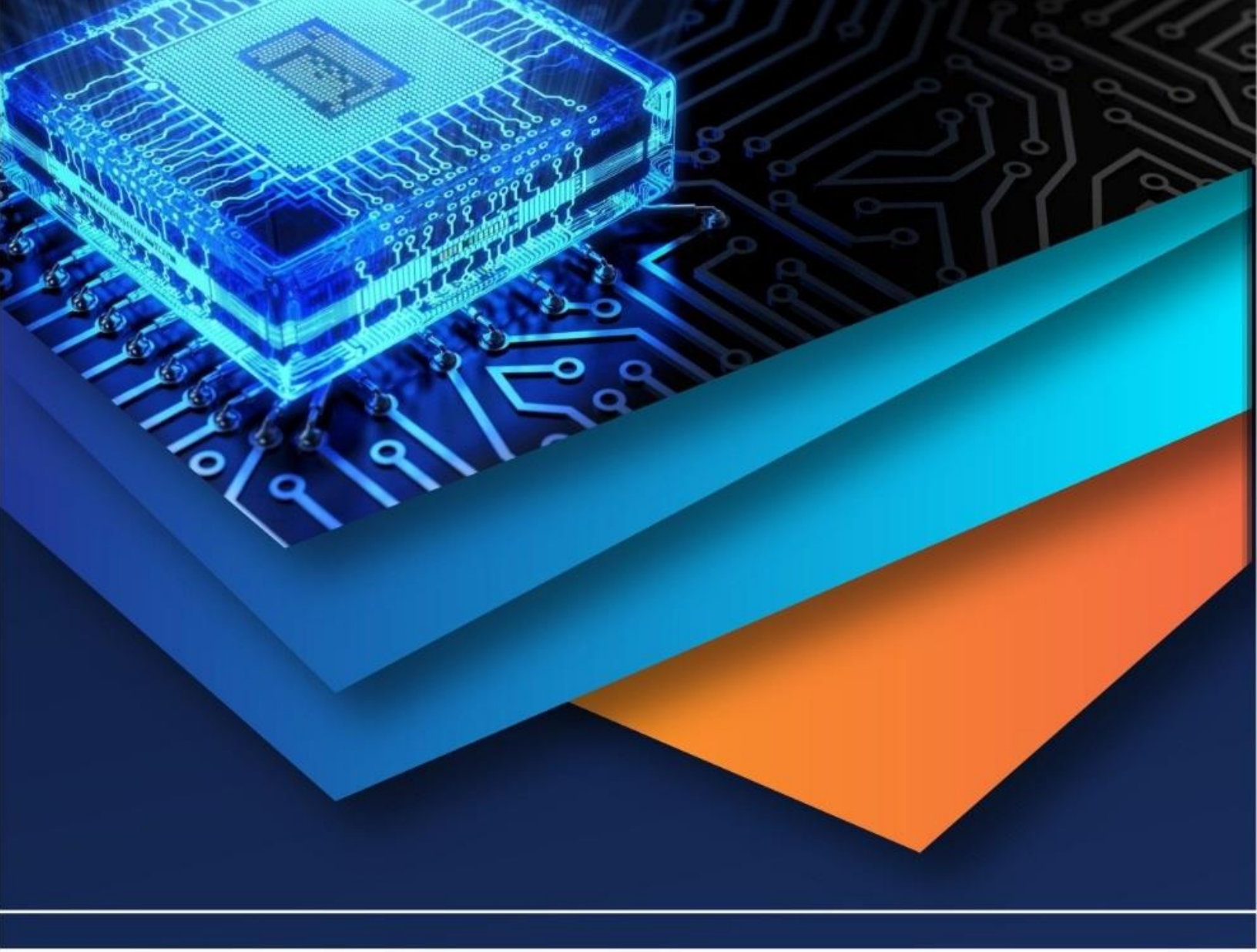

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