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**Visualization Tool for Electric Vehicle Charge and Range
Analysis**

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1. INTRODUCTION:

A vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source and has an electric motor instead of an internal combustion engine.

The Electric Vehicle (EV) is not new, but it has been receiving significantly more attention in recent years. Advances in both EV analytics and battery technologies have led to increased automotive market share. However, this growth is not attributed to hardware alone. The modern mechatronic vehicle marries electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer, and data analysis, to form a comprehensive transportation solution. Advances in all these areas have contributed to the overall rise of EV's, but the common thread that runs through all these elements is data analytics. The new EV's are combined Electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer to form a comprehensive transportation solution.

1.1 Overview:

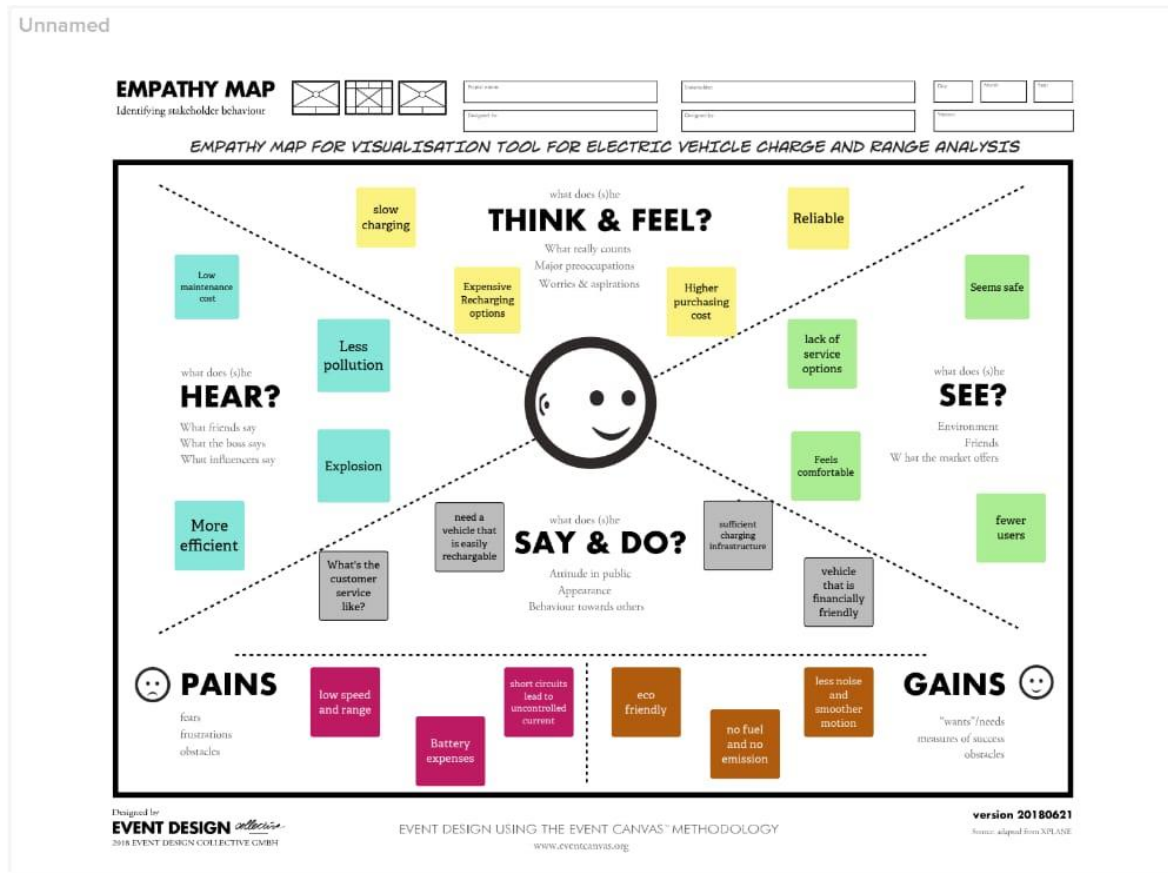
To accomplish this, research in the field has been deducted and the key factors which define and influence the state of infrastructure have been outlined. Existing visualizations related to the Mobility infrastructure as well as similar domains have been analyzed. A total of five visualizations have been designed to represent the current state of electric mobility infrastructure. Those include the distribution of charge points among the world, charging networks within Europe, charging speed, range of EVs (Electric Vehicles) and the relation between purchase price and range of EVs. The results have then been tested and re-evaluated with people representing the two target groups. They have then been implemented and presented on a landing page together with the findings of Gleb Podorozhnyy, whose project focused on the market side. Presented as a story and including background information as well as interesting facts and figures, an extensive overview of the current state of Emobility has been created. Hubject hopes to benefit from the project by attracting new clients as a thought leader of Emobility

1.2 Purpose:

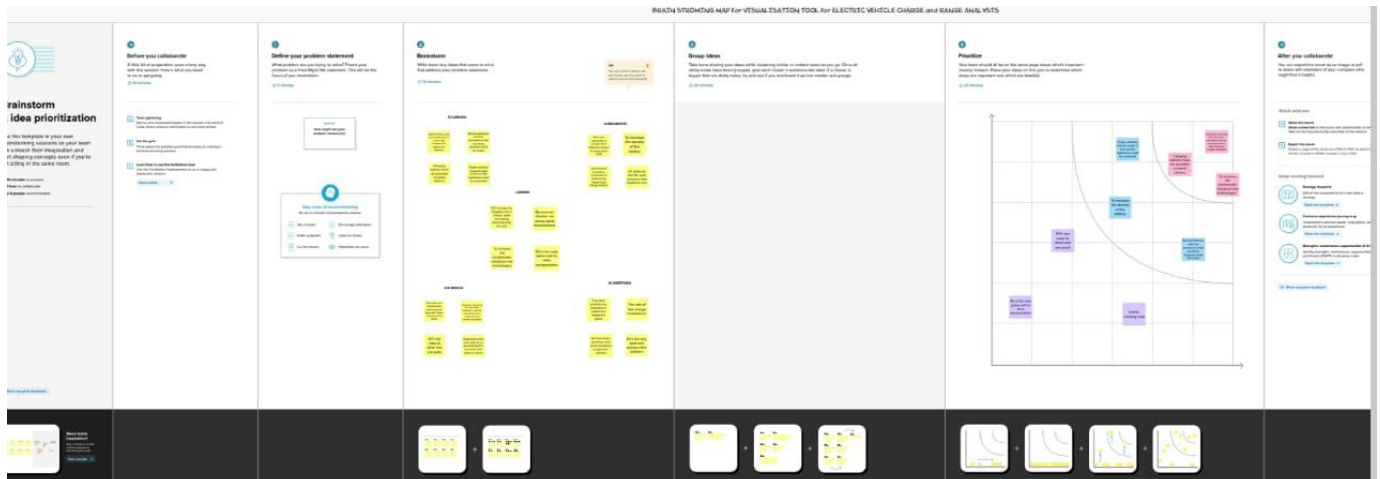
This EV charging system aims to subsidize and nullify the effect of these factors and provide a user-friendly design for charging. requirements. A fast-charging module is connected to the system, which boosts the power level and enhances the speed of charging. According to the theory of ampere-hour integration, SOC is particularly critical because it can accurately reflect the energy state, and its calculation formula is as follows: is the remaining electric quantity and is the initial electric quantity at a certain temperature or the rated charge at a certain temperature.

2. Problem Definition & Design Thinking:

2.1 Empathy Map:



2.2. Ideation & Brainstorming Map:

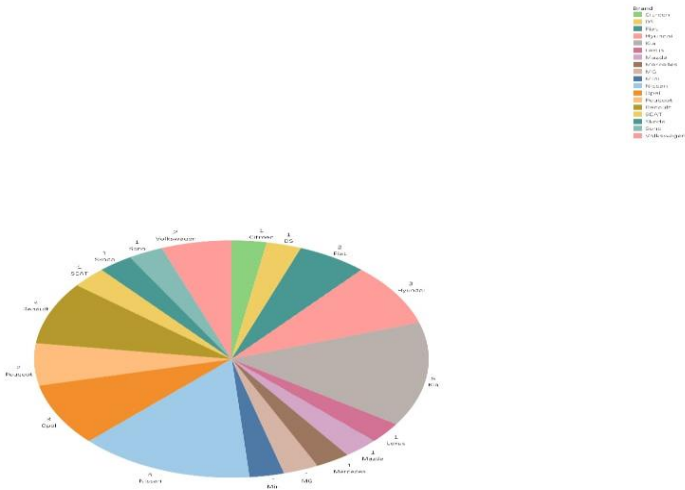


3. Results:

Different Electric Cars in India



No of Models by Each Brand

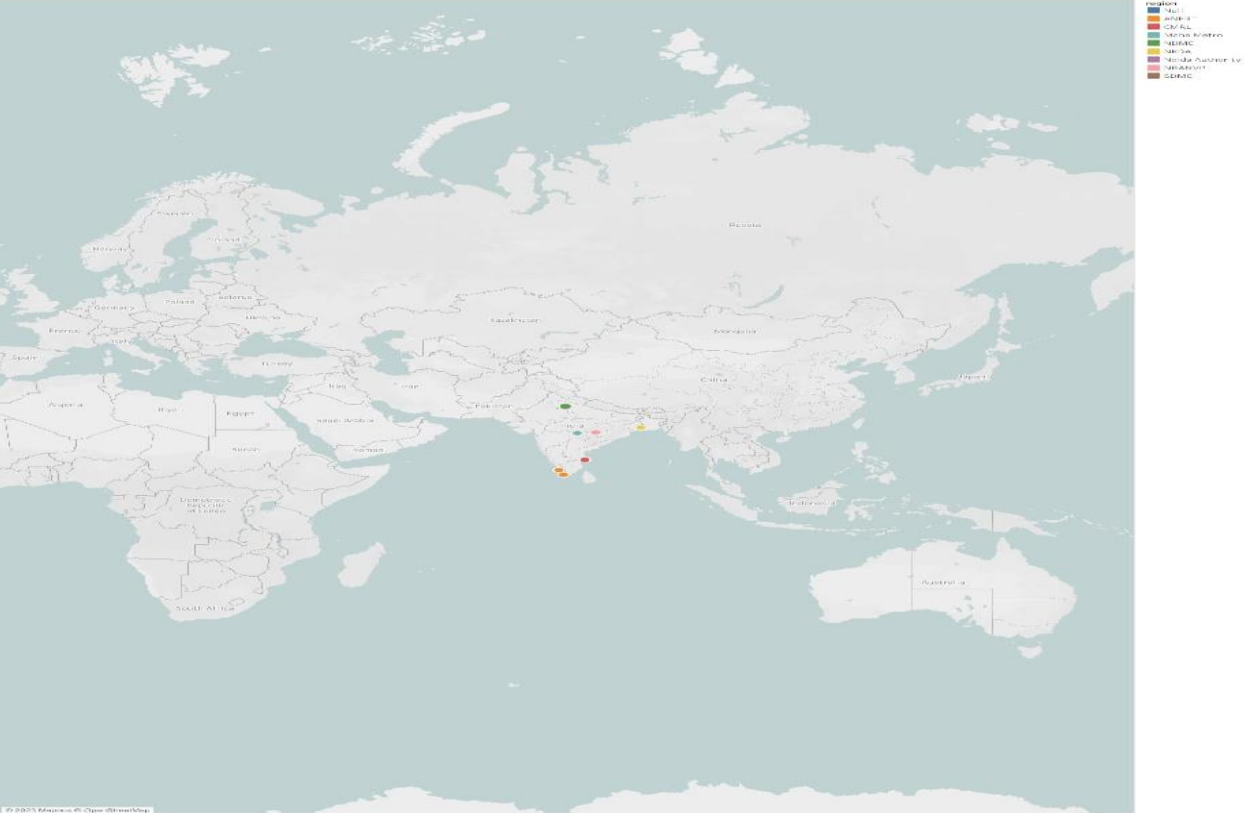


BodyStyle

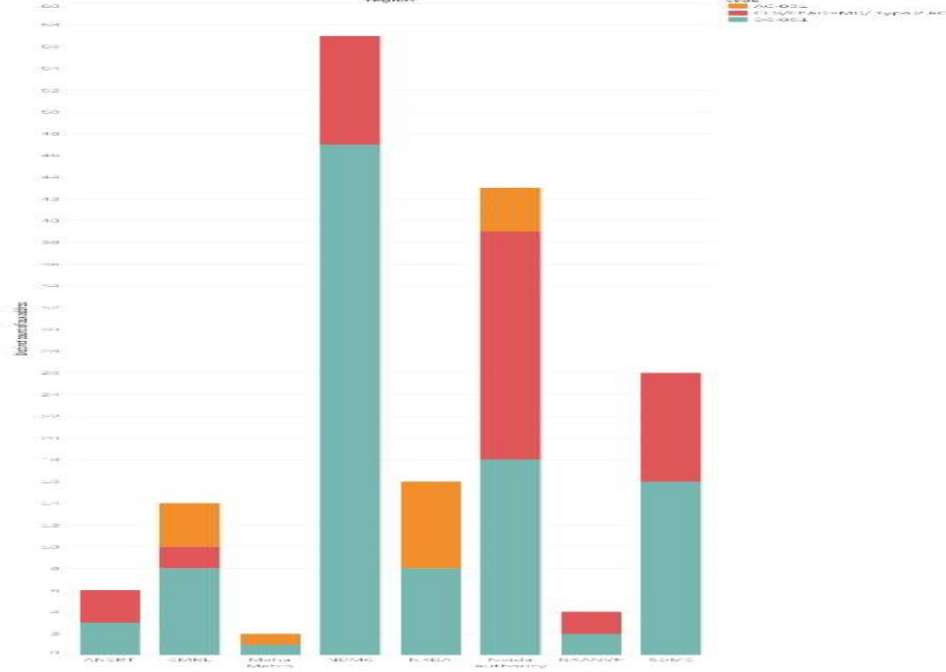
- Cabrio
- Hatchback
- Liftback
- MPV
- Pickup
- Sedan
- SPV
- Station
- SUV

Model	Price Range (Lakhs)
Audi E-Tron	118-119
Audi E-Tron GT	178-180
BMW iX	115-116
BYD E6	28-29
Hyundai Kona Electric	23-24
Jaguar I-Pace	112-113
Mercedes-Benz EQC	99-100
MG ZS EV	25-26
Porsche Taycan	149-150
Tata Nexon EV	17-18
Tata Nexon EV Max	19-20
Tata Tigor EV	14-15

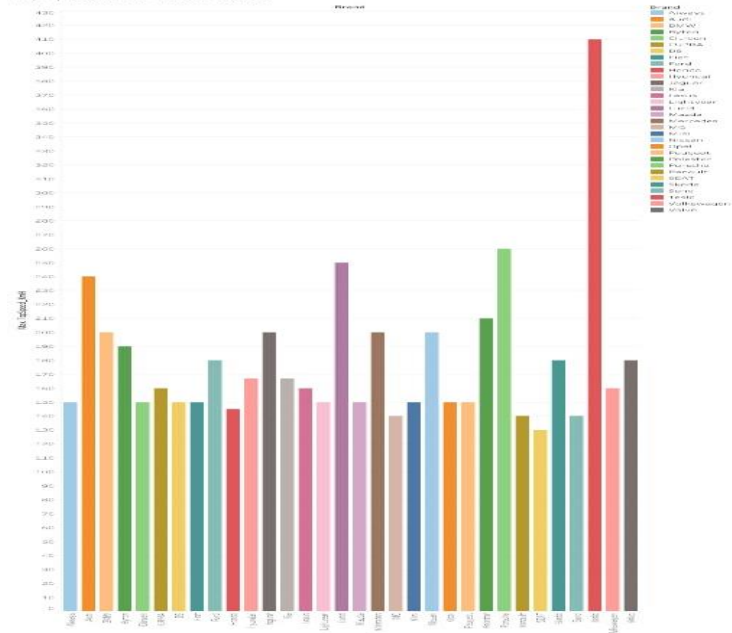
EV charging stations in India on map



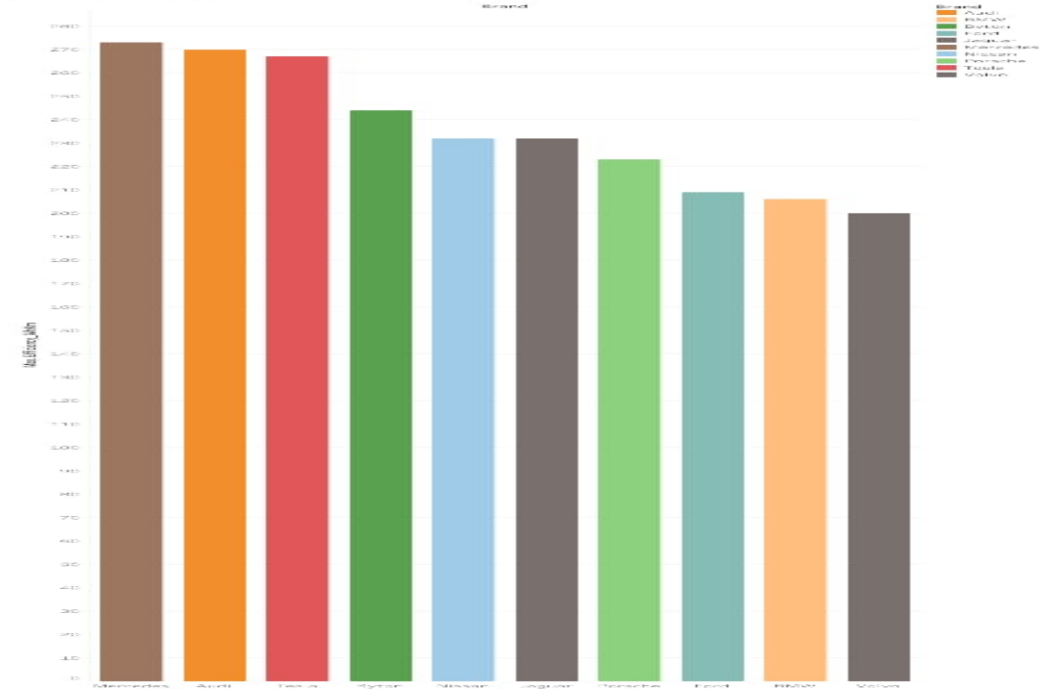
EV charging stations in India by Region and Type



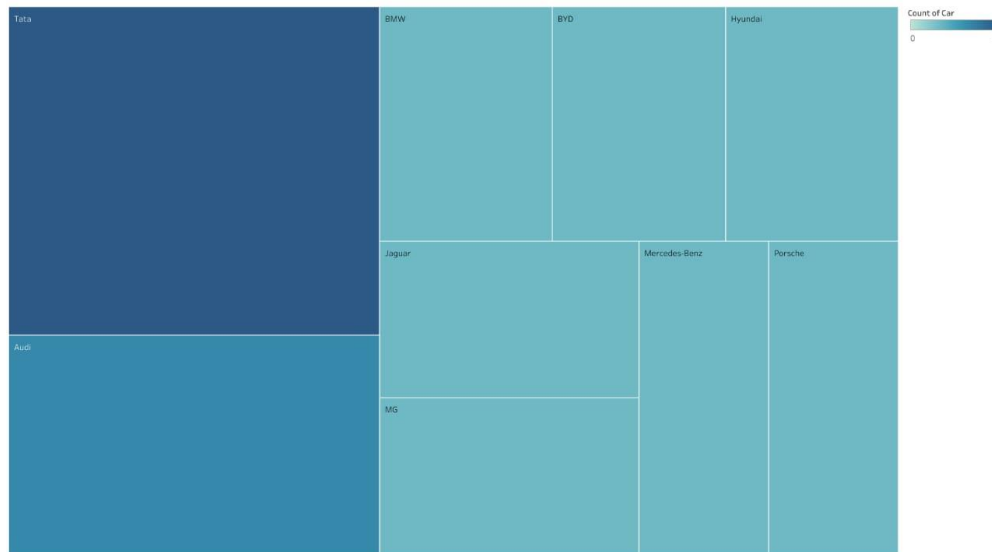
Top Speed for different Brands



Top 10 EV Brands



Brand filtered by PowerTrain



4. ADVANTAGES & DISADVANTAGES:

4.1 ADVANTAGES:

Electric vehicles use electricity to charge their batteries instead of using fossil fuels like petrol or diesel. Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements. Using renewable energy sources can make the use of electric vehicles more eco-friendly. The electricity cost can be reduced further if charging is done with the help of renewable energy sources installed at home, such as solar panels.

Electric vehicles have very low maintenance costs because they don't have as many moving parts as an internal combustion vehicle. The servicing requirements for electric vehicles are lesser than the conventional petrol or diesel vehicles. Therefore, the yearly cost of running an electric vehicle is significantly low.

The availability of fossil fuels is limited, and their use is destroying our planet. Toxic emissions from petrol and diesel vehicles lead to long-term, adverse effects on public health. The emissions impact of electric vehicles is much lower than petrol or diesel vehicles. From an efficiency perspective, electric vehicles can convert around 60% of the electrical energy from the grid to power the wheels, but petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels. That is a waste of around 80%. Fully electric vehicles have zero tailpipe emissions, but even when electricity production is taken into account, petrol or diesel vehicles emit almost 3 times more carbon dioxide than the average EV. To reduce the impact of charging electric vehicles, India is ambitious to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by the year 2030. Therefore, electric vehicles are the way forward for Indian transport, and we must switch to them now.

4.2 Disadvantages:

Compared to standard automobiles with a one-time charge, electric vehicles have a shorter driving range. Furthermore, there are few charging stations accessible, and charging time is also quite long, so they are concerned about a breakdown if the car requires charging in the middle of the journey.

The disadvantages for the charging stations for electric cars:

- You are better to continuously “top up” the charge instead of draining the battery which can take between 4-8 hours to charge, depending on the charger.
- You need to research where the nearest EV charging points are.
- Environmental factors can affect the performance of the battery such as temperature.

Range anxiety refers to an EV owner's fear that the vehicle's battery does not have sufficient charge for it to reach the destination. It is linked to how far the EV can travel on a single battery charge and the availability of charging points.

5. APPLICATIONS:

OPERATING RANGE – TAKING IT ALL INTO ACCOUNT

So what is the actual operating range? Operating range takes this battery health factor into consideration and also accounts for weather (use of HVAC systems in extreme weather), varying terrain, driver behavior, frequency of stops, and any potential added weight of an agency's specific vehicle configuration that may differ from the base model. These elements can have a significant impact on vehicle efficiency and resulting operating range when buses are out on the road in real service scenarios.

$$\text{OPERATING RANGE} = \frac{\text{Usable energy in batteries (kWh)}}{\text{Operating efficiency (kWh/mile)}}$$

- **Range**
 - Range refers to how far a vehicle can go on a single charge. Range is calculated by dividing the amount of energy in the batteries (kWh) by the efficiency of the vehicle (kWh/mile).
- **Efficiency**
 - Vehicle efficiency (kWh/mile) is defined by the amount of energy consumed per mile, measured in terms of kilowatt hours per mile.
- **Nominal range**
 - Nominal range is defined by taking the total nameplate energy within the battery pack as reported by the OEM and dividing this number by the vehicle efficiency score as reported by The Altoona Bus Research and Testing Center (Altoona).
- **Operating range**
 - Operating range is calculated by dividing the usable energy within the battery pack by the operating efficiency of the vehicle.
- **Usable energy**

- Usable energy refers to the amount of energy that is accessible after taking battery health limitations into account, which enables a more consistent and predictable energy draw over the lifetime of the battery.
- **Altoona tested efficiency.**
- Altoona tested efficiency refers to the vehicle efficiency as reported by the Altoona Bus Research and Testing Center, which is based on dynamometer testing on simulated courses that represent driving central business district, arterial, and commuter routes.
- **Operating efficiency**
- Operating efficiency considers weather, varying terrain, driver behavior, frequency of stops, and vehicle weight.

Grid Infrastructure

Copper is an integral part of grid infrastructure because of its reliability, efficiency and performance. Copper's properties are vital to the interconnected network of plants, devices and lines that generate and distribute electricity and power throughout the country.

There are several key pieces of infrastructure that are built to support the delivery of electricity to consumers.

Underground Transmission

In underground power transmission, copper plays a very important role because of its unique mechanical and physical properties. Copper is a preferred underground cable material because of its high electrical and thermal conductivity, strength, formability, ease of joining, resistance to creep and resistance to corrosion. Underground transmission lines have many benefits including:

- Longer life expectancy
- Reduced maintenance costs due to less exposure
- Protection from weather and other external hazards
- Advantages of copper cables

6. CONCLUSION:

Both developed and developing countries have become more active in EV introduction and diffusion. In developed countries, the government has led the promotion of next-generation environment-friendly vehicles. In the industrial world, not only conventional auto manufacturers but also large and small enterprises have joined the EV business as new business opportunities. In accordance with the implementation of many pilot projects and EV related events, public expectation on EVs is high. However, there is no clear indication for full-fledged diffusion. This is because of high prices of EVs, limited models, lack of charging infrastructure, and lack of trust in the market in terms of life span of EVs and safety. On the other hand, big auto manufacturers have become bolder in EV development, which is seen to address the above-mentioned problems and accelerate EV diffusion.

7. FUTURE SCOPE:

The future of the electric vehicles global market is expanding at a CAGR of 21.7%, which is expected to continue. Growth from 8.1 million units is anticipated to reach 39.21 million by 2030. Multiple factors, including worries about pollution, are driving this rapid expansion.

This is consistent to reach net zero carbon emissions by 2070. The Indian electric vehicle market was worth USD 1,434.04 million in 2021, and it is predicted to grow to USD 15,397.19 million by 2027, at a CAGR of 47.09% during the forecast period (2022-2027).

An electric vehicle charging station is equipment that connects an electric vehicle (EV) to a source of electricity to recharge electric cars, neighborhood electric vehicles and plug-in hybrids. The basic conclusion is that when it comes to climate change and air quality, electric cars are clearly preferable to petrol or diesel cars. Contrary to some public doubts and uncertainties about the environmental benefits of electric cars, science is increasingly clear.

8. APPENDIX:

<https://drive.google.com/file/d/1OmskT-EDFls8ywANYrQUfKdsIUZX71AM/view?usp=drivesdk>