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EV CHARGING STATION

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Abstract:
Electric Vehicle (EV) Charging Station (CS) infrastructure needs and problems in the Indian context are explored in this paper. There has been a progressive evolution in the performance and dependability of market processes regarding the allocation of energy and the energy mix in the Indian electricity market due to liberalization, transmission, and distribution of distributed and renewable power generation, privatization, and expansion. Using a systematic approach, we examine key factors affecting the commercial viability of EVs in the present energy market. This paper outlines a scenario informed by market and regulatory considerations in which an aggregator manages charging for electric cars and supplies ancillary grid services. Smart charging infrastructure networks are needed to help drivers of electric cars locate charging outlets. Assuring EV adoption and lowering associated costs and risks (such as those stemming from battery degradation, economic uncertainty, a lack of charging infrastructure, the potential for costly repairs, and the vehicle's inability to be integrated into smart grids) requires careful consideration when deciding where to install charging stations. It is possible to eliminate some obvious risks, including Grid, Range Anxiety, Extra Weight, and Driver Mood.

Keywords- infrastructure, charging stations location conditions, electric vehicle battery, charging stations, smart charging, Charge scheduling, Electric vehicle,

I.INTRODUCTION

A.Electric Vehicles:

Catalyst Research Volume 23, Issue 2, November 2023 Pp. 5087-5105

The term "electric vehicle" (EV) refers to any vehicle that is propelled by electric motors (sometimes called "traction motors") rather than conventional gasoline engines. An electric vehicle's power source might be the energy already present in the car, collected by a collector system, or the vehicle could generate its electricity from a fuel source using batteries, solar panels, or electric generators. Electric vehicles (EVs), such as cars, trains, boats, planes, or ships, may run on electricity. Electric vehicles (EVs) were initially developed in the middle of the 19th century, as electricity was one of the most popular means for automobile propulsion since it allowed for more comfort and manoeuvrability than gasoline-powered vehicles. For the last century or so, modern internal combustion engines were the standard for propelling automobiles, but electric power is still widely used for other sorts of transportation, including railways and many types of small vehicles. The abbreviation EV is often used to refer to electric vehicles. Electric vehicles (EVs) have had a renaissance in the twenty-first century, thanks to technological developments and a shift toward the use of renewable energy. As the EV market grew, a handful of "DIY" engineers started disseminating information on how to make EV conversions at home. In order to boost the number of adoptions, governments worldwide, particularly the United States and the European Union, have instituted incentives. From 2% of the world's vehicle fleet in 2016 to 22% by 2030, the predicted growth rate for electric cars. [1] Over the last several decades, there has been a resurgence of interest in electric transportation infrastructure due to concerns about the environmental effect of petroleum-based transportation networks and the prospect of peak oil. Electric vehicles (EVs) are distinct from their internal combustion engine (ICE) counterparts because a wide variety of resources, including fossil fuels, nuclear power, and renewable resources like tidal power, solar power, hydropower, and wind power, can generate the electricity they use. Originating from many different sources to a certain extent, electric cars' carbon footprints and other pollutants are influenced by the fuel and technology used to generate power. Batteries, flywheels, or supercapacitors might then store the energy on board the vehicle. Combustion-powered vehicles are limited to a select number of energy options, often non-renewable fossil fuels. One significant benefit of hybrid or plug-in

This is accomplished by the vehicle's regenerative braking system, which transfers the kinetic energy normally wasted as heat during frictional braking back to the battery. [2]

A. About conventional fuels

Petroleum is a dark yellow to black liquid that is found naturally occurring and is extracted from rock formations deep inside the earth. It is often refined into a plethora of different types of fuels. Distillation is the process that separates a liquid mixture into fractions that each have a distinct boiling point. This method, known as fractional distillation, is used to separate the various components of petroleum. It comprises hydrocarbons of varying molecular weights and may include various chemical substances. To be clear, the term "petroleum" refers to both crude oil in its natural form and the many refined forms that are commercially available. Petroleum is a kind of fossil fuel that is formed when a large number of extinct organisms, the most of which are zooplankton and algae, are entombed deep inside sedimentary rock and subjected to extreme heat and pressure. The most common technique for recovering petroleum is known as oil drilling.

Reservoir characterization, sedimentary basin analysis, and structural geology (on a reservoir scale) are done before drilling begins. It is estimated that the global use of petroleum is roughly 95 million barrels per day due to its usage in producing several different types of commodities. Petroleum usage as a fuel contributes to climate change and ocean acidification. The United Nations Intergovernmental Panel on Climate Change warns of "severe, pervasive, and permanent repercussions" on people and ecosystems without phasing out fossil fuels, especially petroleum.

B. Overview of Batteries

Batteries are used in a broad variety of portable electronic devices to both store and provide electrical power. Batteries are made up of one or more electrochemical cells that are linked to one another by wires. While the positive terminal of a battery is referred to as the cathode, the negative terminal of a battery is referred to as the anode. By way of an external electrical circuit, electrons will be moved from the negative terminal to the positive terminal in the course of this process. The free energy difference between the reactants and the products of a redox reaction is transmitted to the external circuit as electricity when a battery is connected to a load. Once reserved solely for devices with many cells, the term "battery" has expanded to cover those with just one. Primary (single-use or "disposable") batteries may only be used once before being thrown away due to permanent changes to the electrode material during discharge. One popular kind of primary battery is the alkaline battery, used to power flashlights and other portable electronics. The electrode's original structure may be returned to its original state by applying reverse current, allowing secondary (rechargeable) batteries to be depleted and recharged. Vehicles employ lead-acid batteries, while laptops and mobile phones use lithium-ion batteries as examples of portable energy storage. Multiple sizes and types of batteries exist, from the tiny cells seen in smartphones and other electronic devices to the massive lead acid or lithium-ion batteries found in automobiles and the biggest solar arrays. Large battery banks the size of rooms offer backup power for critical facilities like data centers and telephone exchanges. Batteries have relatively low specific energy compared to more typical fuels like gasoline. However, the greater efficiency with which electric motors transform chemical energy into the mechanical effort in cars helps to mitigate this disadvantage. [3]

Lithium-ion Battery:

A lithium-ion battery has a high number of recharge cycles. The military and aerospace sectors also increasingly use lithium-ion batteries due to their reliability and performance in portable devices and electric vehicles. John Good Enough, Akira Yoshino, Rachid Yazami, and Stanley Whittingham, made significant contributions to the development of this technology during the 1970s and 1980s; in 1991, Sony and the Asahi Kasei group led by Yoshio Nishi brought it to market. Battery discharging as well as charging involve the movement of lithium ions via an electrolyte from a negative electrode to a positive electrode. The positive electrode of a Li-ion battery is made up of an intercalated lithium compound. The negative electrode of a Li-ion battery is typically made of graphite. It has a high energy density, a low rate of self-discharge, and it does not have any memory effect. However, they threaten public safety since their flammable electrolyte may lead to explosions and fires if the batteries are broken or charged incorrectly. [4]

Lead-acid battery:

First introduced in 1859 by French scientist Gaston Plante, the lead-acid battery is a rechargeable battery that may be used again. Although the cells have a poor energy density (the amount of energy contained in a given volume), their power density (the amount of power generated in response to a given weight) is high because of their capacity to produce strong surge currents. Because of these qualities and their cheap price, they are a viable option for supplying the high current needed by car starting motors. Lead-acid batteries are widely used because they are inexpensive, even in situations when surge current is not required and alternative designs have the potential to provide a better energy density. In 1999, lead-acid batteries had a manufacturing market value of around $15 billion, accounting for 40-45 percent of the batteries sold globally (excluding Russia along with China). Battery backup systems in cell phone towers, hospitals, and other high-availability locations often employ large-format lead-acid designs for storage. Customized versions of regular cells may be utilized to extend their storage life and decrease their upkeep needs. Most often, (valve-regulated lead-acid) batteries (also known as gel-cell batteries and absorbed glass-mat batteries) are used in these applications. [5]

D.Needs of battery vehicle

Cheaper to run- Owners of electric vehicles benefit from much cheaper operating expenses. It costs about a third as much per kilometer to power an electric car as it would to fill up with gas. You may determine the cost savings using any one of the available calculators. View My Electric Car's Gasoline Savings Calculator to see how much money you might save.

Cheaper to maintain- There are fewer components in a battery electric vehicle (BEV) than in a regular gas or diesel-powered automobile. In an electric vehicle, equipment like radiators, starting motors, fuel injection systems, and exhaust systems are unnecessary and hence not subject to regular maintenance costs. BEVs are simple and robust because they only have one moving element (the rotor). Brakes, tires, and suspensions are the only things that need attention2. Inevitably, you'll need to get new batteries since they'll run out. Due to the higher expense of repairing the gasoline engine, PHEVs (Plug-in Hybrid Electric Vehicles) are more expensive to maintain. However, the electric motor causes far less wear and tear on the petrol engine's parts because of its low maintenance needs and few moving parts.

Better for the environment

Less pollution - Using an electric vehicle is a proactive step in reducing harmful emissions into the atmosphere. A fully electric vehicle produces no exhaust.

Renewable Energy - A greater reduction in emissions of greenhouse gases is possible if the EV is charged using renewable energy. Instead of using the grid to power your electric vehicle throughout the day, you may use your solar photovoltaic system. Green electricity may be purchased through your local utility provider as an alternative. Then, using the grid to charge your EV still results in less GHG emissions.

Eco-friendly materials – More sustainable practices are being used in EV manufacturing. The Ford Focus Electric's recyclable materials and bio-based cushioning are also impressive features. Parts of the Nissan Leaf's interior and exterior are constructed from recyclable materials, including plastic water bottles, grocery bags, and even the metal frames of decommissioned automobiles and appliances.

Health Benefits- The good news is that exhaust emissions have decreased, which is great for everyone's health. With improved air quality, fewer health issues and fewer air pollution expenses may be expected. Electric vehicles (EVs) reduce noise pollution since they are quieter than gas or diesel-powered automobiles.

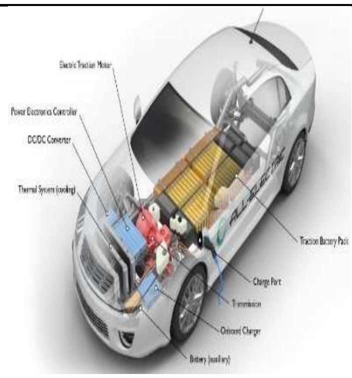

Fig. 1- overview of electric vehicle

Fig.-2- charging time

Charging time-

Charging time is related on battery capacity and charger capacity. Charging time is proportional to charging level, which in turn is governed by the charger's electronics and the vehicle's battery's voltage tolerance. The SAE International guidelines in the United States classify three different speeds for charging electric vehicles: Level 1 (normal household 120V AC), Level 2 (normally increasing household 240 VAC), and Level 3 (Super Charging, 480V DC or higher). There has been an intense rivalry in the market to determine which standard for Level 3 charging should be widely accepted, even though charge times may be as low as 30 minutes for 80%.

The formula for determining the charging time is as follows: Charging time [h] = Battery capacity [kWh] / Charging power [kW]. First-generation EVs have useable battery capacities of about 20 kWh, providing a range of around 160 km. This is the case with vehicles like the original Nissan Leaf. While several automakers have dabbled with long-range EVs, Tesla was the first to market with the Model S, offering three different battery sizes (40 kWh, 60 kWh, and 85 kWh) and claiming a range of 480 km for the latter. Although the electric range of a plug-in hybrid car is only around 20 to 40 kilometers, the complete range of a conventional vehicle is guaranteed by the gasoline engine. Batteries may be charged normally (up to 7.4 kW) using the in-car chargers that automakers install. Connecting it to the power grid through a charging wire provides 230 V AC electricity. Manufacturers have settled on two approaches to rapid charging (22 kW, even 43 kW and more):

• Charge at a 3 to 43 kW rate using the vehicle's built-in charger and 230 V single-phase or 400 V three-phase electricity.

• Put to use a 50-kilowatt (kW) external charger that converts alternating current (AC) into direct current (DC) for the car (e.g., 120-135 kW Tesla Model S). [6] While many electric vehicles (EVs) can be charged from a standard residential wall outlet, charging stations are more convenient and sometimes include current or connection monitoring systems to cut off power when the EV is not being charged.

There are two main types of security sensors:

• Sensors, which measure the current draw and keep the circuit open only when the power consumption falls within a certain range. Faster responses, fewer potential failure points, and likely lower development and implementation costs are all advantages of sensor wires. However, current sensors may utilize common connections and provide a convenient way for utilities to track how much power is used or billed.

• Special (multi-pin) power plug fittings are needed for extra physical "sensor wires" that provide a feedback signal, as defined by standards like SAE J1772 and IEC 62196. Overheating Blink chargers were causing problems for both the charger and the vehicle as early as 2013. The business decided to fix the problem by decreasing the maximum current.

“**Table- 1 charging time and level of charging**

Charging time for 100 km of BEV range	Power supply	Power	Voltage	Max. current
6–8 hours	Single phase	3.3 kW	230 V AC	16 A
3–4 hours	Single phase	7.4 kW	230 V AC	32 A
2–3 hours	Three phase	11 kW	400 V AC	16 A
1–2 hours	Three phase	22 kW	400 V AC	32 A
20–30 minutes	Three phase	43 kW	400 V AC	63 A
20–30 minutes	Direct current	50 kW	400–500 V DC	100–125 A
10 minutes	Direct current	120 kW	300–500 V DC	300–350 A.”

F. need protection for charging station

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literature review

Afida Ayyob et al. (2014) This research provides a thorough analysis and comparison of several electric car models, focusing on the battery charger and its associated components found at a charging station. We evaluate production electric cars and their prototype counterparts regarding electric range, battery capacity, charger power, and charging time. The effects of electric car charging on the utility distribution system are described, along with the various charging stations and standards already used for such purposes. We're the people that write the books on charging station standards, including IEC 61851 (IEC, 2010), IEC 61851-23, IEC 61851-24, and IEC 62196-Plug, Socket-Outlet, Vehicle Connector, and Vehicle Inlet (IEC, 2011). Plugs, socket outlets, and couplers for industrial applications (IEC, 2012) etc.: IEC 62196-1, IEC 62196-2, IEC 62196-3, IEC 60309. He researches electric vehicles, battery chargers, and charging infrastructure. There is also an in-depth analysis of the existing standards for EV charging in use today. Electric range, battery capacity, and charger power are compared between commercial and prototype electric cars to provide light on the current stage of EV development. Eventually, she leaves. Time to charge, etc. [1]

Adam Junid et al (2016)

The effectiveness of Electric Vehicle (EV) Charging Station Installation in Malaysia is Evaluated in this Paper. The research looks at (i) how far along electric vehicle charging stations are expected to be at this point, (ii) what the main challenges are to establishing a nationwide charging infrastructure for EVs in Malaysia, and (iii) what can be done to overcome them. Following this study strategy, he polls Nissan, Mitsubishi, and Renault—three firms with outlets in Malaysia selling electric vehicles—to acquire primary data. Research reveals potential solutions to the problems. Several challenges, including price, lack of government support, and vandalism/theft, have slowed the development of EV charging stations. To counteract these issues, it is suggested that the number of public charging stations for electric vehicles (EVs) be expanded to cover the whole nation and that EV charging stations be installed in every gas station and shopping center. Initial EV station financing will likely come from government grants and Will have to come from subsidies given that EV station operating needs a significant number of EV customers to become a sustainable company. [2]

Praveen Kumar et al. l (2013) In this study, they explore the possible need for Electric Vehicles (EV), Charging Station (CS) infrastructure in India, as well as the difficulties that may arise from implementing such a system. Due to their low onboard energy, BEVs are now restricted to a range of around 100 kilometers before recharging; this problem may be mitigated with better real-time traffic management and the widespread adoption of plug-in hybrid cars. There has been a progressive evolution in the efficiency and dependability of market processes regarding the allocation of energy and the energy mix in the Indian electricity market due to liberalization, transmission, and distribution of distributed and renewable power generation, privatization, and expansion. Having trouble finding a charging station for your electric vehicle? Smart charging infrastructure networks are here to help! Information on the availability of charging slots at the closest CS is gathered via interactions between EVs and EV-Charging Station Selection (CSS) servers through mobile networks, and this data is then included in the algorithm used to pick a charging station. Streamlining processes and decreasing wait times. In order to address load management concerns locally, India should engage in scaled-down retrofitting projects rather than undertaking system-wide reforms. Longer battery life and grid balance may result from promoting home charging. Large-scale charging infrastructure in the world's second-most populated nation requires careful design to account for the country's growing population, increasing urbanization, traffic volumes, and risks. Transportation, energy, and power electronics firms are working to bring about the widespread availability of commercial charging terminals and fast-charging stations for electric cars.[3]

Kara M. Kokelman et al. (2018) This study models the optimal location of charging stations for long-distance road trips throughout the United States. The range of the vehicles and the number of charging stations (from 50 to 250 in the US) are taken for granted in each scenario (from 60 miles to 250 miles). To increase the amount of long-distance highway travel that may be accomplished by BEV owners in the United States, this study creates a novel flow-refueling location model (FRLM) to locate suitable places for charging stations 11. 12 . To be. Origin and target locations were grouped into 196 points (beginning at 4,000 14 NUMA centroids) and just over 38,000 OD points in order to manage the massive amount of input data present for this very large scale 13 challenge. More than 90% of all long-distance automotive traffic in the nation occurred along these 15 heavily used corridors. [4]

Marcy Lowe et al. (2010) In this study, the author argues that high-tech batteries are crucial to the automobile industry's transition from internal combustion engines to electric drivetrains. The ability to produce domestically-sourced lithium-ion batteries is crucial if the United States maintains its global competitive edge. Hybrid, plug-in, and fully electric vehicles will account for over half of all new vehicle sales by 2020. As a result, the United States is the only country without access to lithium-ion batteries. Both its current and potential status in the automobile business is on the line. [5]

Somudeep Bhattacharjee et al. (2017) write that several factors—including battery expense and deterioration, economic risk, and a lack of charging infrastructure—make site selection for an EV charging station very important. The associated hazards must also be considered. All issues are range anxiety, supplementary loads, drivers' attitudes, and difficulty integrating EVs into smart grids. In this article, we take a multifaceted look at these issues by comparing and contrasting (i)three distinct kinds of EV charging stations (Level 1, Level 2, and DC), (ii)various battery types, and (iii)various EV models. We researched and contrasted the specs of several battery packs and charging hubs. They recommend installing charging stations at schools, restaurants, hotels, hospitals, temples, airports, and retail complexes with parking lots, as well as in public areas like parking lots and garages. The installation of public charging facilities for electric vehicles. According to him, level 2 charging stations are preferable since the vast majority of electric vehicles now on the market are designed to accommodate just such vehicles.

Time spent at the charging station by the user is a crucial factor in station placement decisions for electric vehicles. The time needed to recharge an electric car varies depending on the charging station type, even if the distance traveled in kilometers remains constant. Compared to other charging stations, level 2 charging stations allow consumers to charge their vehicles quickly and easily. Pbacid (Lead-acid), Ni-Cd (nickel-cadmium), Ni-MH (nickel-metal hydride), Li-ion (Lithium-ion), LiPo (Lithium-ion Polymer), LiFePO4 (lithium-iron-phosphate), and Li-S (lithium-sulfur) batteries were evaluated for capacity and price. The research concludes that the lead acid battery is the best option for EV use. [6]

Shaohua Cui et al. (2018) In this study, they analyze where various sized and style charging stations are located. Users have varying charging needs, which may be accommodated by installing various charging stations. Since charging stations may vary in size, the government can spend less on station construction without sacrificing the required minimum journey time for passengers. To make our topic more applicable, this article additionally considers the user's worried mileage and other considerations. Additionally, he uses two networks to validate the model's accuracy. By adjusting the cost of the charging station's installation, the starting electrical quantity, and the concern range of agents, he can examine the end charging station's position as well as the size and style of the charging station. The model's reasonableness and practicability are reflected in the end product, which is practicable. The model was then applied to the more sophisticated and extensive Sioux Falls network in order to provide more tangible results. Finally, the findings of our research indicate its significance and applicability. [7]

Doug Kettles et al. (2015) The technology and standards around electric cars (EVs), EVSE, and related infrastructure are the focus of this paper. The article examines regulations regarding roadways, automobiles, and other infrastructure. The paper also assesses the obstacles and difficulties to expanding the current network of EV charging stations and provides solutions to aid in speeding up the implementation of EVSE infrastructure to accommodate the rapid expansion of EVs. Slow and limited progress in creating standards to back up EVSE infrastructure growth has been a major issue. Different kinds of onboard chargers are available for PEVs, and there is a wide range of power levels for recharging batteries, equipment connections, and even, in one instance, connectors for the same charging level. Are. In addition, certain charging networks have issues with equipment that often breaks down and has unacceptable wait times. These features aren't just "bells and whistles" for the PEV customer; they have genuine, long-term effects on the PEV owner's ability to operate and enjoy their vehicle. Converting to electric cars is challenging for the average motorist because to worries about reliability, a lack of physical layer standards, and the private

Catalyst Research Volume 23, Issue 2, November 2023 Pp. 5087-5105

nature of present PEV charging networks. If only those with access to the Internet and the means to utilise it could find nearby charging stations, the demand for PEVs would drop significantly. [8] Authors Yu Miao et al. (2019) This article introduces readers to Li-ion batteries as a viable energy storage option for EVs. Components of battery management systems are discussed, and various materials for positive and negative electrodes, electrolytes, and physical implementations of Li-ion batteries are given and contrasted. Current lithium batteries' functionality is very sensitive to material and temperature properties. Most of the battery's heat is produced at the electrodes; thus, it's important to investigate different cooling technologies and electrode design parameters to decrease or compensate for the heat and increase battery life and capacity, as previously described. As the lifespan of EV batteries dwindles, studies are revealing several methods for either reusing them as a complement to the current power system or recycling the battery components when they are no longer functional. [9]

In this article by Henry Lee et al. (2018), Although the barriers to EV development have gotten more manageable in recent years, they remain substantial. Significant improvements have been made to the total cost of ownership of BEVs; if installed battery costs continue to fall below $300 per kWh, genuine parity with ICEs might be achieved in the next 5-7 years. The efficient rollout of low-cost charging infrastructure to sustainably expand EV ownership is of considerably higher relevance. Based on the results of a separate economic study, it seems that home Level 2 charging, when accessible, maybe the best choice for most of an EV owner's charging requirements and that Time-of-Use (TOU) charges (primarily for nighttime charging). It can minimize the average cost of power to a lesser extent than the price of gasoline for an internal combustion engine. Indications of an imminently massive EV industry may be seen in the exceptional investment and product development levels anticipated by almost all major OEMs. [10]

In this article, Avinash et al. 2020 - In India, the energy and environmental landscape of personal transportation might benefit from the widespread adoption of PEVs (plug-in electric vehicles), such as PHEVs (plug-in hybrid electric vehicles) and BEVs (battery electric vehicles). The federal government needs to initiate mandatory efforts to construct EV charging infrastructure. One possible first approach is to urge major participants in global markets to do case studies on suitable sites and sufficient numbers of EV supply infrastructure (EVSE). Projections of EVs need research into how the increased current, energy production, transmission and distribution network, traffic volume, emissions, and the demand for more parking space would change the status quo. The established infrastructure must be appropriately operated and maintained. Private companies should be contracted rather than the government to keep things running smoothly. [11]

The EV charging station aims to achieve the following:

•To facilitate rapid uptake of EVs in India by providing a secure, dependable, easily accessible, and affordably priced charging ecosystem.

•To advocate for a reasonable rate that may be collected from EV drivers and charging station proprietors.

•For local businesses to get access to new sources of revenue and jobs.

•The goal is to foster early-stage efforts to build a charging network for electric vehicles and ultimately develop a market for the EV charging industry.

•to increase the readiness of electrical distribution networks to adopt infrastructure for the charging of electric vehicles (EVs).

Site location for electric vehicle charging station-

Regarding public charging stations, there are certain guidelines for how close together or far apart each one may be placed.

•There has to be at least 1 charging station for every three kilometers of the grid. There should also be a charging station every 25 kilometers along major routes and highways.

• Long-range electric vehicles (like long-range SUVs) and heavy-duty electric vehicles (like trucks, buses, and so on) are needed to have at least one Fast Charging Station with Charging infrastructure Specifications according to paragraph 4. At least one station per 100 kilometers should be built, ideally inside or near the rest stops described in paragraph 3. Heavy-duty electric vehicle charging stations are required to be installed in city bus terminals known as Transportnagars. Additionally, truck and bus changing stations are not required inside urban areas.

Only until these conditions are met may new public charging stations be installed in any given location.

• The relevant state/UT governments/their Agencies must use the density as specified above/distance requirements for the dual purposes of arranging land m any manner for public charging stations and giving precedence 1n building of distribution network containing transformers/traders etc. This must be done regardless of whether there is government funding. Existing Oil Marketing Company retail outlets (ROs) may be given preference by the relevant governments (Central/State) for the construction of Public EV Charging Stations (in conformity with safety criteria including "firewalls etc."). The preference may also be given within such ROs to COCO (Company Owned and Company Operated) ROS. In cooperation with the Central Nodal Agency, the State Nodal Agency must explicitly approve any departure from the standards as mentioned above before they may be implemented.

Charger specifications for electric vehicles

• A dedicated transformer, the necessary substation hardware, and a safety appliance.

Line metering infrastructure, comprising 33/11 KV wires and their supporting hardware.

•Appropriate civil works.

•Adequate space for charging and entry/exit of vehicles.

•CCS (Combined Charging System) and CHadeMO are the two current international standards widely adopted and utilised by car manufacturers worldwide. So, each public charging station has to feature one or more electric kiosk boards where users can find plugs for every charger.

Infrastructure for the electric vehicle charging station-

The following are the minimum standards that must be met by public charging stations for long-range electric vehicles and heavy-duty electric vehicles:

Each Public Charging Station must include at least two 100 kW chargers (with 200-1000 V each of various standards (CCS & CHAdeMO) and with one connection gun each, in addition to the basic charging infrastructure necessary for Public Charging Stations as indicated in paragraph 3.

• Adequate Liquid-Cooled Cables for High-Velocity Onboard Charging of Fluid-Cooled Batteries (currently available in some long-range EVS).

It's worth noting that fluid-cooled batteries (FBS) are typically required for fast charging/long-distance use of EVs and Heavy duty vehicles like buses/trucks etc., so Fast Charging Stations (FCS) for Long Distance EVs and/ or Heavy Duty EVs may also have the option of swapping facilities for batteries to meet the charging requirements as per para 3 and para 4.1 & I above.

IV.Methodology

Electric Vehicle Charging - An EVSE's charging capacity may be described on three levels: Level 1, Level 2, and DC rapid charging. Figure 1 displays the respective ranges made available, with more explanation in the next paragraphs.

Level 1- 120 Volt Charging- This most basic method of charging requires a 120V AC connection to a regular household or business power outlet, which supplies 15-20 amps of current and has a maximum power output of 1.4 kW. Manufacturers of EVs often include Level 1 portable chargers. A Level 1 EVSE will take 10-14 hours to fully charge an AEV with a range of 60-80 miles.

Level 2 - 208/240 Volt Charging - Time spent charging is cut in half with Level 2 charging, which calls for a 208/240V AC power connection. Electric dryers for homes normally need 240 V electricity, but many businesses require 3-phase electrical service at 208 V. "Level 2" charging is compatible with any voltage. Even though the J1772 standard connection used by most EVs can deliver up to 80 amps of power (19.2 kW), the majority of presently available cars only draw up to 30 amps while charging, which results in a range of 3.3 to 6.6 kW6. An AEV with a range of 60-80 miles will normally take 3-7 hours to fully charge using Level 2 equipment; Nonetheless, this varies from one EVSE to another and from one car to another, since both the EVSE and the vehicle have their own charging capacities. A fully charged battery may extend the range of a plug-in hybrid electric car (such the Toyota Prius Plug-in) by roughly 10 miles, and a full charge can be attained in about an hour.

DC Fast Charging –

DC rapid charging equipment, sometimes referred to as Level 3 chargers, supplies additional energy to the battery system of an electric car. In as little as 30 minutes, a full charge may be applied to any electric vehicle. The connection for DC fast charging levels 1 and 2 are different versions of the J1772. For rapid charging devices, three distinct connection types are available: CHAdeMO, which Nissan uses, Mitsubishi, and Kia; SAE combi, which is used by American and European automakers including BMW, Chevrolet, Tesla, Mercedes-Benz’s supercharger, which is used only by Tesla Model S and subsequent cars. Also, Tesla has released an adaptor to let its customers utilize CHAdeMO devices.

"Table. 2 – direct current specification

Power supply	**Power**	**Voltage**	**Max current**	**Charging time**
Direct current	50kw	400-500V	100-125A	19-24 Min.
	120kw	300-500V	300-350A	8-10 Min.

Table- 3 charging range added per hour of charging."

Miles of Range per Hour of Charging		Level 1	Leval2	Level3 **DC fast Charging**
	90			
	80			
	70			
	60			
	50			
	40			
	30			
	20			
	10			
	0			

Level 1

•The typical electrical outlet found in American homes operates at 120 volts alternating current and either 15 or 20 amps.

•Will take the most time, anything between eight and ten hours to fully charge.

•The simplest; the most convenient for car owners.

•Power consumption is comparable to that of a microwave oven or hair drier.

•Optimal for NEVs going slowly and certain PEVs with a limited range on electric power alone; may also work well in places where a PEV may be parked for many days or weeks.

Level 2

•Maximum current of 80 A at 208/240 volts (100 A circuit).

•Only the SAE J1772 plug will be used.

•use a level of energy consumption typical of much larger home appliances like refrigerators and washing machines.

•Requires two to three-hour full charge*.

Level 3 (DC fast Charging)

•480 VDC / 100 A (and up) fast charge.

•80% charge in around 30 minutes*.

Residential Charging Station Installations-

A majority of EV owners charge their vehicles at home. Homeowners who charge their automobiles at night when not in use may save a significant amount of money compared to gasoline since electricity is significantly cheaper. As a result, the cost of installing an EVSE may often be kept to a minimum since many houses already have their power lines. Charging equipment might be difficult to install for residents of condominiums and apartments if there is no dedicated parking space available close to a power outlet. Level 1 charging may be performed with existing 120V outlets using manufacturer-supplied equipment; however, a separate 15-amp circuit with GFCI protection is often recommended. The Table below summarises the need for and the steps involved in installing charging stations for private homes.

Commercial Locations- Charge stations for electric vehicles are second most often seen in places of employment, after the owner's residence. The number of Vermont companies that provide EVSE to their staff, visitors, and/or customers continues to rise. There are many other considerations for placement in these zones.

•**Parking capacity** – To fully charge, vehicles need overnight parking. Conceivably, conflicts between EVs and conventional cars might be mitigated via the strategic placement of charging infrastructure in regions with surplus parking capacity and the limitation of EV charging places.

•Proximity to employment/destinations – Charging an electric vehicle may take a long; thus, it's helpful to have charging stations near other services like stores, restaurants, and bathrooms so that EV drivers can pass the time while their cars are charging.

•**Modal Connections** – Charging stations near walkways, bus stops, parks, and rides provide owners easy access to more places and activities.

Working and Processes

An Overview of Electric Vehicle Charging Infrastructure: Charging stations for EVs may be roughly categorized by the estimated charge rates they provide and the kind of electricity they use (AC or DC). Power electronics, the amount of charge already present, battery size, and the quality of the charging station all affect how long it takes for a certain car to recharge. The proper term for these charging hubs is electric vehicle supply equipment (EVSE). The electric vehicle is equipped with an inverter that converts the AC power from the EVSE (at 120 volts alternating current [VAC] up to 2 kilowatts [kW]) or the EVSE (at 240 or 208 VAC up to 19.2 kW) to DC electricity that charges the batteries. In order to provide DC power directly to the car at greater amps, DC EVSE uses an off-board inverter. The plugs used at Level 1 and Level 2 charging stations have been standardized so that all-electric vehicle types may use them. The SAE J1772 standard for automotive connectors has stringent standards for safety and stress resistance. It's important that DC fast charge stations, like the one at Diane's Downtown Automotive in Ithaca, support both CHAdeMO and SAE J1772 Combo, the two most common connection types for DC fast charging. Although Tesla's proprietary connector differs, the company provides CHAdeMO and SAE J1772 Combo converter cables as optional extras and ships an SAE J1772 compatible adapter cable with every car. Connecting EVs to electric vehicle charging equipment, also known as Electric Vehicle Supply Equipment, is how the vehicles have their batteries recharged (EVSE). This safeguard system interacts with the car's electrical system and monitors everything to ensure it's charging safely. Electric vehicle supply equipment (EVSE) is the conduit, control, and monitoring device that links the car to the electric grid; the actual "charger" is inside the vehicle.

Side Consideration- The steps required to install electric vehicle charging stations in a given area will vary based on who owns the land and what it is used for. Next, we'll go through the process of establishing a charging station in further depth after discussing many major aspects that should be considered when deciding where to put an EV charging installation on a property.

General Siting Issues-

• **Availability of power** – The proximity to a source of electrical power is a major component in estimating the total cost of an installation. If there is spare capacity, it will be cheaper and take less time to install charging equipment next to existing power lines. Property owners may decide to make investments in efficiency enhancements for other power consumption on the property to reduce monthly power bills and free up service capacity in crowded situations. It is possible that installing a new service drop and metre from a utility distribution transformer would be more cost-effective if it would shorten the distance that energy would travel to arrive to the best site for the charging station.

• **Constructability** – As previously said, the trenching required for conduit lines may be decreased by locating equipment close to power sources. Many installations still need to trench, and it's preferable to do so in grass medians rather than on hard surfaces like asphalt or places with significant landscaping.

• Mounting – If there is sufficient wall space, a wall-mounted device is commonly chosen since it requires less initial investment and is easier to install. Adding an extra port is usually far more cost-effective than adding a new single-port device, the availability of dual-mount alternatives for charging equipment may also assist in decreasing total installation costs.

• **Environmental protection** – The charging apparatus should be protected from the elements as much as possible. Water or areas where it is likely to pool should be avoided.

Choosing the location – Free charging stations for the public Public charging stations should be installed in convenient areas, such as parking lots near railway stations, retail malls, restaurants, hotels, and resorts. In making your site choice, keep in mind the following:

• traffic, with the installation's scale determined by projections of use.

• The time that electric vehicles will have to wait at the charging facility.

• Contextual factors: automobiles halted for charging must not impede traffic flow.

•The area can't be a snow dump or impede snow removal efforts in the winter; it must be kept free and accessible at all times.

• Protection against collisions.

• **Impact on pedestrian traffic** – must not impede foot movement, lest it attracts more pedestrians and, thus, be more likely to be vandalized.

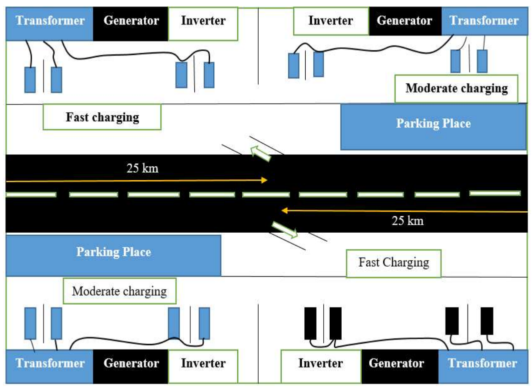
• Mobile network connectivity, if needed by the charging station The potential for the necessary excavation work to be accomplished.

• **Proximity of distribution panel.**

• The charging station should be easily visible so that motorists would utilize it. There is also the length of the charging line to think about about the normal placement of EV charging plugs and the mounting requirements (pole-mounted, fixed to a concrete foundation, etc.). Charging stations, both

public and private - Identifying the most suitable charging station installation for your requirements is made easier by this section, which outlines the many options available. This Guide frequently references private and public stations; thus, it is necessary to clarify the difference between them. A "private station" has been bought by an individual for their usage. A public station is accessible to the general public and may be on public or private land.
Charging station selection criteria- A wide range of models are available, each one tailored to a certain purpose. Consider the following criteria while settling on a charging station:
• The necessary force (pricing, capacity, vehicle, charging time).
• The communication requirements (help system, payment system, access control).
• The number of plugs and cables (for shared-access stations).
Public or private charging stations in commercial zones – Businesses subject to Rate G could avoid optimization fees by keeping their building's maximum power use below 50 kilowatts (kilowatts) while installing Level 2 charging stations for their staff and customers. If the maximum power demand of a charging station is more than the 65k W presently being billed, then an additional cost per additional k W may be incurred. Rate M or Rate G 9. Consider using one-on-one wires or a smaller network of charging stations if this is the case. Heavy industrial charging station - Rate L customers in the manufacturing, mining, and quarrying industries have a minimum monthly billing requirement of 5,000 k W. The installation of Level 2 charging stations shouldn't significantly affect the maximum power need of cars, even if charging is briefly halted or reduced during plant machinery startup. During off-peak hours, when electricity demand is lower, the plant's cheap cost per kilowatt hour makes it an attractive candidate for usage in fast-charging stations.
Apartment building parking areas - Before installing a charging station in the parking lot or garage, it is important to think about factors like its position, who owns the parking space and the grid connection facilities, and how many people live in the building.J1772 plug-ins are widely used at 208 or 240 V, 30 A charging stations. Installing a charging station for an electric vehicle in a condominium where the parking space is on the owner's property (such as a townhouse) is the same as in the case of a detached dwelling. Each condo owner with a garage parking space must consult with the condo association to determine where the charging station should be installed. The condo unit owner's or common area meter may provide power to the station. Either way, the wiring is similar to what you'd find in an underground garage or storage facility, where you'd find a block heater or lighting outlet. Workplaces- Workplace installations often have more leeway regarding charging times because of workers' regular work schedules. A 3-kilowatt (kW) charging station may provide enough energy to power an electric vehicle (EV) for less than 50 kilometers (km) of driving, or around 10-kilowatt hours (kWh). It takes around 7 hours for a Level 1 charger to provide 10 k W h, so it may not be quick enough to offer a complete charge. However, if the E V stays plugged in for the work shift, AC Level 2 chargers with a 3.6 k W rating (240 V, 15 A) may be sufficient. High-mileage users like sales reps, delivery persons, and short-stay users like guests and clients may need charging stations rated 7.2 k W or even 19.2 k W.
Site Plan - Many different layouts and designs for an electric vehicle charging station are possible, depending on considerations such as the layout of the parking lot, the proximity of electrical outlets,

and other factors. When clearing snow around electric car charging stations, wheel stops are a common hazard. Protecting an electric vehicle charging station with bollards is a good idea, they are also useful at the wheel stops for the same reason. Strategies for siting electric vehicle charging stations include:
• Availability of power (Level 2 for DC fast charging, 240V for 3 phase).
• Parking areas for EVSEs should be delineated on a flat, paved surface.
• Safer lighting and increased visibility.
• Accessibility for users with disabilities. Alternatives for mounting or erecting a barrier around EVSEs to prevent damage from passing automobiles.
• Identifying and limiting access to certain areas through signs and pavement markings.



“Fig. 5- actual infrastructure for the electric vehicle charging station”.[20]

Results and Applications

Lower costs: By exposing customers to demand-side management and reducing the need for drivers as well as station owners, electric vehicle (EV) use may be reduced significantly through utility demand response programs. In addition, all customers will save money in the long run because of better usage of utility production, distribution, and transmission facilities made possible by load management's avoidance of long-term utility expenditures.

More charging stations in more locations: The cost of installing charging stations and other utility investments is reduced if utilities are allowed to include them in their standard rate applications.

More than half per station. This could open up opportunities for adding more stations to schools, workplaces, apartments, homes, hospitals, retailers, hotels, etc.

Fuel independence and clean air: According to the US Department of Energy, switching from gas-powered automobiles to clean EVs could cut oil imports in half and greenhouse gas emissions by more than 38% per vehicle.

Built on positive customer relationships: Utilities and their ratepayers have historically and actively worked together. Utilities may provide their customers more value by helping them charge their electric cars with clean, inexpensive power by aiding with the implementation of charging infrastructure.

Improved power planning: Providing utilities with access to data from EV charging infrastructure allows utilities to better plan for the rollout of additional stations and fluctuations in local energy demand.

Grid reliability:

Utilities may be able to provide both the grid and automobiles with electricity at the same time if the infrastructure for charging electric vehicles expands. This includes variable renewable energy sources like solar power.

Expanding the Smart Grid: By installing state-of-the-art charging infrastructure like smartphone applications and "Vehicle Grid Integration" (V2I) enabled stations, we can ensure that all EV drivers, both now and in the future, will be fully integrated into the future smart grid.

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Conclusion and future scope

• five main technologies will make the switch to electric mobility possible: on-road charging, contactless charging, solar charging of EVs, vehicle-to-grid, and smart charging; These innovations have the potential to strengthen the grid and increase the proportion of renewable energy sources, which will have far-reaching effects on the energy market as a whole and disrupt the transportation industry. For innovations to be rapidly advanced and widely used, the correct economic models and standards are essential.

• As its infrastructure improves, India has become the biggest EV market worldwide. Electric vehicles (EVs) are expected to become the standard in terms of both technology and power supply. The initial strategy of global central encouraged market players to undertake research to identify viable places for the building of EV charging infrastructure and supply equipment, with the aim of increasing public awareness in our country. The potential for electric vehicles (EVs) is substantial across all vehicle categories, including two-wheelers, auto rickshaws, cargo trucks, buses, and even larger vehicles with more than four wheels.

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