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Obstacles in Electric Vehicle Adoption and Charging Infrastructure in India

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Abstract

This essay examines the potential demand for infrastructure for electric vehicles (EV), charging stations (CS), and related issues in the context of India. The best substitute for with a car an (ICE) internal combustion engine is an EV. The concentrating solely on EVs is not sufficient because electrical vehicle charging point are crucial for the electrical vehicles. There are some difficulties in installing these charging stations because these vehicles are electrically powered. EVs and EVs- Charging Station selection (CSS) server delivers information about the availability of charging slots at the closest CS over the mobile network, reducing individual waiting time and enhancing efficiency. Depending on the level of charging, charging stations can be of different types[1]. The Institute of electrical and electronics engineering (IEEE), the International elctromechanical commision (IEC), Society for Automobile Engineers (SAE), and the International Organization for Standardization are just a few of the standards bodies that provide guidelines and voltage levels for charging vehicles to their rated capacities.

Keywords: Charging Station Selection, Consumption, Greenhouse Gas, Hypothesis

Introduction

Global warming and climate change are the main problems in the present that could have a negative impact on the nature or human life on Earth. Greenhouse gas (GHGs) are the primary contributors to climate change. The use of fossil fuels for transportation has received the most attention ever paid to air pollution and GHG emissions, especially in large, dense cities.87 billion tonnes of co2-equivalent greenhouse gases emissions were participant transportation filed globally in 2016, and that number increased to 8.04 billion tonnes in 2017. According to a prediction, 24% co2 emission in transportation in the world and 75% those emission comes from road traveling. 291 Mt of CO2 equivalent emissions, or 18% of all energy consumption, were generated by the transportation sector in India in 2017, accounting for 29% of all emissions.

Using electric vehicles improves traffic and maintains a better living conditions because they have zero and extremely low emissions from tailpipes and significantly less sound. As a result, zero-emission vehicles are becoming more and more popular throughout the automotive industry. In 2019, there were 1.5 million more battery electric vehicles (BEVs) added to the fleet, bringing the total number of BEVs in use to close to 4.8 million.

An electric vehicle charging station needs to be constructed and placed in the ideal location in order to promote the use of electrically powered vehicles, reasonably priced, clean electrical energy from the grid, and renewable energy sources. EV owners will experience less range anxiety and their cars will perform similarly to those with internal combustion engines if there is a sufficient network of charging stations. The market penetration of electric vehicles must rise in order to highlight ongoing developments in recharging technology. The current problem with EV adoption can be explained by the "chicken or egg" hypothesis. Because they want to be sure that their trips will be successful. it takes to charge their devices; customers are waiting for adequate charging infrastructure. Before the owners of the infrastructure for charging EVs can start to make money, there must be enough EVs on the road. Only government policies can address each of these issues. Another important factor that has a big impact on the adoption of EVs is the lack of suitable batteries that can supply enough energy for a longer period to increase the range of EVs.

Three revolutions are currently taking place in the transportation sector: shared mobility, autonomous driving, and electrification. Therefore, when designing the infrastructure for electric vehicle charging, it is essential to consider the interactions and potential synergies between these three emerging revolutions. The adoption of electric vehicles is rising, adding a new and significant electrical load to the power grid that will require infrastructure change. The transmission lines can only be used for distributing electricity due to their limited capacity. The distribution grid must be entirely rebuilt in order to support EV charging.

Regarding the potential impacts of substantial grid-connected renewable energy generation (REG) systems and electric vehicle charging infrastructure, the network's performance must be accurately assessed (EVCS). With the help of these analyses, the electric utilities will be better equipped to deal with any potential operational problems.

The necessary infrastructure and each station's rate of charge for recharging electric vehicles. The EV charging infrastructure, which consists of various charging station arrangements. The need for an optimization unit to reduce charging times at charging stations, a prediction unit to help the optimization unit make the best decision possible, and an efficient communication network for information exchange are the three main barriers to developing an efficient charging infrastructure. Putting up Electric Vehicle Charging Stations is not without its difficulties (EVSE). There are more vehicles on the road every day, which means that more electrical power is needed.

This will put pressure on the grid to deliver more electricity, which could overload it. As a result, there will be a need for more power generation, which, if it is done with fossil fuels, will be just as bad for the environment as ICE vehicles. In addition, overloading the grid can result in voltage regulation problems, voltage fluctuations, an increase in peak demand, a decline in system efficiency and reliability, an increase in thermal loading, and—perhaps most significantly—a negative impact on load forecasting. The electrical distribution system relies on load forecasting to calculate the peak load and base load in order to decide how much power needs to be generated. However, since EVs and EVCS have been deployed, it is getting harder to predict how much load the system will be under different conditions.

Figure 1:

Electric Vehicle Types Stations

One of the many developed technologies, electric vehicles (EVs), has drawn a lot of interest as a replacement technology that is integrating into the contemporary transportation system. According to the kind of electricity they use for propulsion, electric vehicles (EVs) can be broadly divided into three categories:

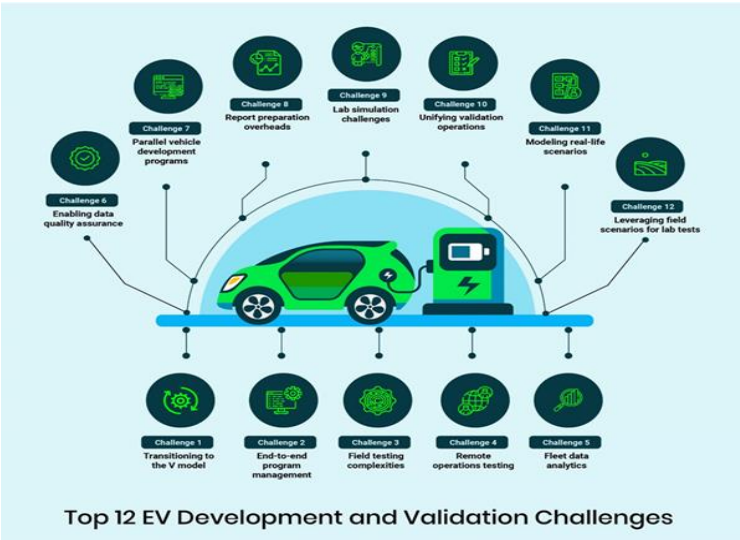

Figure 2:

Examples of electric vehicles:

HEVs are propelled by both internal combustion engines and electric propulsion systems. By doing this, conventional internal combustion engine cars can be outperformed in terms of fuel economy, low emissions, driving range, etc.

PEVs include BEVs and PHEVs. The BEV has eps (electric propulsion system) and is entirely by rechargeable batteries power. PHEVs have a gasoline engine that can be used as a backup in case the battery completely drains, as well as an eps that battery are powered. Fuel cell technology, either alone or in conjunction with a battery or supercapacitor, powers the electric propulsion system of FCEVs. Figure 3 displays a thorough classification of EV types.

EVCS is a part of the infrastructure for EV charging. The power source, the station's integration into the power grid, the power levels used during charging, the infrastructure used during charging, mobility, and the direction of power flow all affect how a charging station is classified. The chart below shows the different categories that EV charging stations fall under.

Depending on the kind of power source that is used for charging, it can be divided into two groups:

Based on how they are connected to the electrical grid, the following charging station types can be divided into categories:

The only grid-connected recharging location is:

(a) In this configuration, the primary electrical grid system supplies all the electric energy needed to charge EVs.

(b) A charging station with integrated grid and renewable energy systems: In this configuration, the renewable energy system and the main power grid coordinate their energy sharing to supply the electrical energy. With the advent of renewable energy systems, the primary power grid isn't put under as much strain for EV charging.

(c) A grid-integrated charging station that uses renewable energy and has integrated energy storage In this setup, a charging station that is connected to the grid includes an energy storage system as well. This system aims to lessen the reliance on grid for EV chargers.

(d) An off-grid energy storage-power electric vehicle charging place: In the configuration, the use of renewable energy or an energy storing systems collaborate to power EV charging. Energy storage technology is being developed to stabilise the erratic nature of renewable energy sources.

In this setup, the electric energy produced by the renewable energy system serves as the sole source of support for EV charging. (e) A charging station powered by renewable energy off the grid without energy storage. To provide a balanced energy supply for EV charging, two or more renewable energy sources are typically integrated, such as in a solar PV and wind energy system.

Based on the charging power levels, three categories can be created:

Regular power outlets, which are typically found in residential settings, are used to recharge an electric vehicle during Level 1 charging also known as normal charging. The rating is typically 110 V/15 A. The term "Level 2 charging," which is also used to refer to semi-fast charging, is used to describe current levels that are higher than those of a typical domestic outlet but that can still be installed in homes and other structures. When compared to standard charging, the rate of charging is high. It typically has a 220 V and 15 to 30 Amp... rating.

(c) Int the high charge, also referred to as Level three charging, necessitates construction of a special infrastructure due to the power levels being significantly higher than those of typical residential or commercial outlet outlets. A typical EV battery can be recharged in as little as 30 minutes using DC fast charging, which typically operates at a voltage rating of 400 to 500 V.

There are three different levels of fast charging, per SAE J1772 standards:

The maximum power rating for DC Level 1 is 36 kW, 200/450 V, and 80 A.

200/450 V, 200 A, and up to 90 kW of power are available at DC Level 2.

The maximum power rating for DC Level 3 is 240 kW, 400 A, and 200/600 V.

Three distinct categories of charging infrastructure can be distinguished, including:

Any infrastructure that permits standard or semi-fast charging is considered distributed charging infrastructure (a). In this, charging stations are scattered across the electrical grid like the place shops, workplaces, parking, homes.

(b) The infrastructure for high charging EVs, which of strategically placed of charging places. Because fast charging EVs consumes a lot of power, a separate fast charging infrastructure has been set up.

(c) Infrastructure for battery swapping: In this infrastructure, an EV's battery is swapped out for a fully charged battery when it arrives at a battery swapping station. As a result, EV charging times are shortened.

Based on mobility, it can be divided into two groups:

A location that is constantly plugged in

(b) A battery-operated device

It can be divided from two categories: charging stations that can either provide power in one direction or in two directions.

The Solar System

The Sun and its gravitationally bound orbiting asteroids allies make up the Solar System[c]. A massive interstellar molecular cloud gravitationally collapsed to form it 4.6 billion years ago. The Sun, which makes up 99.86% of the system's mass, makes up the majority of the system's remaining mass, which is mostly found in Jupiter. Mercury, Venus, Earth, and Mars are the inner solar system's four terrestrial planets. Most of their songs are made up of metal and rock. More massive and heavier than all the planets in our solar system put together are the four enormous planets in the outer solar system. The next two, Uranus and Neptune, are ice giants that are mostly made of volatile substances with relatively high melting points in comparison to hydrogen and helium, like water, ammonia, and methane. The two largest planets, Jupiter and Saturn, are mainly hydrogen and helium-based gas giants. All eight planets have orbits that are very close to the ecliptic, which is the plane of the Earth's orbit. Among the countless tiny bodies in the Solar System orbiting the Sun are numerous dwarf planets and countless small bodies.

[d] Among the smaller bodies that are orbited by natural satellites, also referred to as "moons" after the Moon, are the six largest dwarf planets and the six major planets. Mercury, the smallest planet in our solar system, is larger than Ganymede on Jupiter and Titan on Saturn, but it is not more massive. Jupiter's moon Calisto is also quite large. A ring of ice, dust, and moonlets surrounds each of the large planets, as well as some of the smaller bodies. Between the orbits of Mars and Jupiter is the asteroid belt, which is home to space junk made of ice, rock, and metal. The Kuiper belt and scattered disc are regions of ice- and rock-dominated objects beyond Neptune's orbit.

Detached objects are a subclass of minor planets found in the outer regions of the Solar System. The number of these items is a contentious topic. Some of these objects can be categorised as dwarf planets because they are large enough to have undergone gravitational rounding. The dwarf planets Gonging, Eris, and Sedna, as well as the asteroids Pluto, Orcus, Haumea, Quaoar, and Make in the Kuiper Belt, are all categorised by astronomers. [d] Comets, centaurs, and interplanetary dust clouds are among the various small-body populations that are free to move throughout the Solar System.

Types of Charging Station

Residential Charging Station: To usher in the era of electric vehicles, residential charging stations are crucial because they significantly lessen the load on the grid. By using less current from the grid for residential vehicle charging, the grid will be able to meet the demand for extra voltage during peak load hours. The best time to charge an electric vehicle is at night, when it is least expensive and has the least impact on the grid, according to. Being base load hours, it lessens the load on the grid. Charging cars at night also lowers the cost of electricity per unit. By using a Level 1 charging station in a residential charging station, as shown in Table. I vehicles can easily charge in 7 to 8 hours.

Parking at a Charging Station: Charging a vehicle requires some time; however, using that time to park the vehicle will reduce the load on the grid and the number of public charging stations. According to the National Household Travel Survey, cars are typically left parked at work for five hours each day. This facility is accessible outside of the workplace in locations with appropriate charging infrastructure policies, such as eateries, shopping malls, libraries, etc. Existing parking lots have been upgraded to smart charging lots with internet connectivity so that visitors to the parking area can make reservations for parking spaces and check traffic conditions. mainly in these places. charging at level 2

Public Charging Stations: Since it takes longer to charge a battery using normal charging methods, public charging stations were introduced to provide fast charging for vehicles.

Fast charging is accomplished with the aid of different charging topologies and fast charger configuration. The charger in a charging station is primarily made up of an AC-DC converter up front and a DC-DC converter down back. Through a DC link capacitor, both converters are connected.

Battery Swapping Station: The Battery Swapping Station (BSS) was introduced to address the issue of time required for charging and the urgent need for a charged vehicle. A BSS allows for the immediate replacement of a discharged battery or battery pack with one that is fully charged, eliminating the need to wait for the vehicle's battery to recharge. By using BMS to monitor the battery life, the BSS looks after it. It determines the battery's SOC level and energy density. The process of deploying a BSS involves several difficulties. One of the main problems with battery design can be solved by making the battery pack in such a way that it can be quickly and easily removed from vehicles and then quickly reattached. The battery packs' brand compatibility is another issue. In order to manufacture interchangeable battery packs for BSS and EVs, manufacturers can use a common standard format. The main challenge for the BSS technology is the battery degradation issue as well as the battery ownership issue.

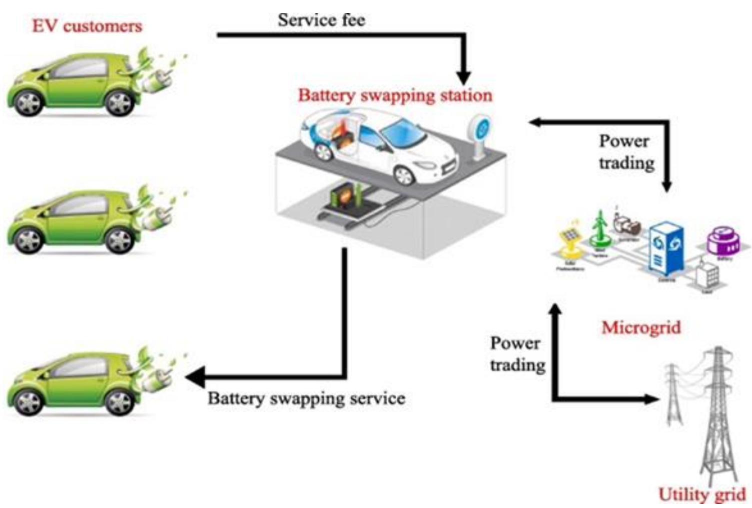

Figure 3:

Methology

Concentrating solely on EVs is insufficient because the deployment of these vehicles depends on electrical vehicle charging stations (EVCS). Because these vehicles are powered by electricity, installing the charging stations presents some challenges. Our paper based on the EV and EVs charging stations, many challenges occurs while establishing the EV charging stations.

In India there is less facilities of infrastacture and manufacturing is available. EV charging station can be of two types:

By Own plant & By companies franchisies. In the own charging plant there is all the expenditure is only of the owner but in the franchise charging plant the expenditure is done by the company.

An EV charging station requires a personal Transformer for proper electricity supply. We should also require around 1500 sq. ft. to 2000 sq. ft. land for a normal size EV charging station. On this land there is a office for management and administration, a slot of parking is available. In the construction of a EV charging station we requires civil, mechanical, electrical, and technical engineer.

For a valid and approved EV charging station we have fulfil some basic criterias like, BRN no., GST no., and license. These requirements are mandatory for running an EV charging station.

In a normal EV charging station, there is a minimum cost of Rs. 3 lakhs for construction, around Rs. 7 lakhs for electricity purpose. There is a software is required around of Rs. 50,000 for the well Electrical vehicle charging management. In this EV charging station, there is around Rs. 3-4 lakh is required for the EV chargers. Although the total manpower is around 4 lakhs. The cost of a unit electricity is around Rs. 2 and we can earn profit of Rs. 20 lakhs to Rs. 25 lakh per annum.

Conclusion

In this research paper, we discuss problems of installing a station in from grid overload, Traffic congestion brought on by longer wait times at EVCS and battery charging time. As solutions to these issues. The careful application of the technologies, the entire electric system for transportation can become more dependable and efficient. The battery, which comprises most of an EV, also need be charged efficiently without causing inside damage, so this article also covers various charging methods. The fastest method of charging a battery quickly without causing it to degrade is multistage charging. India are developing and is moving the toward environmentally implementation. The infrastructure of a country's transportation system has a significant impact on its development. Some guidelines and standards that could result in a significant change in the automotive industry are discussed in order to deploy EVCS in India. By switching to 100% electric vehicles, the environment will experience a noticeable improvement. It will significantly aid in creating a sustainable future. Authorities must first install faster, renewable energy-powered charging stations before putting them into place, though. Currently, there are many

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