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# Introduction to charging technology in E-vehicles

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## ABSTRACT

***With growing need of mobility, the percentage of fossil fuel consumption is increasing day by day. The fuel like Petrol and diesel are depleting and also causing pollution. So, there is an emergent need to switch to more environment friendly mode of mobility. Considering this E-Vehicle has become best substitute for IC engine cars. This Paper lightens Techniques of Charging of Electric Vehicles, Levels of Charging, Recent Technology in Charging and Batteries used in of Electric Vehicles.***

***Keywords:*** *Electric Vehicles, Charging Technology, EV, Batteries, Fast Charging, Rapid Charging, Li-Ion Batteries*

## 1. INTRODUCTION

An electric vehicle charging station is a group of equipment that connects an electric vehicle (EV) to an electrical source to recharge electric vehicles, neighbouring electric vehicles and plug-in hybrids. Smart metering, cellular capability and network connectivity are the advanced features of Charging station.

Charging stations are also referred as electric vehicle supply equipment (EVSE). They are supplied at municipal parking by electric utility companies or at retail outlets sold by private companies. There are variety of charging connector standards available at the Charging Station.

EVSE usage fees vary from monthly or annually flat rates to kWh to hourly rates. Charging stations can be free of cost and are usually funded by local government. Charging an electric car is very easy - just plug it in and wait. You can charge your car at a public or home charging station with a home socket or specially designed charger, where you charge your car and the time taken affects the cost. Electric Vehicles can be recharged at public charging stations. Some are free, some charge a small fee, and are available nationwide. However, for convenience, many EV car owners do most of their charging at home.
Electric cars can travel up to 200-300 miles in single charge, so charging at home will be enough to run on a daily basis, but may require supplementing on long journeys.

## 2. IMPORTANCE OF EV CHARGING STATION

There is rapid growth in the sale of electric vehicles. However, Currently, there is a transition periods in the market, as companies and cities scale up to satisfy the demands.

The demand for e-cars comes with a few things that require collaboration between cities and car owners.

Another difference between electric and traditional vehicles is that electric vehicles needs public charging stations. So the problem is there are tons of electric vehicles driving around, but there are scare charging stations to help people stay on the road for proper commuting.

The purchase of e-cars comes with a home charging station. Usually, they are charged overnight at people's homes, which helps to hide another problem with electric cars: they take longer to charge.

The current cluster of e-cars on the market can operate 8-10 hours in single charge. After that it takes a few hours to recharge the battery. Therefore, the requirement of the EV charging station becomes significant.

## 3. CATEGORIES

### A. Residential charging stations

The owner of the EV connects to a standard device when he returns home, and the car is charged overnight. Because it is inexpensive and convenient, majority of the users charge their vehicles at home. There should be dedicated wiring circuit for the wall mounted charging station at home. This type of charging station doesn't need any user authentication so it is very convenient.

### B. Public charging stations

Private or commercial business, sometimes offers free charging in partnership with the owners of the parking lot. These charging station have both Level 1 and Level 2 type of chargers. The consumer can choose to connect the charger according to his need. This type of stations are situated where the vehicles are parked for longer time. The charging station at the Parking lot of malls, commercial complex, airports and offices are some of the example.

### C. Fast charging

The Fast Charging which is also known as Rapid Charging can charge the vehicle up to 80% in just 20 minutes. The reason behind this rapid charge is the off- board charging module which delivers the output of 35 KW to 80KW at max. The charging current and voltage varies from 45V to 450V and 20Amp-200Amp respectively. It has CHAdeMO and a CCS connector

 

attached to it. Tesla's Supercharger is also an example of Fast Charging.

**D. Battery swapping**

It is the quickest form of charging than all the charging methods. It takes less than 3 minutes for bikes and less than 10 minutes for car to swap its batteries. But, it needs a complex infrastructure for car battery swapping as the size of car's battery is big. Mobile support can also be provided for discharged vehicle.

## 4. LEVELS

The charging power and vehicle battery capacity determines time taken for charging. We can say that, the time taken to charge depends on the charging level used, and the charging level depends on the voltage handling of the batteries, Battery Management System and charger electronics in the car. The various charging levels are as follows:-

**A. Level 1**

Level 1 is generally used for charging when only 120-V is available, as in other residential areas. Depending on the type of battery and vehicle, charging at level 1 may add approximately 2 to 5 miles in distance to PEV per hour of charging time. On one side of the cord is a standard, three-prong household (connector NEMA 5-15) and on the other end there is J1772.

**B. Level 2**

Level 2 EVSE can easily charge a standard EV battery overnight, and will be a standard installation for home, workplace, fleet and public facilities. It provides charging with 240-V (typically for residential systems) or 208-V (typically for commercial systems) electrical service. These installation is usually made of hard wires for safe operation (although wall plug is possible). Level 2 EVSE requires the installation of charging equipment and a dedicated circuit of 20 to 80 amp. It adds 10 to 20 miles per hour of charging. The Level 2 device uses the same connector on the Level 1 car and equipment.

**C. Level3 (DC fast charging)**

DC fast charging EVSE (input 480-V AC to EVSE) enables faster charging in areas such as heavy car corridors and public fuelling stations. DC fast charger can add 60 to 80 miles in distance to PEV in 20 minutes. DC fast charging uses a different connector to the J1772 connector used to charge the Level 2 AC. Leading fast charging standard are (CCS1 in the U.S. and CCS2 in Europe) Combo CHAdeMO and Tesla.

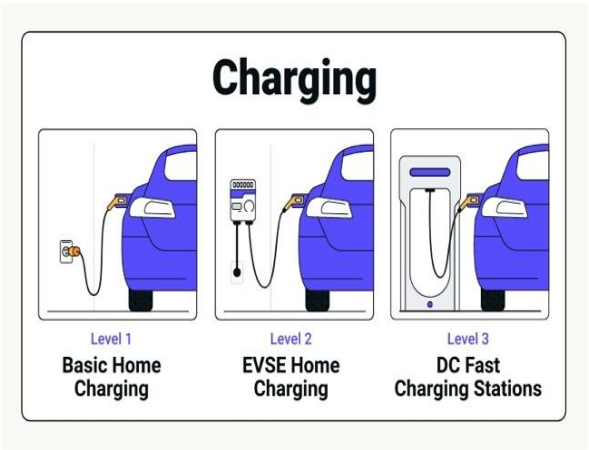


**Fig. 1: Levels of Charging**

## 5. BATTERIES USED IN E-VEHICLE

Batteries are the main part of the electric car. From which the car gets the power to drive.

**A. Lithium ion battery**

As Lithium-ion Batteries have high power-to-weight ratio as compared to other electric storage system they are used in many devices such as cell phones and laptops. They also have a high power-to-weight ratio, good high-temperature performance, high energy efficiency, and low emissions. Many parts of lithium-ion batteries can be recycled, but the cost of material replacement remains a challenge for the industry. Most modern PHEVs and EVs use lithium-ion batteries.

**Fig. 2: Li Ion Battery used in Nissan Leaf**

**B. Nickel metal hydride battery**

Nickel-metal hydride batteries, frequently used in computer and medical equipment, offer reasonable specific energy and specific power capabilities. Nickel-metal hydride batteries have a much longer life cycle than lead-acid batteries and are safer and more tolerant of abuse. These batteries are widely used in HEVs. Relatively expensive, high emissions and heat production at high temperatures, and the need to control hydrogen loss as some of the disadvantages of Nickel-metal hydride batteries.

**Fig. 3: Nickel Metal Hydride Batteries in EV**

**C. Lead acid battery**

Lead-acid batteries are economical, reliable and can be engineered for high power. However, certain low energy, cold temperatures, and short calendar and cycle life impede their use. For the application in the Commercial Electric vehicles, there is a development of advanced high-power lead-acid batteries.

| | Lithium Ion | Nickel-Metal | Lead-Acid |
|---|---|---|---|
| Easy Access / Inexpensive | ✓ | ✗ | ✓ |
| Energy Efficient | ✓ | ✓ | ✓ |
| Temp. Performance | ✓ | ✗ | ✗ |
| Weight | ✓ | ✓ | ✓ |
| Life Cycle | ✓ | ✗ | ✓ |

**Fig. 4: Comparison of Electric Car Batteries**

 

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