Electric Vehicle Charging Station

Small and Medium Enterprises Development Authority

Ministry of Industries & Production

Government of Pakistan

www.smeda.org.pk

HEAD OFFICE

4th Floor, Building No. 3, Aiwan-e-Iqbal Complex, Egerton Road,

Lahore

Tel:(92 42) 111 111 456, Fax:(92 42) 36304926-7

helpdesk@smeda.org.pk

REGIONAL OFFICE PUNJAB	REGIONAL OFFICE SINDH	REGIONAL OFFICE KPK	REGIONAL OFFICE BALOCHISTAN
3rdFloor, Building No. 3, Aiwan-e-Iqbal Complex, Egerton Road Lahore, Tel: (042) 111-111-456 Fax: (042) 36304926-7 helpdesk.punjab@smeda.org.pk	5TH Floor, Bahria Complex II, M.T. Khan Road, Karachi. Tel: (021) 111-111-456 Fax: (021) 5610572 helpdesk-khi@smeda.org.pk	Ground Floor State Life Building The Mall, Peshawar. Tel: (091) 9213046-47 Fax: (091) 286908 helpdesk-pew@smeda.org.pk	Bungalow No. 15-A Chaman Housing Scheme Airport Road, Quetta. Tel: (081) 831623, 831702 Fax: (081) 831922 helpdesk-qta@smeda.org.pk

Table of Contents

1. Introduction to SMEDA

The Small and Medium Enterprises Development Authority (SMEDA) was established in October 1998 with an objective to provide fresh impetus to the economy through development of Small and Medium Enterprises (SMEs).

With a mission "to assist in employment generation and value addition to the national income, through development of the SME sector, by helping increase the number, scale and competitiveness of SMEs", SMEDA has carried out 'sectoral research' to identify policy, access to finance, business development services, strategic initiatives and institutional collaboration and networking initiatives.

2. Disclaimer

This information memorandum is to introduce the subject matter and provide a general idea and information on the said matter. Although, the material included in this document is based on data/information gathered from various reliable sources; however, it is based upon certain assumptions, which may differ from case to case. The information has been provided on as is where is basis without any warranties or assertions as to the correctness or soundness thereof. Although, due care and diligence has been taken to compile this document, the contained information may vary due to any change in any of the concerned factors, and the actual results may differ substantially from the presented information. SMEDA, its employees or agents do not assume any liability for any financial or other loss resulting from this memorandum in consequence of undertaking this activity. The contained information does not preclude any further professional advice. The prospective user of this memorandum is encouraged to carry out additional diligence and gather any information which is necessary for making an informed decision; including taking professional advice from a qualified consultant/technical expert before taking any decision to act upon the information.

For more information on services offered by SMEDA, please contact our website:**www.smeda.org.pk**

3. Electric Vehicles

An electric vehicle, often known as an EV, is propelled by one or more electric motors or traction motors. An electric vehicle can be self-contained using a battery, solar panels, or an electric generator to convert gasoline to energy. It can be fueled by electricity from off-vehicle sources through a collector system.

Nowadays, energy efficiency is a foremost priority, fueled by a growing concern about climate change and rising oil prices in nations that rely heavily on imported fossil fuels, resulting in high demand for electric vehicle charging stations in the worldwide.

Considering the environmental impact, the world is moving towards electric vehicles. Many Countries around the world are taking initiatives to reduce the CO2 emissions by introducing electric vehicles. Government of Pakistan is also committed to control the harmful emissions, therefore GOP has recently approved an Electric Vehicle

Policy. Pakistan is the 5th most populous country in the world and correspondingly has a large number of vehicles. The country has almost twenty-four million two and three-wheelers, four million passenger cars, and half a million buses and trucks. Presently, there are few electric vehicles (EVs) in the country, with almost two thousand all-electric passenger cars and around a dozen fast charging stations. The manufacturing of EVs and their parts is a nascent industry in the country. However, EVs are getting popular due to high petroleum prices and recently announced incentives by the Government of Pakistan (GoP) on promoting the adoption of electric means of transportation. The incentives by the GoP and the high interest of the general public in EVs have opened a new untapped market for the EV value chain in the country.

4. Types of Electric Vehicles

There are four types of Electric Vehicles (EVs): hybrid electric vehicles (HEV), plug-in hybrids (PHEV), battery electric vehicles (BEV) and extended range electric vehicles (EREV).

- **Hybrid Electric Vehicles HEVs** have two motors: an internal combustion engine and an electric motor. Their storage batteries are generally low-capacity, which greatly limits their range and top speed in electric mode. They cannot be recharged from the grid and are therefore not covered by this Guide. Examples: Toyota Prius and Honda CR-Z.
- **Plug-in Hybrids PHEVs** are hybrids that can be plugged into the power grid for battery charging. In general, they have a medium-capacity battery that allows the vehicle, in all-electric mode, to achieve a range of several dozen kilometers, and rates of acceleration and top speeds comparable to those of gasoline-powered vehicles. Examples: Chevrolet Volt (often classified as an EREV), Ford C-Max and Fusion Energy, Cadillac ELR and Toyota Prius PHEV.
- **Battery Electric Vehicles BEVs** operate solely on the electricity stored in a high-capacity battery, which can be recharged from the grid. Depending on battery capacity, they have a range of 100 to 400 km. Charging time varies by battery capacity and whether a fast-charge station is used. It is also affected by the ambient temperature and the remaining battery charge at the start of charging. Examples: Nissan LEAF, Mitsubishi i-MiEV, Tesla Model S and Kia Soul EV.
- **Extended Range Electric Vehicles EREVs** are battery electric vehicles equipped with an internal combustion generator that produces enough power for the vehicle to reach a charging station when its battery is depleted. The BMW i3 is currently the only EREV available in Québec.

5. Electric Vehicle Charging Station

An electric vehicle charging station (EV charging station), also known as an electric recharging point, charging point, charge point, or electronic charging station (ECS), is a component of an infrastructure that provides electric energy for the recharging of plug-in electric vehicles, such as electric cars, neighborhood electric vehicles, and plug-in hybrids.

A charging station (see Figure 1) is usually in the form of a fixture connected directly to an electrical distribution panel, or sometimes to an electrical outlet. It has one or more charging cables (see Figure 2) equipped with a connector that is similar to a gas-pump nozzle and is used in the same way: it simply connects to the EV's charging socket to charge the battery. The station has lights that indicate that the EV is connected and charging. It can also have a button for starting or stopping the charging operation. Some have additional features: energy meter, electronic payment system, card-controlled access system, Internet access, etc.

*Figure 1 – **Charging station***

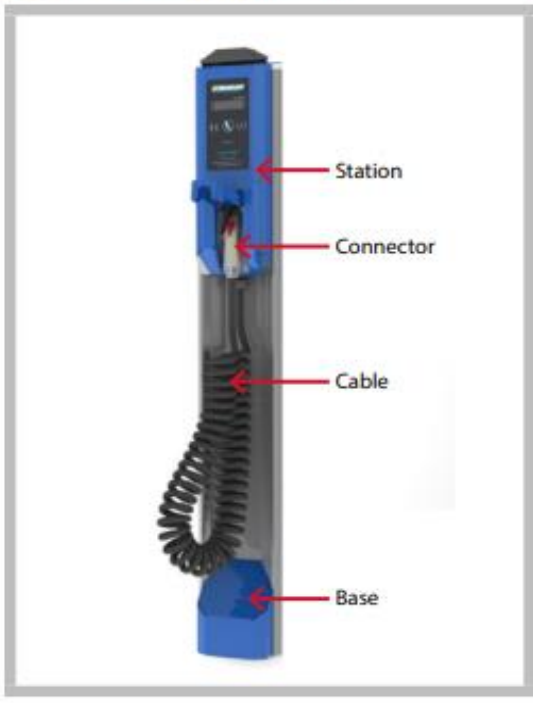


*Figure 2 – **Dual charging station***

Note: The images are provided for illustrative purposes and in no way constitute an endorsement.

5.1 Types of Electric Vehicle Chargers

Depending on the degree of charging that they give, there are three types of electric chargers available for EVs:

- **Level 1 Charging (Slow Charging):** It is a primary charging device that charges at a sluggish rate. It may be used on residential circuits and runs 120 volts (V) using an Alternating Current (AC) connector. This device takes around 8 to 12

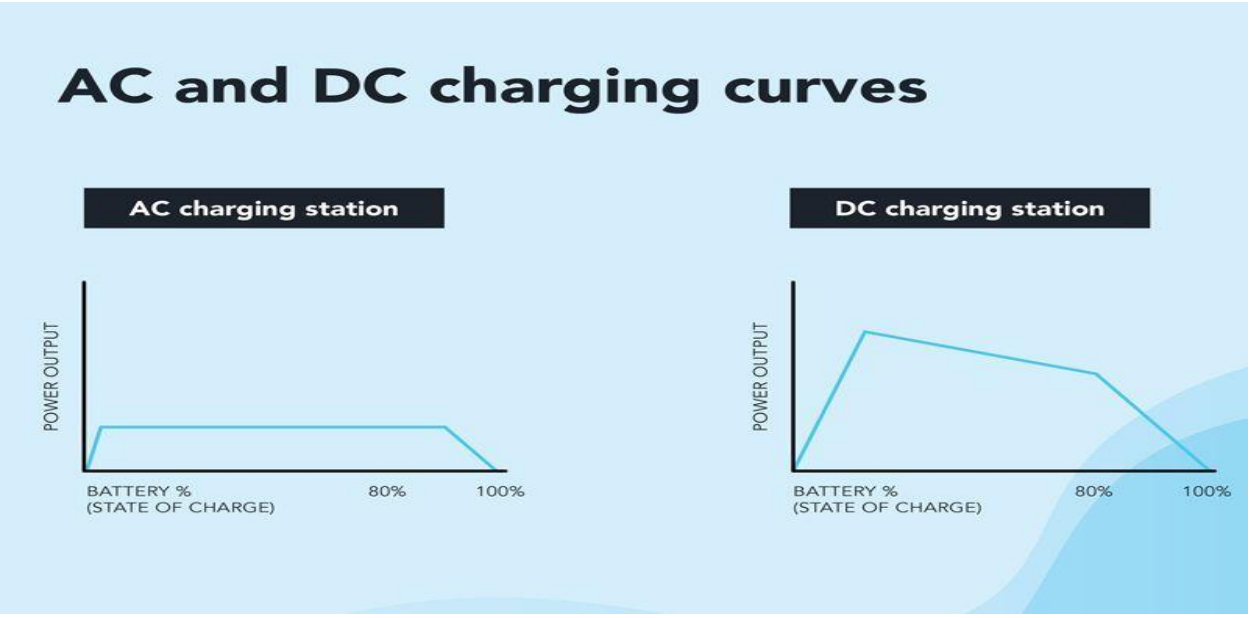
hours to charge a battery. It is primarily used in households to charge electric vehicles overnight.

- **Level 2 Charging (Standard Charging):** A 240 volts (V) AC socket allows for a charging duration of 4 to 6 hours on average. It works with all-electric vehicles, including plug-in hybrids. The majority of these stations are found in public parking lots and business and residential structures.
- **Level 3 Charging (Rapid Charging):** Using a 480 volts (V) Direct Current (DC) socket can charge a battery up to 80% in 20-30 minutes. It is not, however, compatible with all-electric vehicles. They are only put at public charging stations.

5.2 Electric Vehicle Batteries Charging System

This charging system is an AC-DC power circuit that is carefully monitored to maintain the nominal properties of the vehicle's batteries and extend their life. It should also keep an eye on the batteries when charging or discharging to avoid any harm. The ACDC power circuit can be implemented in various topologies depending on the system's requirements.

With AC charging, the power flow to an EV is flat (meaning that it will charge at the same speed from 0-100 percent full), whereas with DC charging, the EV's battery initially accepts a quicker flow of power, and then slowly starts to ask for less power as it begins to fill up. The reason for this is simple: the EV doesn't want to damage the battery with a surge of power. As a result, with a DC or Level 3 charger, the initial phase of charging (to 80 percent full) goes quicker than the last 20 percent (which may take roughly the same amount of time as the first 80 percent).



5.3 Working of Electric Vehicle Charging Station

- The electric car charging station is made up of many electric vehicles charging devices, each of which is made up of a transformer, capacitor, and a control unit with a high-quality CPU and inbuilt memory for the station's software.
- The charging station includes a charging wire and connector that connects to the car through an appropriate plug and a stand that fits the vehicle's charging port.
- An adequate distribution and control panel, which fundamentally has additional safety and fail-safe systems necessary to manage suitable electric load, transfers the electrical power received from the grid to an electric car charging unit.
- The electrical power is given to the electric car charging machine, which uses its transformer set to change the input AC voltage to the appropriate value, which is determined by the user's selection of the charging level
- Level 1 charging provides 110-120V AC alternating current at the charger point, and Level 2 charging provides 220 to 240V AC at the charger point. Level 3 charging requires a three-phase input AC supply that is then passed through a transformer, rectifier, and ripple factor reducing circuit to produce the DC power supply that is supplied to the charging point.
- The control system governs the different interface and control activities depending on the software feed in the machine, which classifies it as a visionary or dumb charging machine. The processor in the control unit processes the data algorithm integrated into the software. The user's input is asked, and the car is charged depending on these inputs.

5.4 Electric Car Charging Times

The state of charge of an EV's battery is measured in kilowatt-hours (kWh), which is similar to a liter or a gallon but for electricity, and each kWh equals the amount of energy you would use to run a 1,000-watt appliance for an hour. The vast majority of electric passenger vehicle batteries today can hold somewhere between 25 and 100 kWh when fully charged.

To give somewhat accurate approximation, overview of how long it takes to charge EVs below. This overview looks at four average battery sizes and a few different charging power outputs.

Type of EV	**Small EV**	**Medium EV**	**Large EV**	**Light Commercial**
Average Battery Size *(right)* **Power Output** *(Below)*	**25 kWh**	**50 kWh**	**75 kWh**	**100 kWh**

Level 1 2.3 kW	10h30m	24h30m	32h45m	43h30m
Level 2 7.4 kW	3h45m	7h45m	10h00m	13h30m
Level 2 11 kW	2h00m	5h15m	6h45m	9h00m
Level 2 22 kW	1h00m	3h00m	4h30m	6h00m
Level 3 50 kW	36 min	53 min	1h20m	1h48m
Level 3 120 kW	11 min	22 min	33 min	44 min
Level 3 150 kW	10 min	18 min	27 min	36 min
Level 3 240 kW	6 min	12 min	17 min	22 min

5.5 Cost to Charge Electric Car

Just like with how long it takes to charge an EV, the cost of charging depends on multiple variables including where you charge it, or the type of vehicle you drive. Here are the approximate costs of charging four different size vehicles (with battery packs from small to large), at three different types of charging stations,

Average cost to charge electric car

Vehicle type	**Battery size**	**Home charging** cost per kWh: $0.15	**Public / workplace charging** cost per kWh: $0.30 + $1 charging fee	**Fast charging** cost per kWh: $0.50 + $2 charging fee
Fiat 500e	24 kWh	$3.60	$8.20	$14.00

Nissan LEAF	40 kWh	$6.00	$13.00	$22.00
Tesla Model S	75 kWh	$11.25	$23.50	$39.50
Porsche Taycan	90 kWh	$13.50	$28.00	$47.00

Important: Prices for each charging segment are approximations based on our experience and do not represent a real-life situation. These calculations are based on a median guesstimate charging tariff and represent the cost to charge from zero to 100 percent.

5.6 Location

Some locations are particularly suitable for the installation of public charging stations: for example, highways, motor way, parking lots, out-side of shopping centers, restaurants, hotels and resorts. The following criteria should be considered for selecting a location:

- Traffic, with the size of the installation to be based on the expected number of users.
- How much time EVs will spend at the station.
- Surrounding vehicle movement – vehicles stopped for charging must not hinder traffic flow.
- Winter use – the location must be cleared and accessible during winter and not be used as a snow dump or hinder snow clearing operations.
- Protection against collisions.
- Impact on pedestrian traffic – must not hinder pedestrian traffic or be subject to high pedestrian traffic and the associated increased risk of vandalism
- Access to a cellular network, if required by the charging station
- Visibility of the charging station to encourage its use by drivers.

5.7 Basic Requirements for EV Charging stations

The owner of electric Vehicle charging station must ensure that sufficient human resources, including technicians is available. Moreover, all the safety standard should be followed. Following safety instructions must be considered for the installation of Electric Vehicle charging station.

- Display safe charging tips/instructions for Operator and EV User.
- Display fixed "Danger Sign" at places where an immediate hazard/ danger exists such as panel, substation, transformer, etc. Display fixed "Caution Sign" at places where it is required to warn against potential hazards or to caution against unsafe practices.

- Fire Prevention system for charging station shall be provided with manufacturer's instruction and applicable legal requirements.
- Fire detection, alarm, and control system shall be provided as per manufacturer's instructions, Pakistan Building Codes and other applicable national and provincial legal requirements.
- The owner of the charging station shall arrange inspection and testing by the Electrical Inspector or Third Party Inspector