

# Types of Charging in ELECTRIC VEHICLES



## LEVEL 1 CHARGING

**It typically provides a charging power of around 1-2 kilowatts (kW) and can take several hours to fully charge an EV battery.**

Power Stages Needed:

- Level 1 Charger
- On Board Charger:
  - » Converts 120V AC to 400+ V DC for the vehicles battery
    - AC to DC Converter + Front end rectification
    - DC to DC Converter

Applications:

- This is the slowest charging method and uses a standard 120V AC household outlet



## LEVEL 2 CHARGING

**It is faster than level 1 charging and is commonly used in residential settings and public charging stations.**

Power Stages Needed:

- Level 2 Charger
- On Board Charger:
  - » Converts 240V AC to 400+ V DC for the vehicles battery
    - AC to DC Converter + Front end rectification
    - DC to DC Converter

Applications:

- It is faster than level 1 charging and is commonly used in residential settings and public charging stations



## LEVEL 3 CHARGING/DC FAST CHARGING

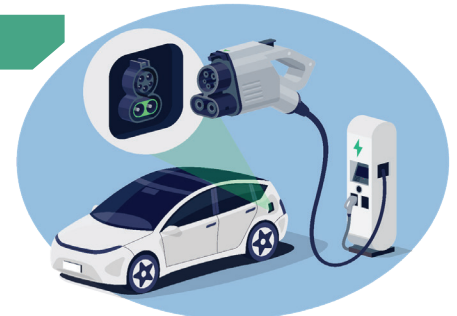
**It uses high-powered charging stations and can charge an EV battery to around 80% capacity in 30 minutes or less.**

Power Stages Needed:

- Level 3 Charger
- Off Board Charger:
  - » Converts 240V AC to 400-800+ V DC for the vehicles battery
    - AC to DC Converter + Front end rectification
    - DC to DC Converter(s)

Applications:

- DC fast charging delivers high power directly to the EV's battery, bypassing the vehicle's onboard charger



## WIRELESS CHARGING

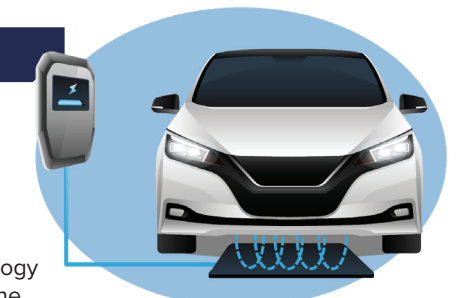
**It uses electromagnetic fields to transfer power from a charging pad or station to the vehicle.**

Key components of a wireless charging system include:

- Charging Pad/Station
- Vehicle Receiver
- Power Electronics
- Communication System

Applications:

- Wireless charging, also known as Inductive Charging or Wireless Power Transfer (WPT), is an emerging technology for charging electric vehicles without the need for physical cables and connectors



## BI-DIRECTIONAL CHARGING

**Bi-directional charging enables electric vehicles to not only consume energy but also serve as energy storage devices, allowing them to discharge power back into the grid or other energy-consuming systems.**

The implementation of bi-directional charging introduces design challenges on the component level, as it requires power electronics and energy management systems capable of:

- Efficiently and safely handling bidirectional power flow
- Managing voltage and current fluctuations
- Ensuring compatibility with various grid standards and protocols

