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# Introduction to electric vehicles

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# EV BASIC SYSTEMS

**Basic systems of every EV consists of:**

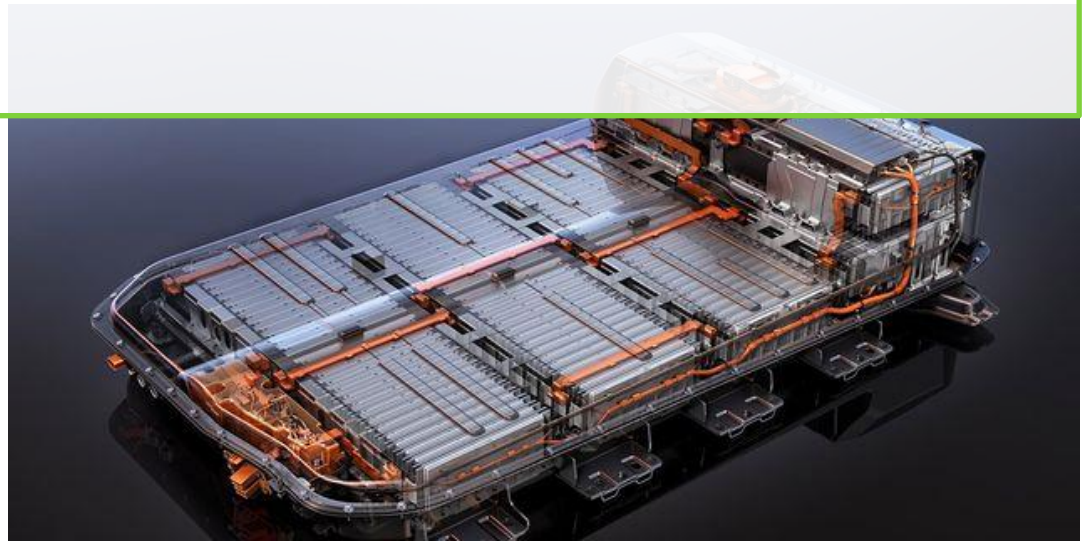
- Electric motor
- Battery
- Power converter
- DC-DC Converter
- Charging connector

## ELECTRIC MOTOR

- Electric motor also called electric machine or motor/generator, it is used to move a vehicle.
- This component can also function as a generator during regenerative braking.
- Depending on the design and application of the vehicle, the vehicle can have between one and four electric machines in the vehicle.

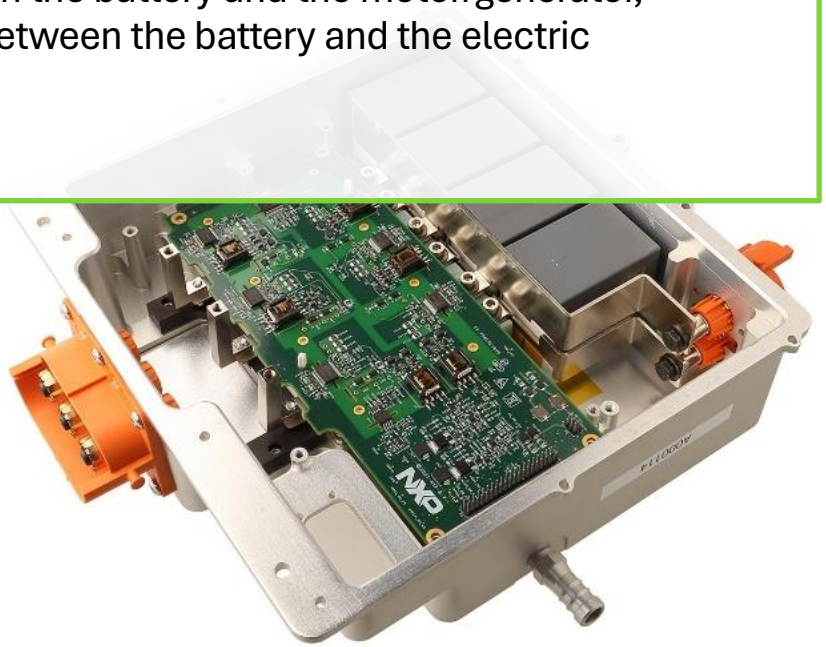
## BATTERY

- Also known as a traction battery, it stores energy and supplies the electric motor with energy and energy;
- The battery includes a range of physically connected battery cells and battery management hardware and software.



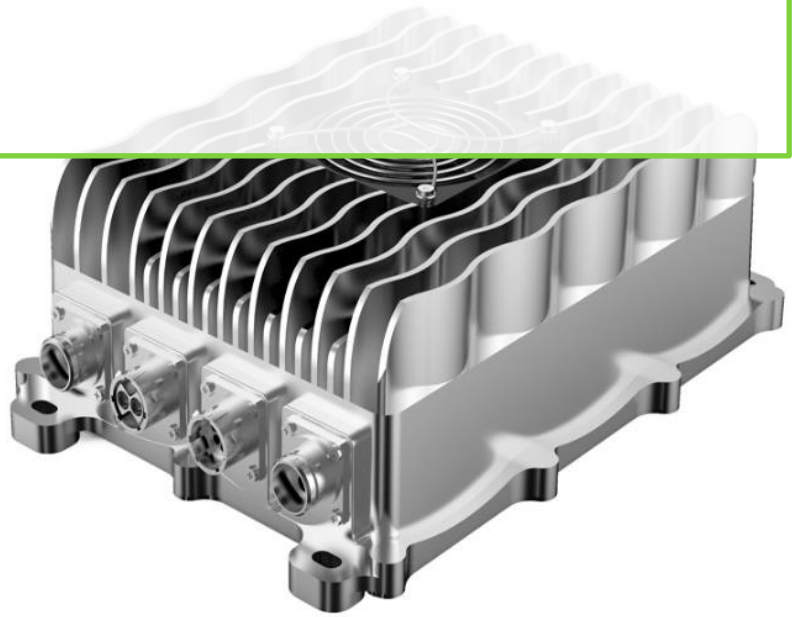
## POWER CONVERTER

- Power converter: Batteries can only store and deliver direct current, also called DC. EV motors require alternating current, also known as AC, to start the vehicle and generate alternating current during regenerative braking.
- The power converter, placed electrically between the battery and the motor/generator, converts electricity to allow the flow of energy between the battery and the electric motor.



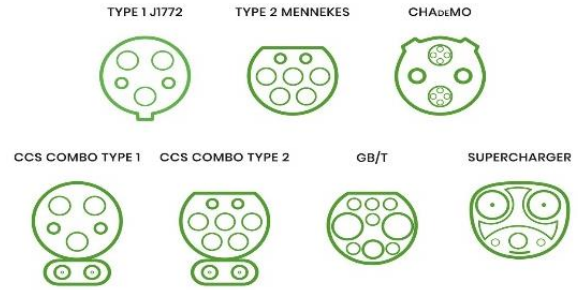
## DC-DC CONVERTER

- Full electric and many hybrid-electric vehicles do not use a conventional alternator to charge a 12-volt battery.
- Instead, these vehicles use a DC-DC converter to raise the high voltage from the battery to low voltage, replenishing the low-voltage battery and supplying electricity for other low-voltage functions.



# CHARGING CONNECTOR

- The connector for charging EV and plug-in vehicles are used to connect to an external power source for charging EV batteries.

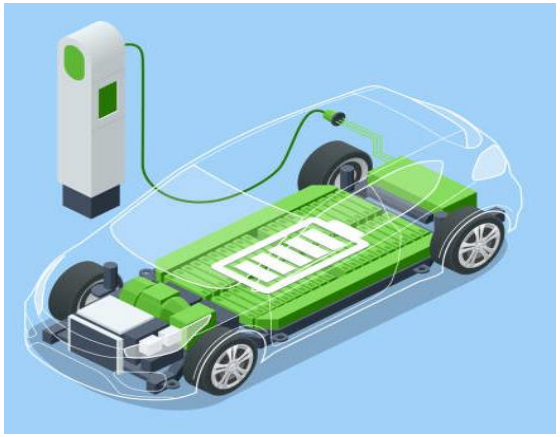



# TYPES OF ELECTRIC VEHICLES

- There are four types of electric vehicles:
- Battery Electric Vehicles (BEVs): Runs solely on electricity, providing greater efficiency compared to hybrid and plug-in hybrid models.
- Hybrid Electric Vehicle (HEV): Combines an internal combustion engine (usually gasoline) with a battery-powered engine. The gasoline engine is used for driving and charging when the battery is low. HEVs are less efficient than fully electric or plug-in hybrid vehicles.
- Plug-in Hybrid Electric Vehicle (PHEV): Integrates an internal combustion engine with a battery charged externally via a plug. This allows the battery to be charged with electricity, making the PHEV more efficient than the HEV but less efficient than the BEV.
- Fuel Cell Electric Vehicle (FCEV): Uses cleanly generated electricity from non-fossil fuels, such as hydrogen, using fuel cell technology.

# BATTERY ELECTRIC VEHICLES (BEV)

They are powered by electricity and connected to charge batteries.



# HYBRID-ELECTRIC VEHICLES (HEV)

**Hybrid-electric vehicles, also called HEV, are powered by both gasoline and electricity. In many HEVs, an electric motor uses battery power to help the engine or move the vehicle independently over short distances. When the engine starts, the battery is charged. There are different levels of hybrid-electric vehicles.**

There are different ways to combine the power of an electric motor and an IC engine (Internal Combustion engine).

- Parallel hybrids — the most common HEV design — connect the motor and electric motor to the drive wheels via a mechanical clutch (electric motor and IC engine directly drive the wheels).
- Series hybrids, which use only an electric motor to drive vehicle wheels, are most commonly found in plug-in hybrid electric vehicles.

# MICRO HYBRID ELECTRIC VEHICLES (MHEVs)

- Micro HEVs. Micro HEVs have limited fuel-saving benefits from inactive stop-start technology, but they still save on fuel compared to petrol-only vehicles.

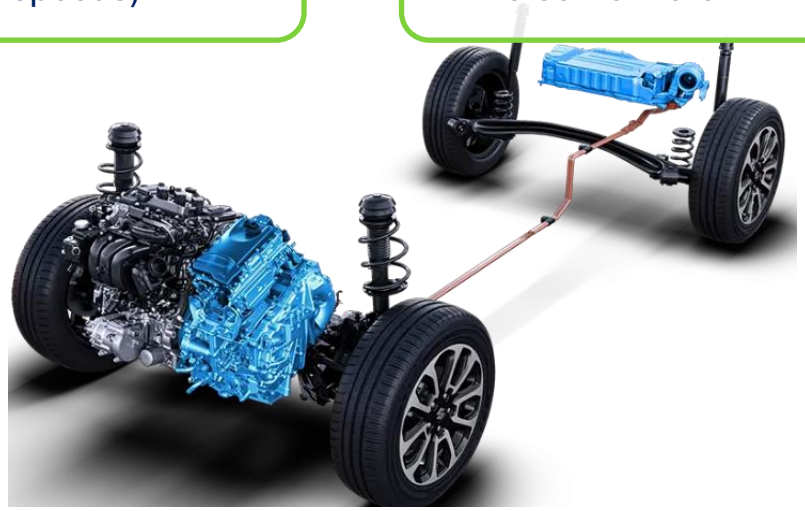
- These vehicles do not require the manufacturer to redesign the entire powertrain, so the price of the vehicle is similar to a gas-powered vehicle. Micro HEV EVs are not capable of regenerative braking.

# MILD HYBRID ELECTRIC VEHICLE

Mild HEVs. Mild HEVs use idle stop technology, but they can also regenerate electricity when stopped.

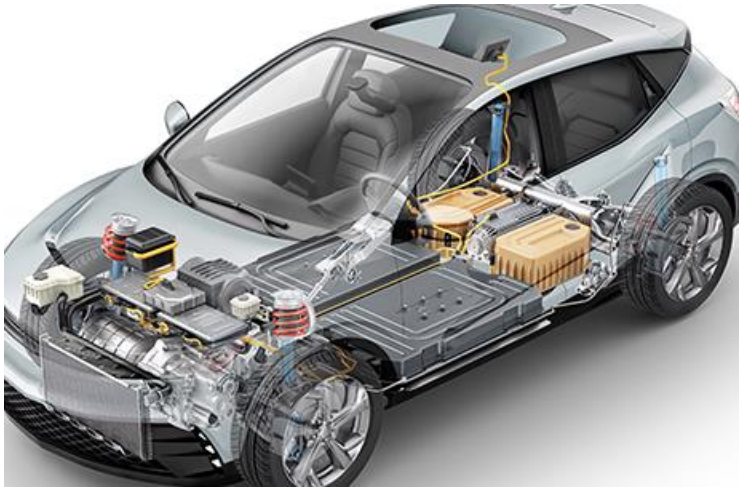
Some manufacturers can also use start assist mode from stop (but not at higher vehicle speeds).

These vehicles, however, are not equipped to drive vehicles using only an electric motor.



# FULL HYBRID ELECTRIC VEHICLE

- Full HEVs use hybrid vehicle functions – idle stop, regenerative braking, engine power assist and temporary electric-only operation.
- Full hybrids have larger batteries and more powerful electric motors, which can propel the vehicle over short distances and at low speeds.

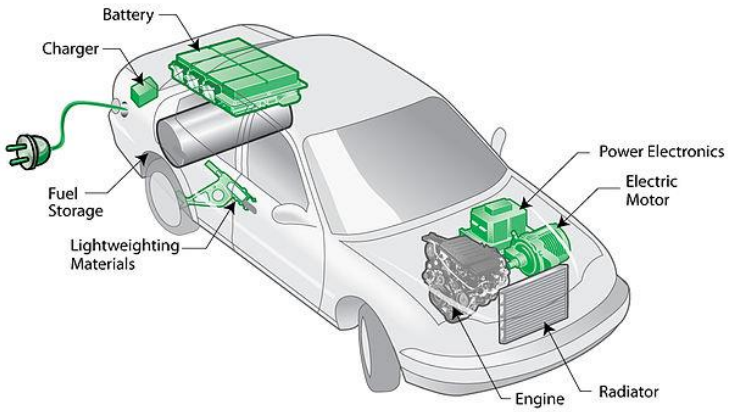


# PLUG-IN HYBRID (PHEV)

Plug-in HEVs. Plug-In HEVs, (PHEVs), use the same hybrid functions as full HEVs, but have a longer range only on electric drive (usually between 40 and 90 km, depending on the design of the vehicle and its battery).

PHEV is an advanced hybrid-electric vehicle that plugs into a charger to recharge the battery.

When the PHEV battery runs out, the motor helps charge the battery to continue driving, reflecting the operation of a full HEV.



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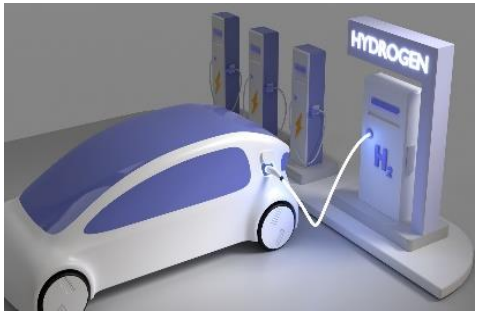
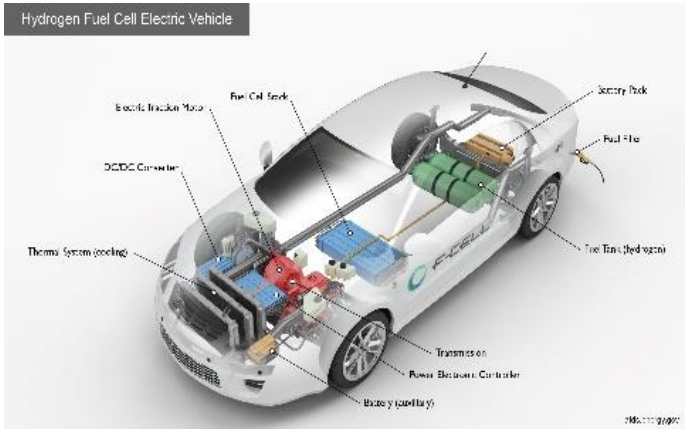
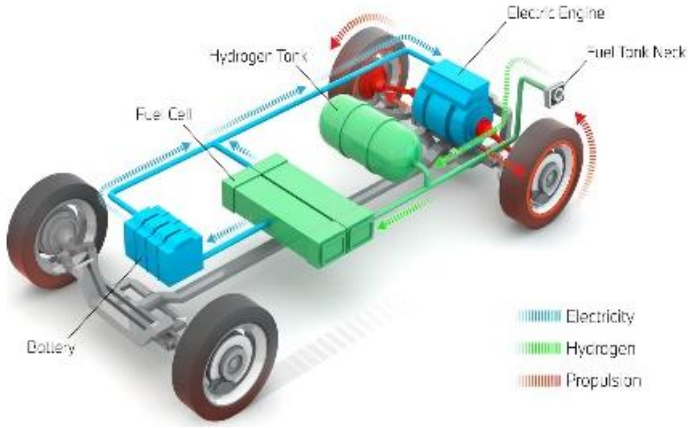
# FUEL CELL ELECTRIC VEHICLE (FCEV)

They are powered by hydrogen and convert hydrogen into electricity in a fuel cell.

FCEW emits only water vapor and warm air.



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# TOP 10 BEST ELECTRIC VEHICLE IN 2024 ACCORDING TO Auto Express

1. Hyundai Kona Electric
2. MG4
3. BMW i4
4. Tesla Model 3
5. BMW iX
6. Porsche Taycan
7. BYD Atto 3
8. Citroen e-C4 & e-C4 X
9. BMW i5
10. Hyundai Ioniq 5


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