

# TNPSC CTSE - 2025 DIPLOMA LEVEL

## MECHANIC ELECTRIC VEHICLE

**POST CODE: 3634**

**SUBJECT CODE: 534**



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# ELECTRIC VEHICLE

## Introduction to electric vehicle

Electric vehicle is propelled with electric motors and draw power from on board electric source in an electric vehicle, it is more durable and mechanically simpler than gasoline vehicle. It gives more fuel efficiency than gasoline engine because it does not produce emission like internal combustion engine. However, automobile industry is not completely moving towards pure electric vehicle production, because there is a problem of existing batteries technology for storing the electric energy. However now a days increasing the usage of hybrid and electric vehicle in our country and globalize.

**Internal combustion engine vehicle :** This type of vehicle uses Internal combustion engine and it has use fuel like petrol, gas, diesel which fuel combusts inside of the combustion chamber with the help of an oxidizer and ignition by spark plug or compressed air heat.

**Electric vehicle :** This type of vehicle uses one or more electric motor for propulsion. Electric vehicles are the automobiles that are propelled by one or more electric motors using the energy stores in batteries.

Comparison between IC engine vehicle with electric vehicle. The following table highlights the points that differentiate and IC Engine vehicle from an electric vehicle



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| Point of comparison         | Internal combustion engine vehicle                                                 | Electric vehicle                                                                                                 |
|-----------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Source of power             | The source of power for ICEV is different types of fuels such as diesel or petrol  | Electricity obtained from charged batteries, ultra-capacitors, etc. is the source of power in electric vehicles. |
| Prime mover                 | Internal combustion engine (ICE) is the prime mover or powertrain.                 | Electric motor is the prime mover in the electric vehicles.                                                      |
| Specific energy             | There is high specific energy of fuel                                              | In electric vehicles, low specific energy of battery.                                                            |
| Power density               | Fuels used in ICEV have high power density.                                        | In power density of power source is low.                                                                         |
| Impact on Environment       | ICEV emits green-house gases which have adverse effect on environment.             | EV does not have adverse effect on environment.                                                                  |
| Travelling distance         | ICEV can travel more than around 300 miles per fill.                               | EV travels less than around 100 miles per charge.                                                                |
| Refilling time              | ICEV requires less refilling time (approx. less than 5 min)                        | EV has long charging time, about 0.5 to 8 hours.                                                                 |
| Space & weight fuel tank    | In ICEV, fuel tank takes less space and the weight of fuel is very less.           | In EV, batter bank takes large. Also, the batteries are very heavy.                                              |
| Maintenance & running costs | The maintenance and running costs of internal combustion engine vehicles are high. | The electric vehicles requires low running and maintenance costs.                                                |
| Efficiency                  | The efficiency of IC engines is about 30%.                                         | The electric motors used in electric vehicles have approximately 80% efficiency.                                 |



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| Point of comparison              | Internal combustion engine vehicle                                                 | Electric vehicle                                                                        |
|----------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Noise production                 | IC engine vehicles produces noise                                                  | Electric vehicles have noise free operation                                             |
| Recovery of braking energy       | In case of IC engine vehicles, the braking energy cannot be recovered.             | In case of EVs, the braking energy can be recovered by using regenerative braking.      |
| Time required for maximum torque | IC engine vehicles require to pick up some speed to deliver maximum torque         | Electric vehicles produce maximum torque instantly after starting of motor              |
| Capital cost                     | IC engine vehicle have average initial cost                                        | The initial cost of electric vehicles is high.                                          |
| Power transmission               | IC engine vehicles, have the system of power transmission load is mechanical only. | Electric vehicles have both mechanical as well as electrical power transmission system. |



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# TYPES OF ELECTRIC VEHICLE

- Battery Electric Vehicle (BEV).
- Hybrid Electric Vehicle (HEV).
- Plug in Hybrid Electric Vehicle (PHEV).
- Fuel Cell Electric Vehicle (FCEV).

**Battery Electric Vehicle (BEVs).** The battery electric vehicles (BEVs) also referred to as all electric vehicles pure electric vehicle. It is run entirely on battery electricity only and have no gasoline engine. BEVs are moved by one or more electric motors powered by rechargeable batteries. Most of the BEV auto manufacturers choose lithium due to their high power to weight ratio resulting in a more extended range in a smaller physical foot print the battery packs are charged using electricity delivered through an Electric vehicle charger. (Fig 1)

Architecture and main components of BEVs

- Electric motor
- Inverter
- Battery
- Controller

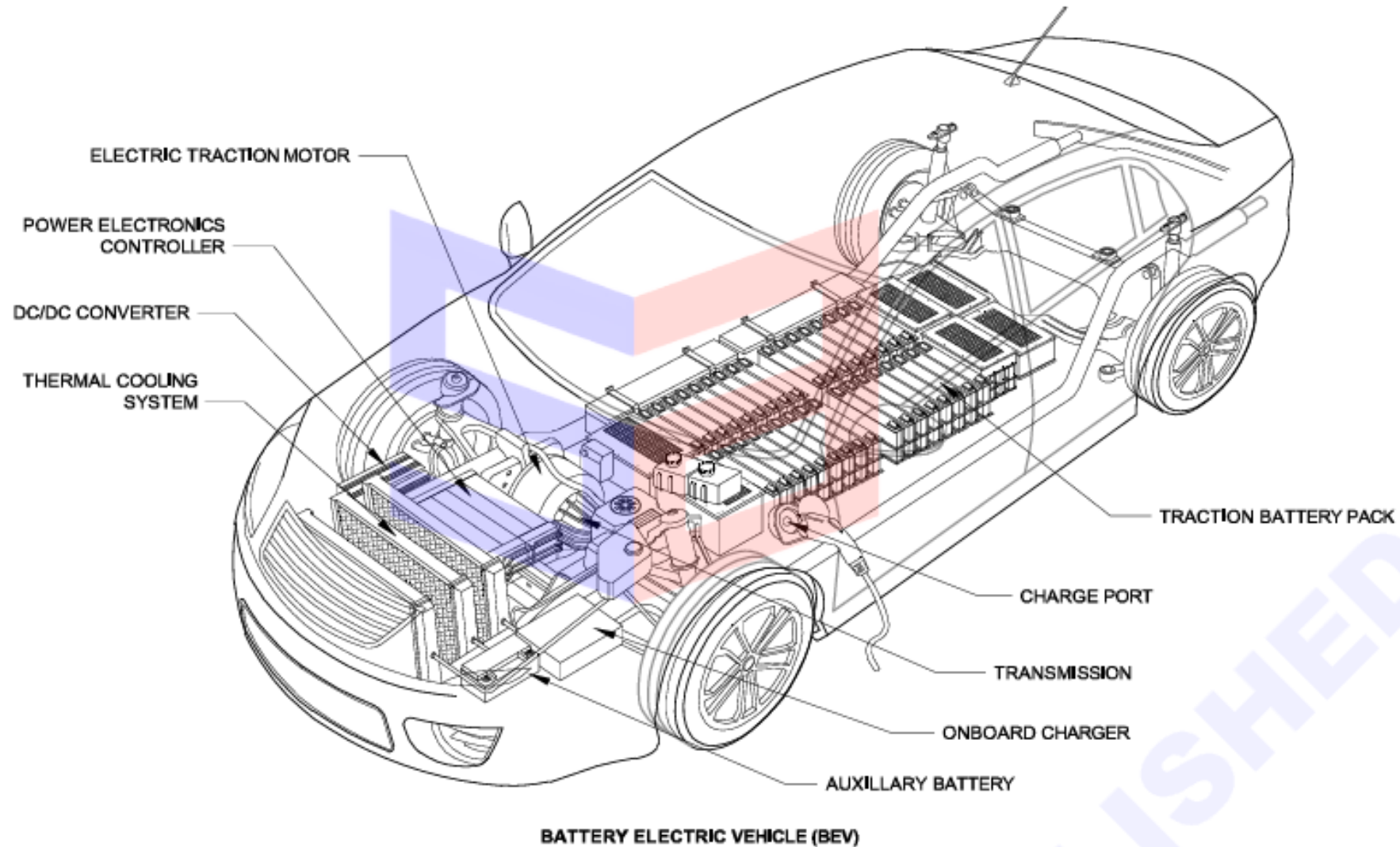
**Working principles of BEV**

- Power is converted from the DC battery to AC for the electric motor
- The acceleration pedal sends a signal to the controller which adjusts the vehicle's speed by changing the frequency of the AC power from the inverter to the motor
- The motor connects and turns the wheels through a cog.
- When the brakes are pressed or the electric car is decelerating, the motor becomes an alternator and produces power, which is sent back to the battery.





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## Hybrid Electric Vehicles (HEVs):

Hybrid Electric Vehicles (HEVs), sometimes referred to as 'self-charging hybrids', use both an internal combustion engine and an electric motor, which uses electricity stores in a battery pack. The main difference between a PHEV and an HEV is that you cannot plug in HEV into an EV charger to charge the battery. Instead, the onboard battery pack is charged via the engine and regenerative braking.

There are different types of HEVS, they include :

- **Mild Hybrid Electric Vehicles (MHEVs)**
- **Full Hybrid Electric Vehicles (FHEVs)**

## Architecture and Main Components of HEV

### Components of HEV

- Engine
- Electric motor
- Battery pack with controller & inverter
- Fuel Tank
- Control module

### Working Principles of HEV

- it has a fuel tank that supplies Fuel to the engine like a regular car
- It also has a set of batteries that run an electric motor
- Both the engine and electric motor can turn the transmission at the same time.



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## Plug-in Hybrid Electric Vehicle (PHEVs):

Plug-in hybrids Electric Vehicles (PHEVs) use batteries to power an electric motor and incorporate an Internal Combustion Engine (ICE) that can recharge the batteries to enable longer driving ranges. A PHEV typically runs on electricity stored in the battery until nearly depleted, generally around 50-90 Kms depending on the vehicle model and battery size and capacity. Then the car automatically switches over to use the ICE and can travel several hundred Kms on a tank of fuel.

### Architecture and main components of PHEV

#### Components of PHEV

- Electric motor
- Engine
- Inverter
- Battery
- Fuel tank
- Control module
- Battery Charger (if onboard model)

## Working Principles of PHEV

PHEVs typically start up in all electric mode and operate on electricity until their battery pack is depleted. Some models shift to hybrid mode when they reach highway cruising speed, generally above 60 or 70 miles per hour. Once the battery is empty, the engine takes over and the vehicle operates as a conventional, non-plug-in hybrid.

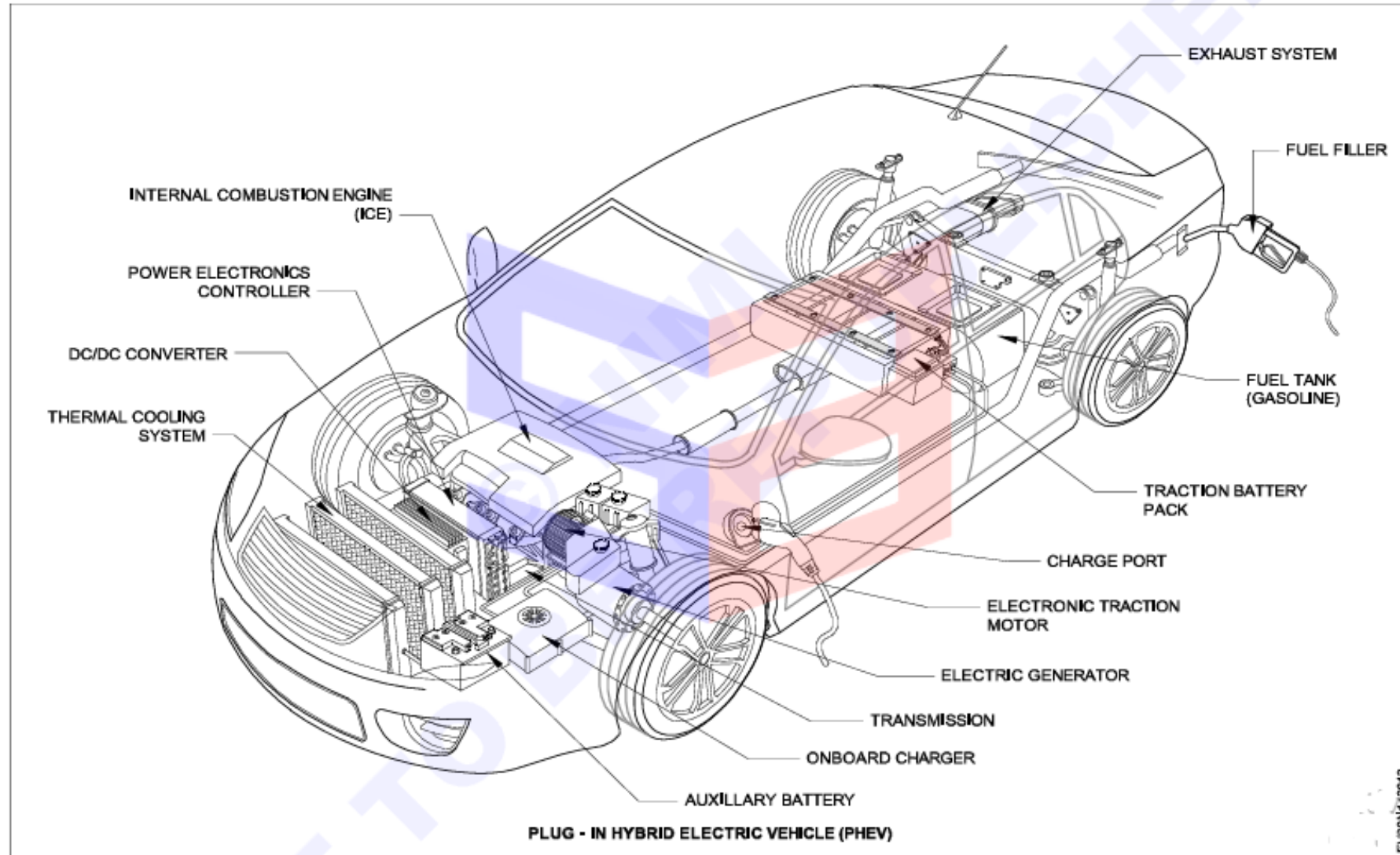
In addition to plugging into an outside electric power source, PHEV batteries can be charged by an internal combustion engine or regenerative braking. During braking, the electric motor acts as a generator, using the energy to charge the battery. The electric motor supplements the engine's power; as a result, smaller engines can be used, increasing the car's fuel efficiency without compromising performance.



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## Fuel Cell Electric Vehicles (FCEVs)

Fuel Cell Electric Vehicles (FCEVs) create zero tailpipe emissions powered by hydrogen. An FCEV uses a similar system as a Battery Electric Vehicle to run the vehicle. In the case of an FCEV, the energy is stored as hydrogen and then converted into electricity by the fuel cell to propel the vehicle. Fuel Cell Electric Vehicles have a gas tank used to store the pure hydrogen; the tank can be fuelled up in just a few minutes, similar to how conventional ICE vehicles are filled up today.

Architecture and Main Components of FCEV

### Components of FCEV

- Electric motor
- Fuel-Cell Stack
- Hydrogen storage tank
- Battery with converter and controller

## Working principles of FCEV (Fig 4)

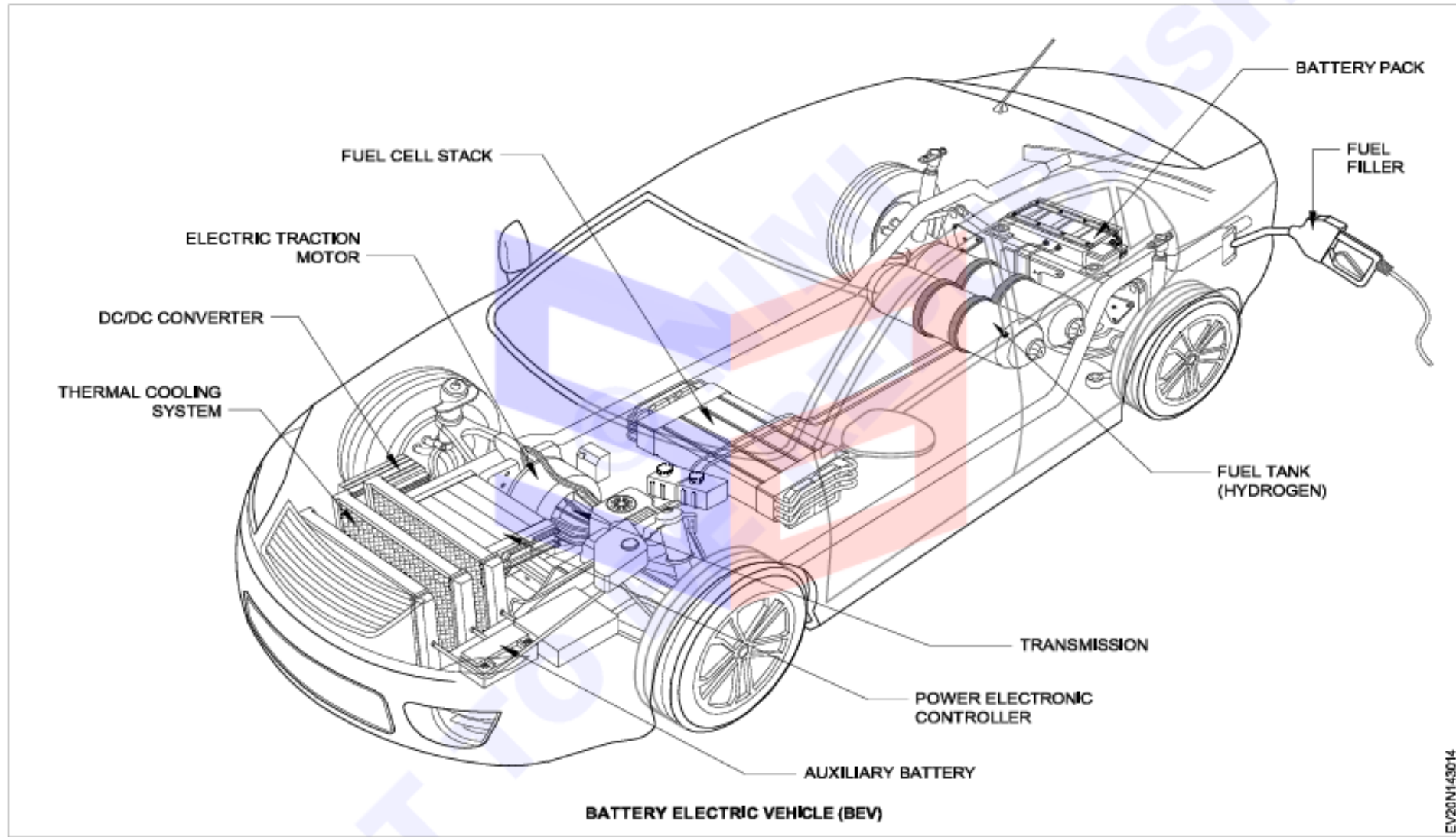
Fuel cell cars are powered by compressed hydrogen gas tank feeds into an onboard fuel cell stack that does not burn the gas, but instead transforms the fuels chemical energy into electrical energy. This electricity then power the cars electric motors. Tailpipe emissions are zero, and the only waste produced is pure water the construction of the fuel cell is similar to a battery.

A fuel, such as hydrogen is fed to the anode and air is fed to the cathode in a hydrogen fuel cell a catalyst at the anode separates hydrogen molecules into protons and electrons, which take different paths to the cathode. The electrons go through and external circuits creating a flow of electricity.



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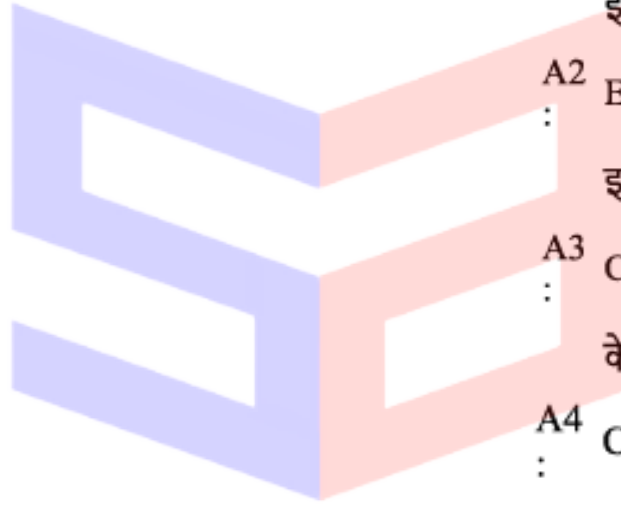
# MCQs

Which is one electric vehicle and hybrid vehicle have following components common except ?  
कौन सा एक इलेक्ट्रिक वाहन और हाइब्रिड वाहन में निम्नलिखित को छोड़कर सामान्य घटक होते हैं?

- A1  
: IC engine  
IC इंजन
- A2  
: ECU  
ECU
- A3  
: Generator  
जनरेटर
- A4  
: Battery  
बैटरी

Which is FCEV energy is converted into energy?  
कौनसी FCEV ऊर्जा, ऊर्जा में परिवर्तित होती है?

- A1  
: Electrical to chemical  
इलेक्ट्रिकल से केमिकल
- A2  
: Electrical to Mechanical  
इलेक्ट्रिकल से मैकेनिकल
- A3  
: Chemical into electrical  
केमिकल से इलेक्ट्रिकल
- A4  
: Chemical to mechanical  
केमिकल से मैकेनिकल



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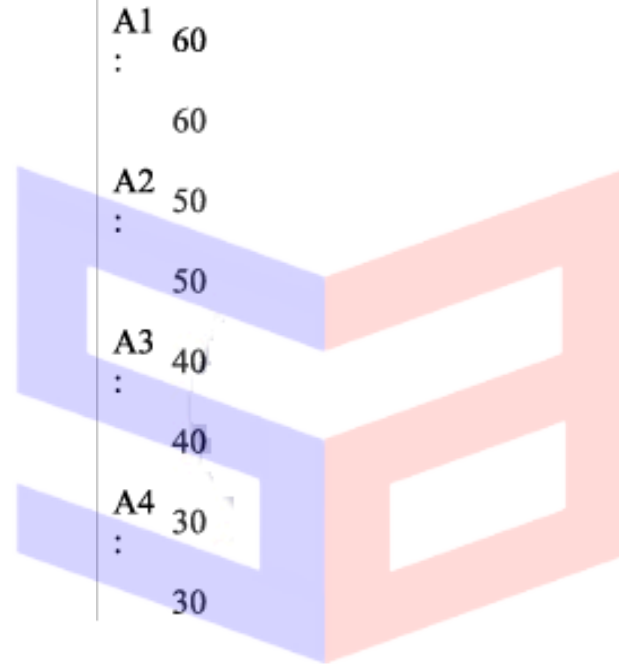


# MCQs

Which is the one Battery electric vehicle charging?  
कौन सा एक बैटरी इलेक्ट्रिक वाहन चार्ज कर रहा है?

- A1  
: Internal plugin  
आंतरिक प्लग इन
- A2  
: No plugin  
कोई प्लगइन नहीं
- A3  
: External plugin and fuel tank  
बाहरी प्लगइन और ईंधन टैंक
- A4  
: Only external plugin  
केवल बाहरी प्लगइन

How much time battery electric vehicle battery can charge from 10 to 80 percent in around minutes?  
कितने समय में बैटरी इलेक्ट्रिक वाहन की बैटरी लगभग मिनटों में 10 से 80 प्रतिशत तक चार्ज हो सकती है?



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# MCQs

Which electric vehicle does not emit CO<sub>2</sub> emission?  
कौन सा इलेक्ट्रिक वाहन CO<sub>2</sub> उत्सर्जन नहीं करता है?

- A1  
: BEV  
BEV  
A2  
: HEV  
HEV  
A3  
: FCEV  
FCEV  
A4  
: PHEV  
PHEV

How many method and modes of charging an electric vehicle.  
इलेक्ट्रिक वाहन को चार्ज करने के कितने तरीके और तरीके हैं।

- A1  
: 3,4  
3,4  
A2  
: 2,3  
2,3  
A3  
: 4,2  
4,2  
A4  
: 3,2  
3,2



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