1.Introduce of electric motor

In 1826 Austria inventor anyos zeduk introduce the first indigenous electric motor and develop the prototype toy car using electric motor

2. Golden era of EV

In 1906 to 1910 was the golden era of EV , during the time EV's were so advance in the sense it was capable to run the range of 100mils per charge also 45 to 50 Kmph speed , during the time 32 % of the automobile were electric vehicle. People were like to buy Electric vehicle because of some key Advantage compared to IC vehicle.

advantageous of EV mentioned below (1906 to1910)

1. Low emission

2. High efficiency

3.easy to start

4. Low cost

3. Domination of electric vehicle by gasoline cars

1. In 1910 Henry ford came up with assembly line production for IC engine in order to reduce the IC engine vehicle cost . It was decreased the total cost of IC vehicle by 30% each year

2. In 1912 Chevrolet came up with self start IC engine . That was the key advantages for IC

3. World war -during world war vehicle needed to go for long range and also refueling needed to be quick . So EV were non reliable for the war situation

4. Oil - lobby

4. Coming up new era in EV

In 1950 5 th December to 9 th December there was 12000 people were death due to smoke Emission by automobile IC engine they call it "The great smoke in London " so among the people internal combustion engines vehicles became environmental concern

Also in 1960 in California there was 600 New disease were reported . all related to bad air pollutions that 48 % of air pollutions came from IC engine automobile vehicle

In the meantime California government decided to start CARB -(California air resource board) organization that controls the air pollution till now also CARB is independent organization

In 1991 CARB came up with regulations which was LEV-1

(1993 to 2003) All vehicles manufacture must provide one electric vehicle as ZEV alternative to the market in lease agreement

But people were not interested to use ZEV company's were end up with loss , so all vehicles manufacture were file the case against CARB eventually they won case in 1999

5.Introduction to Hybrid Electric vehicles

Again 2003 CARB came up new with project for the vehicle manufacturers

LEV -II is 10 to 15 % less emission

ULEV - 70 to 80 % - emission (hybrid)

PZEV -0 Emission (electric vehicle)

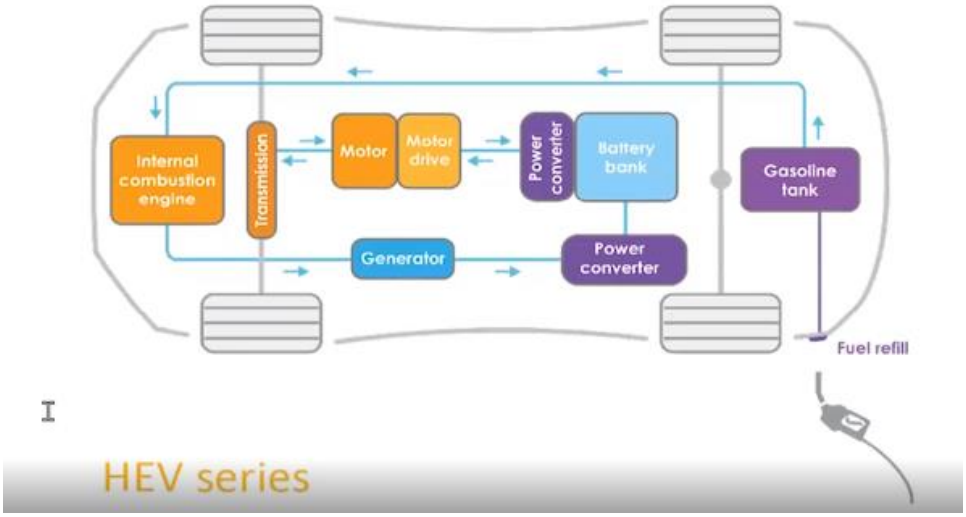
In 2006 Santa Monica TESLA introduce the TESLA roster fully electric car

2010 Nissan introduce the first EV (Nissan leaf) in affordable price for family

1 . Series Hybrid Electric vehicles

A series hybrid is like a battery electric vehicle (BEV) in design. Here, the combustion engine drives an electric generator instead of directly driving the wheels. The generator both charges a battery and powers an electric motor that moves the vehicle

Series Hybrid Electric vehicles diagram

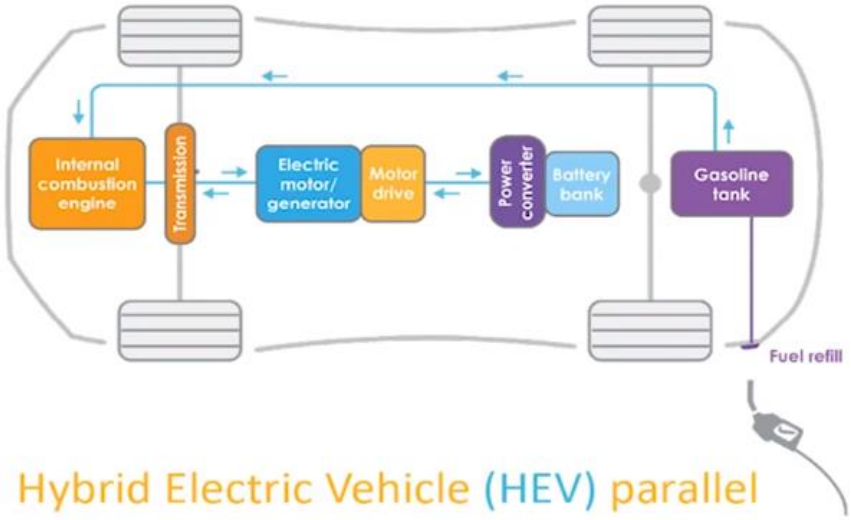


In series hybrid Vehicle electric Motor is the primary source , IC engine is secondary source

2 . parallel Hybrid Electric vehicles

A parallel hybrid is propelled by both an internal combustion engine (ICE) and an electric motor connected to a mechanical transmission. Power distribution between the engine and the motor is varied so both run in their optimum operating region as much as possible. There is no separate generator in a parallel hybrid.

parallel Hybrid Electric vehicles diagram

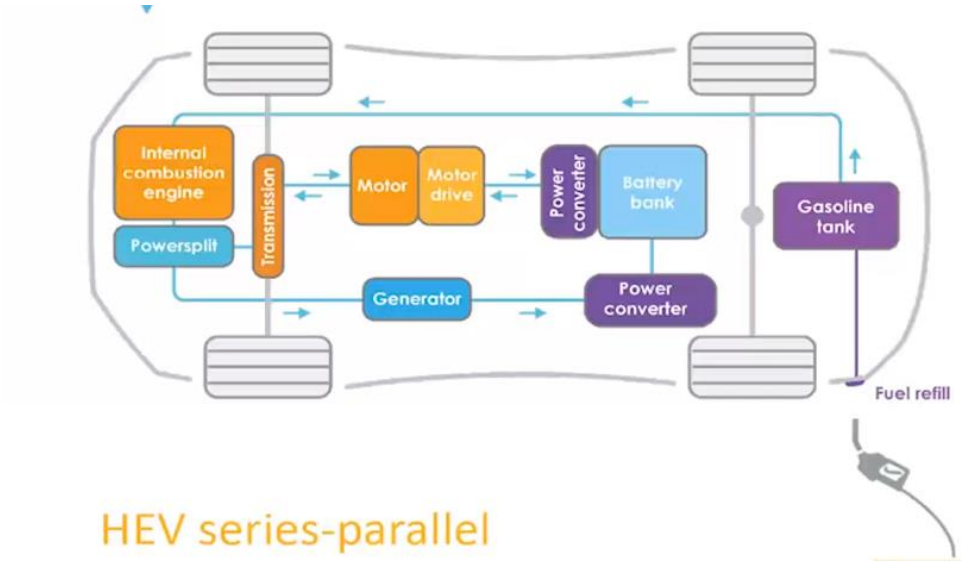


In Parallel hybrid Vehicle IC engine is the primary source , Electric motor is secondary source

3. Series - Parallel Hybrid vehicle

series-parallel hybrid are parallel hybrids that incorporate power-split devices, allowing for power paths from the ICE to the wheels that can be either mechanical or electrical. The main principle is to decouple the power supplied by the primary source from the power demanded by the driver

Series - Parallel Hybrid vehicle diagram



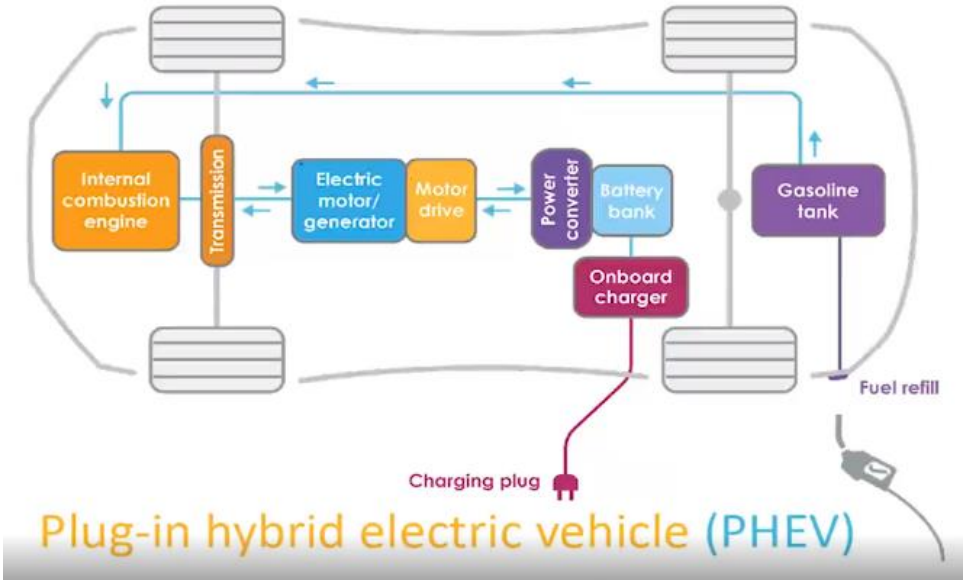
In Series - Parallel Hybrid vehicle the main principle is to decouple the power supplied by

the primary source from the power demanded by the driver

4. Plug in Hybrid electric vehicle

Plug-in hybrid electric vehicles (PHEVs) use batteries to power an electric motor and another fuel, such as gasoline, to power an internal combustion engine (ICE). PHEV batteries can be charged using a wall outlet or charging equipment, by the ICE, or through regenerative braking.

Plug in Hybrid electric vehicle diagram

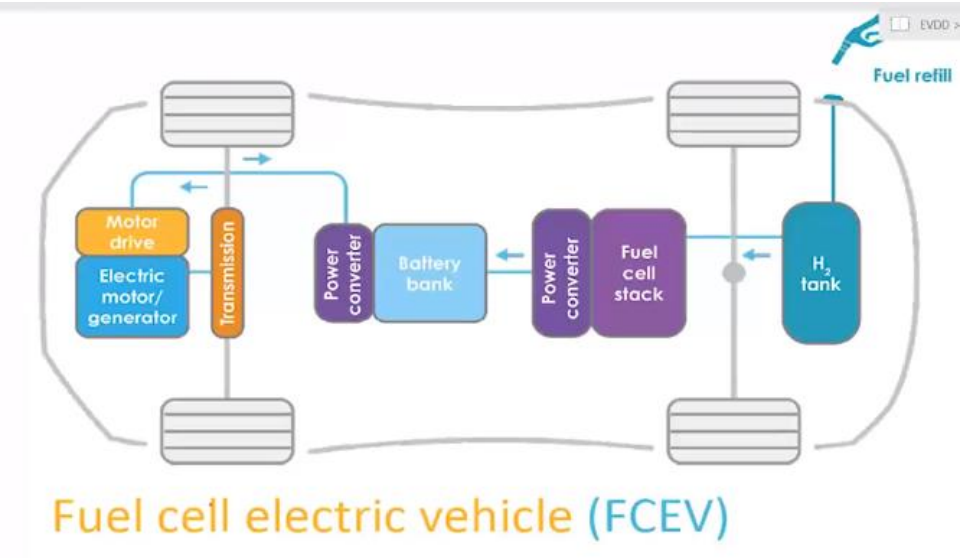


Plug in Hybrid electric vehicle ICE is the More powerful than electric motor

5. Fuel Cell Electric Vehicle

FCEVs use a propulsion system similar to that of electric vehicles, where energy stored as hydrogen is converted to electricity by the fuel cell and power the electric motor by battery pack

Fuel Cell Electric Vehicle diagram



Advantages of a Hybrid Vehicle

1. Environmentally Friendly
2. Less Dependence on Fossil Fuels

Disadvantages of a Hybrid Vehicle.

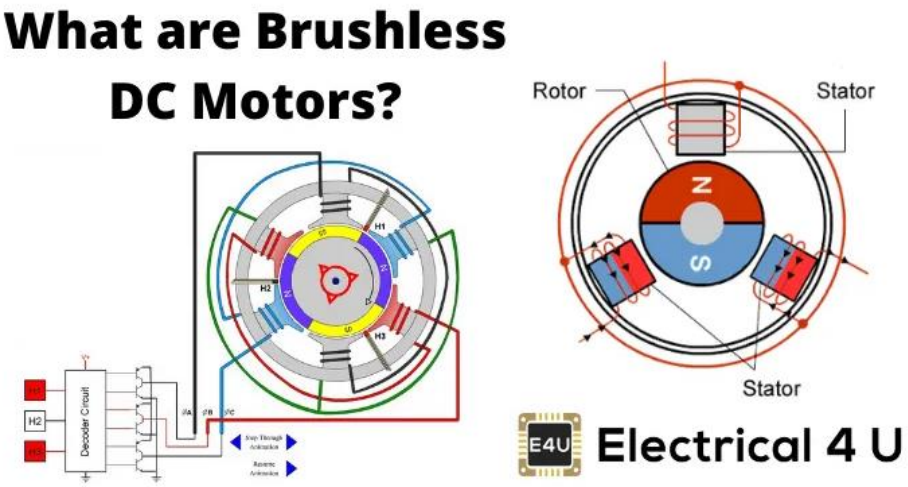
1. Less Power
2. Can be Expensive

Brushless Motor DC motor (BLDC) explanation

A brushless DC motor (also known as a BLDC motor or BL motor) is an electronically commuted DC motor which does not have brushes. The controller provides pulses of current to the motor windings which control the speed and torque of the synchronous motor.

Brushless DC motor has only two basic parts: rotor and the stator. The rotor is the rotating part and has rotor magnets whereas stator is the stationary part and contains stator windings. In BLDC permanent magnets are attached in the rotor and move the electromagnets to the stator. The high power transistors are used to activate electromagnets for the shaft turns. The controller performs power distribution by using a solid-state circuit.

Diagram & Construction of Brushless Motor DC motor



Battery Pack

Components of battery packs include the individual batteries or cells, and the interconnects which provide electrical conductivity between them. Rechargeable battery packs often contain a temperature sensor, which the battery charger uses to detect the end of charging.

Classification	Definition
Battery Cell	Basic unit of a lithium ion battery that exerts electric energy by charging and discharging. Made by inserting cathode, anode, separator and electrolyte into a rectangular aluminum case.
Battery Module	A battery assembly put into a frame by combining a fixed number of cells to protect the cells from external shocks, heat or vibration.
Battery Pack	Final shape of the battery system installed to an electric vehicle. Composed of modules and various control/protection systems including a BMS (Battery Management System), a cooling system, etc. e.g.) 8 modules(12 cells per module) go into a battery

Lithium-ion battery composition (basically at cathode electrode material)

1. NMC (622) - Nickle 60%, Manganese 20% cobalt 20%
2. NMC (811) - Nickle 80%, Manganese 10% cobalt 10%
3. NCA - Nickel-Cobalt-Aluminum Oxide

Advantages of Battery Pack (**Lithium-ion battery)** Electric Vehicle

1. High energy density
2. Charge & discharge rate

Disadvantages of Battery Pack (**Lithium-ion battery)** Electric Vehicle

1.temprature rise /thermal management

2. expensive