

## Review Paper of Electric Vehicles

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### ABSTRACT

Dangerous gaseous are emitting from the internal combustion engine (vehicles), these harmful gasses are the main cause of the air pollution. The aim of this paper is to clarify the importance of electric vehicle and how we can control or reduce the dangerous gaseous from the environment. Here, we have been discussing the principle of electric vehicle and also focusing on different types of electric vehicles.

**KEYWORDS:** Global Warming, Environment, Electric vehicles

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### 1. INTRODUCTION

In India air pollution is the main cause of global warming. Day to day increasing the concentration of greenhouse gases since industry revolution because of human actions. Whenever nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), ozone(O<sub>3</sub>), carbon dioxide (CO<sub>2</sub>) gasses are accumulate in the atmosphere absorbs solar radiations that have reflect the earth's surface.[2] In urban areas, most of the peoples are facing problem to breath, increase in distinct forms of cancer just because of air pollutants. Pollution of air is caused by bad roadway condition, older vehicle, bad fuel quality.[1] Nowadays, electric vehicles are very popular because they helps to decrease the greenhouse gas emission.[6] In place of internal combustion engine (ICE), EV's operate on an electric motor. The fundamental principle of electric vehicle is base on the conversion of energy (converts electrical energy into mechanical energy). To store their energy, electric vehicles use different types of power.

### 2. Working principle of electric vehicles:-

Electric vehicle is a fusion of three components.

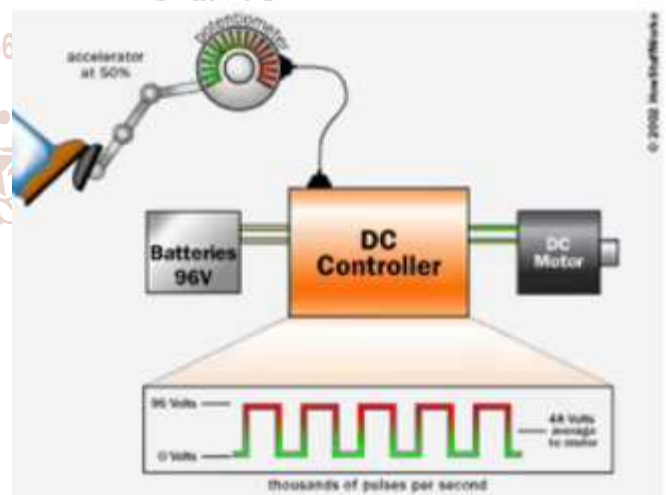


Fig 2.1 Principle of EV's [4]

**2.1. Electric motor-** The main role of electric motor is to convert electric energy into mechanical energy. Most of the manufactures have been concentrate on brushless DC motor (BLDC) due to its effective cost, size, power saving, more efficiency and controllability. The main parts of motor are rotor and stator. The rotating part called as rotor having permanent magnet & the stationary part called as stator

carrying stator winding. [3] Magnets are used in electric motor to create a motion.

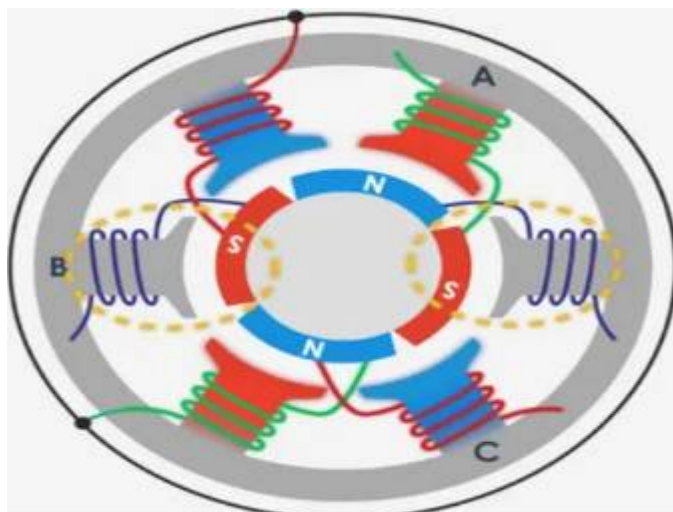


Fig 2.2 BLDC motor [4]

of switch will be depending on the accelerating pedal. The switch will be ON if we push the pedal then the variable resistor type controller show signal to the motor controller. Vehicle is at rest position when motor controller has no power.

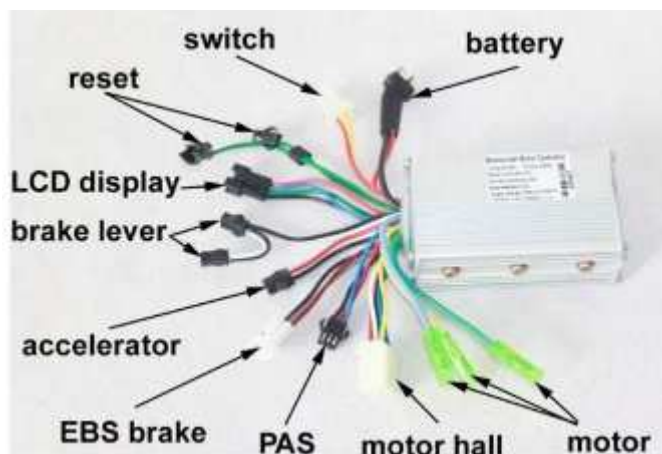


Fig 2.3 Motor controller

**2.2. Motor Controller-** The controller grasps power from the batteries and supply it to the motor. In cars, the controller takes 300 volts DC from battery pack and converts it into maximum of 240 volts AC, to send to the motor. Mostly brushless DC motor is used in electric vehicle because this is more superior then brushed DC motor. [3] The ON/OFF state

**2.3. Batteries-** The foremost function of the battery is to store electric energy. In present scenario most of the electric vehicles used lithium ion batteries because of its fast charging time, no maintenance requirement, specific energy density, etc.

In the following table, we discuss different type of batteries specifications:-

Specification	Lead acid	Ni-Cd	Ni-Mh	Li- ion		
				Cobalt	Manganese	Phosphate
Specific energy density	30-50	45-80	60-120	150-190	100-135	90-120
Fast charge time	8-16 h	1h typically	2-4 h	2-4 h	1h or less	1h or less
Charge temperature	-20 to 50°C	0 to 45°C	0 to 45°C	0 to 45°C <sup>10</sup>	0 to 45°C <sup>10</sup>	0 to 45°C <sup>10</sup>
Overcharge tolerance	high	Moderate	Low	Low, cannot tolerate trickle charge		
Maintenance requirement	3 to 6 months	30 to 60 days	60 to 90 days	Not required		
In use since	Late 1800s	1950	1990	1991	1996	1999

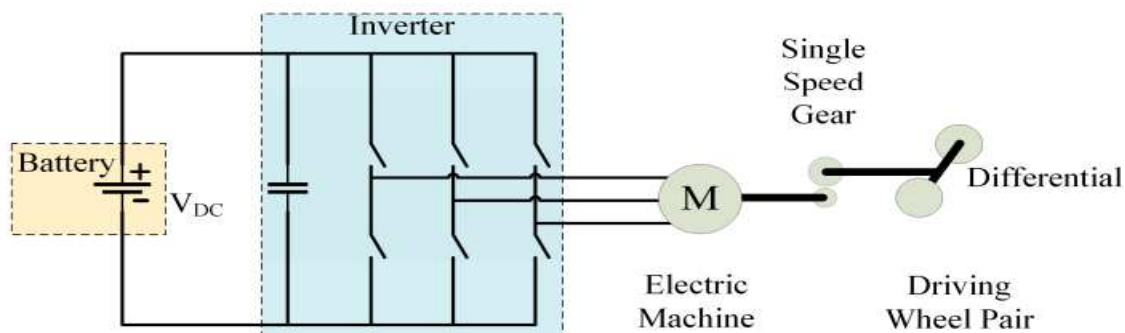
Table 2.1 Battery types

**3. Types of electric vehicles (EV's)-**

Electric vehicles are classified into three types.

**3.1. Battery electric vehicle (BEV)**

Battery electric vehicles have no engine and batteries are used to supply power to the drive configuration. These vehicles directly depend upon the capacity of the batteries because of its energy storage ability. On one time charging BEV can cover 100 to 250 Km but its range be dependent on road condition, battery type, weather conditions, vehicle design, etc. [6] Almost 36 h are required to replenish the batteries. [7] Battery electric vehicles are more effective then hybrid and plug-in hybrid electric vehicle

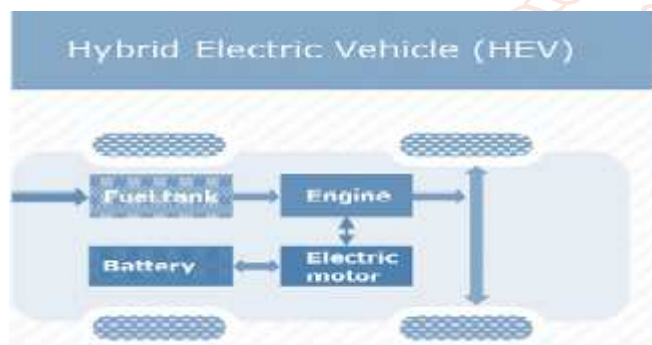


**Fig. 3.1 Battery electric vehicle configuration [6]**

Examples of BEV are Mahindra Verito, MG ZS, TATA Tigor, Mahindra E20 plus, , TATA Nexon, Hyundai Kona, etc [12]

### 3.2. Hybrid electric vehicle (HEV)

Hybrid electric vehicle is a combination of conventional ICE and a battery/electric motor. When electric motor does not give the power supply then Fuel is in active mode. These vehicles release not so much greenhouse gases. Battery is charged by those type of electricity which is produce by braking system (converts kinetic energy into heat). [14]

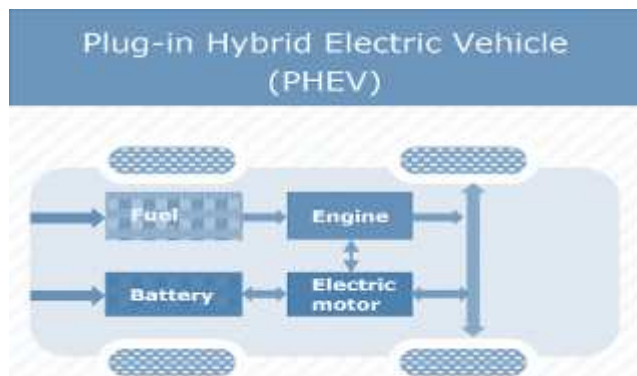


**Fig 3.2 Hybrid electric vehicle configuration**

Examples of HEV are battery pack with controller & inverter, Engine, Electric motor, Fuel tank, Control module, etc.

### 3.3. Plug-in hybrid electric vehicle (PHEV)

Plug-in hybrid electric vehicles are similar to hybrid electric vehicle but they have large battery and small engine. [12] These vehicle can be powered by petrol, bio-diesel or rechargeable battery. Battery can be charged by externally electric power system or braking system.



**Fig 3.3 Plug-in hybrid electric vehicle configuration**

Examples of PHEV are Ford C-Max Energi, Mini Cooper SE Countryman, Ford Fusion Energi, BMW i8, BMW X5 xdrive40e, Fiat 500e, Mercedes C350e, Mercedes S550e, Mercedes GLE550e, Audi A3 E-Tron, etc.

### 4. Advantages of electric vehicle

- EV's are environment friendly (no fuel, no pollution, no noise)
- Required low maintenance
- Reduce the dependency on fossil fuels.
- Lower emissions & better mileage [13]
- Safety of vehicles
- More efficiency
- Cost of electricity is lower than from fuel
- EV's can charge easily at home [1]

### 5. Disadvantages of electric vehicle

- EV's are more expensive
- Batteries are not recyclable
- Recharging takes much longer time than refueling
- Lack of availability of charging station
- Lack of skilled workers

### 6. Conclusion

Global warming is the major issue in our country. For controlling global warming electric vehicles has been introducing. In this paper, we discuss the configuration of different types of electric vehicles. Hybrid electric vehicle integrate the most advanced technologies and considerably contributes to reduce global warming.

In future, the life span of the battery is being increased.

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