Basics of Electric Vehicles: Advantages, Challenges, and Classifications

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Electric Vehicles are those vehicles which use one or more electric motors for propulsion. They are highly important in the present automotive industry.

Environmental issues and expected reduction of conventional fuels in the near future attract manufacturers to the electric vehicle. A typical passenger vehicle emits around 4.6 metric tons of Carbon-dioxide per year. And one liter of petrol emits 2.3 kg of carbon dioxide when it burnt. Atmospheric temperature increases as a result of the greenhouse gas emission. Environmental impacts of conventional vehicles and depletion of fossil fuels make alternative fuel vehicles and electric vehicles popular.

Have you ever seen an electric vehicle?

The first electric vehicle that I saw was a remote-controlled toy car. :-) Electric vehicles can be toy cars, trains, trolleybus, car, scooter, truck, bus, and even aircraft these days!

There is no wonder if astronauts go to space in electric-powered space crafts. The first solar-powered aircraft **"Solar Impulse 1"** had its first flight in 2009 and **"Solar Impulse 2"** traveled around the globe in 2015.

Electric vehicles have their advantages and disadvantages compared to conventional internal combustion engine vehicles.

People will go for an electric and hybrid electric vehicle if they are far better than IC engine vehicles. Comparison of conventional and electric vehicles is necessary to find which one is the best.

Advantages of Electric Vehicle

Why should people use the electric vehicle? Why would one go for an electric or hybrid electric vehicle when conventional internal combustion (IC) engine vehicles are popular and available?

Following are a few advantages of EVs that might convince you why one must go for an electric vehicle. :-)

You may also like: **Why you should not buy an electric vehicle!**

#1 Electric Vehicles have zero tailpipe emission

Electric motors emit no gases as Internal Combustion Engine does. So Battery Electric vehicles are zero emission vehicles and **Hybrid Electric Vehicles (HEV)** are low emission vehicles.

They are **eco-friendly** in terms of air pollution. Are Electric Cars really good for the environment? Adverse effects of environmental pollution make vehicle manufacturers think about electric vehicle production. Governments also started taking measures to reduce the carbon footprint.

World's most populated cities suffer from air pollution. As a result, diesel engine vehicles have been banned in several cities. Emission-free electric vehicles are highly important here.

#2 EVs cause no noise pollution

Noise pollution from the electric vehicle is low compared to conventional vehicles. Noisy IC engines are replaced with silent electric motors in electric vehicles.

Electric motors are so silent compared to an internal combustion engine. Battery electric vehicle which has only electric motor is not even identified with noise when they move.

#3 Electric vehicles are maintenance free/less maintenance

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#3 Electric vehicles are maintenance free/less maintenance

Power train in an electric vehicle is not as complex as the IC engine. The maintenance cost of electric motors is less compared to that of IC engines.

It's estimated that an electric car has less than 25 (Chevrolet Bolt) moving parts while an IC engine vehicle has more than 10000.

Other components such as oil, engine cooling system, exhaust system, etc. are absent in an electric vehicle.

You can read

- **The life expectancy of electric vehicle: How long an EV lasts?**

#4 Low running cost

Cost to run an electric vehicle for 1 km is much less than that for an IC engine vehicle. Fuel cost shows exponential growth in the coming years and latest technologies reduce the cost of electric power generation.

So the running cost of an electric vehicle will further decrease in the future. Are Electric Cars really economical?

Challenges faced by Electric Vehicle

Although electric vehicles are having many advantages, there are a number of challenges that they face and have to overcome to get popular.

- **Reasons why You should not buy an electric car!**

The popularity of electric vehicle would depend on how the manufacturers get over following drawbacks.

#1 Lack of electric vehicle public charging stations

More charging stations should have to install all over the area where the vehicles are expected to be used. This process takes time. As the electric vehicles increase the number of charging stations also increase.

#2 Longer charging time

Refilling of fuel in a conventional vehicle is a matter of seconds. But recharging a battery of electric vehicle consumes more time. So Long trips in electric vehicles are inconvenient.

Does charging time really matter in an electric vehicle?

Fast charging techniques cut the time required for charging of an electric vehicle. A driver can't continuously drive the vehicle for a long. So the charging can be done during breaks in long trip and which takes less than half an hour.

#2 Short range or EVs

Distance traveled by an electric vehicle with a fully charged battery is much less than that of a conventional vehicle whose fuel tank is fully filled.

The average distance that could be traveled by a fully charged battery electric vehicle is around a few 100 km. For long distance transit, it would be a problem but for regular use, the range will be sufficient.

#3 Battery replacement

Life of battery and replacement cost is a major constraint which detaches people from an electric vehicle. Life of electric car battery ranges from 5 to 10 years.

- **Electric vehicle battery life expectancy: How long an EV battery lasts?**

Battery technologies are being developed day by day to improve storage capacity, life, etc. Price of the battery shows a reduction for the last 2 years.

It would be expected to continue the same trend of reduction in battery cost in the future as well. Batteries used in Electric vehicle are briefly described here. **Electric vehicle batteries**

Classification of Electric Vehicles

Classification of Electric vehicles can be done based on different factors. Let's have a look at the classification based on the power sources and configuration.

Electric Vehicles are broadly classified into

- **Battery Electric Vehicle** (BEV)
- **Hybrid Electric Vehicle** (HEV)

- **Plug-in Hybrid Electric Vehicle** (PHEV)

#1 Battery Electric Vehicle

Battery electric vehicle is generally referred by the term electric vehicle which is exclusively working on electric energy which stored in a battery. An electric motor powered from the stored electricity drives the vehicle.

BEVs are equipped with a power socket to charge the battery. Those vehicles can be charged from electric car charging stations also.

Regenerative braking may also be provided to store the energy from braking. Read below article about

Regenerative Braking: Theory, Advantages, and Challenges

The short range of battery electric vehicles can be overcome by use Hybrid Electric Vehicles and Plug-in Hybrid Electric Vehicles.

You may read **Electric Vehicle Glossary: The complete list of EV terms** for more details.

#2 Hybrid Electric Vehicle

A hybrid electric vehicle uses **one or more source of energy** along with **electricity** for propulsion. A common combination is an **Internal Combustion (IC) engine** with an **electric motor**.

Range of the vehicle (distance traveled per unit fuel) improves considerably with this combination. An electric motor propels a vehicle at a high-efficiency

region of operation of the IC engine and improves the fuel economy of the vehicle.

The strategy of power split among electric and IC engine depends on manufactures. Based on the percentage of hybridization, HEVs are classified into **micro**, **mild** and **strong hybrids**.

Hybrid electric vehicles have no plug-in capability. They cannot be connected to an external electrical socket for charging. The battery of HEVs get charged by regenerative braking and energy generated from an electric machine connected to the IC engine

#3 Plug-in Hybrid Electric Vehicle

Plug-in Hybrid Electric Vehicles (PHEV) are more or less hybrid electric vehicles which have plug-in capability. Their batteries can be charged from external power socket along with regenerative braking from the vehicle.

PHEVs have high-capacity battery compared to HEVs and no need to rely on fuel and regenerative braking always to get charged.

Classification of Hybrid Electric Vehicles

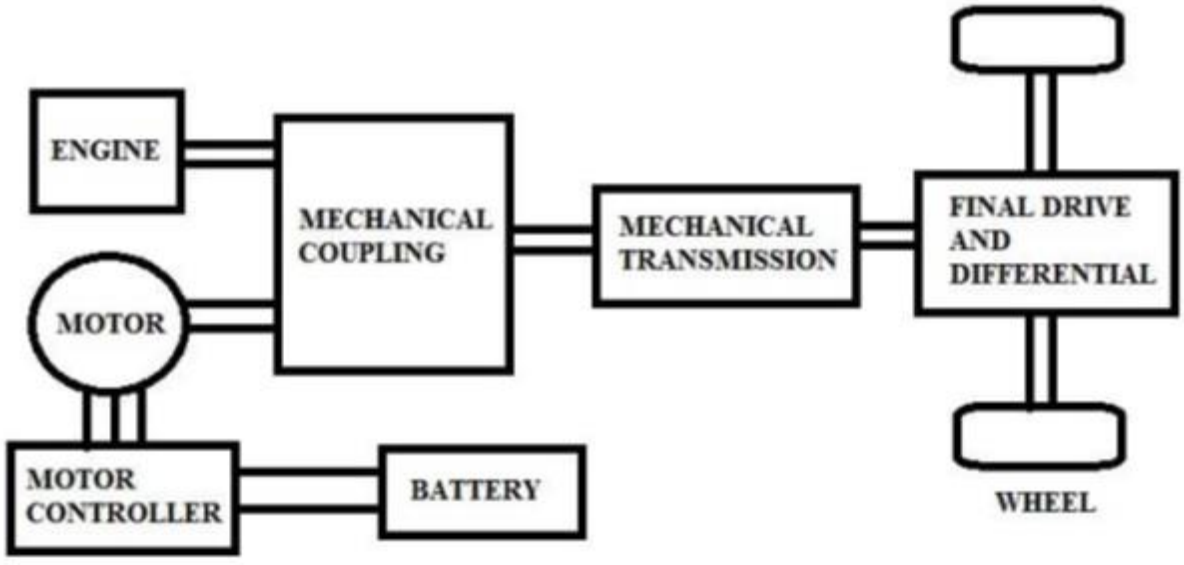
Hybrid electric vehicles are classified as **Parallel**, **Series,** and **Series/parallel** hybrid electric vehicles based on the drive-train configuration. Series/parallel drive-trains enable the engine and electric motor to provide power independently or in conjunction with one another.

#1 Parallel Hybrid Electric Vehicle

An electric motor and **internal combustion engine** can offer mechanical power **simultaneously** to the wheels of parallel hybrid electric vehicles. They can drive the wheel independently as well.

The internal combustion engine and electric motor work together to generate the required energy for the vehicle. The engine is connected directly to the wheels of hybrid electric vehicle and it helps to reduce the losses due to the conversion of mechanical power to electricity and vice versa as in a series hybrid electric vehicle.

Since motor need not bear the full load of the vehicle, rating of motor and battery can be less compared to a series hybrid electric vehicle. So parallel power train configuration is popular in a hybrid electric vehicle.



Block diagram of parallel hybrid electric vehicle

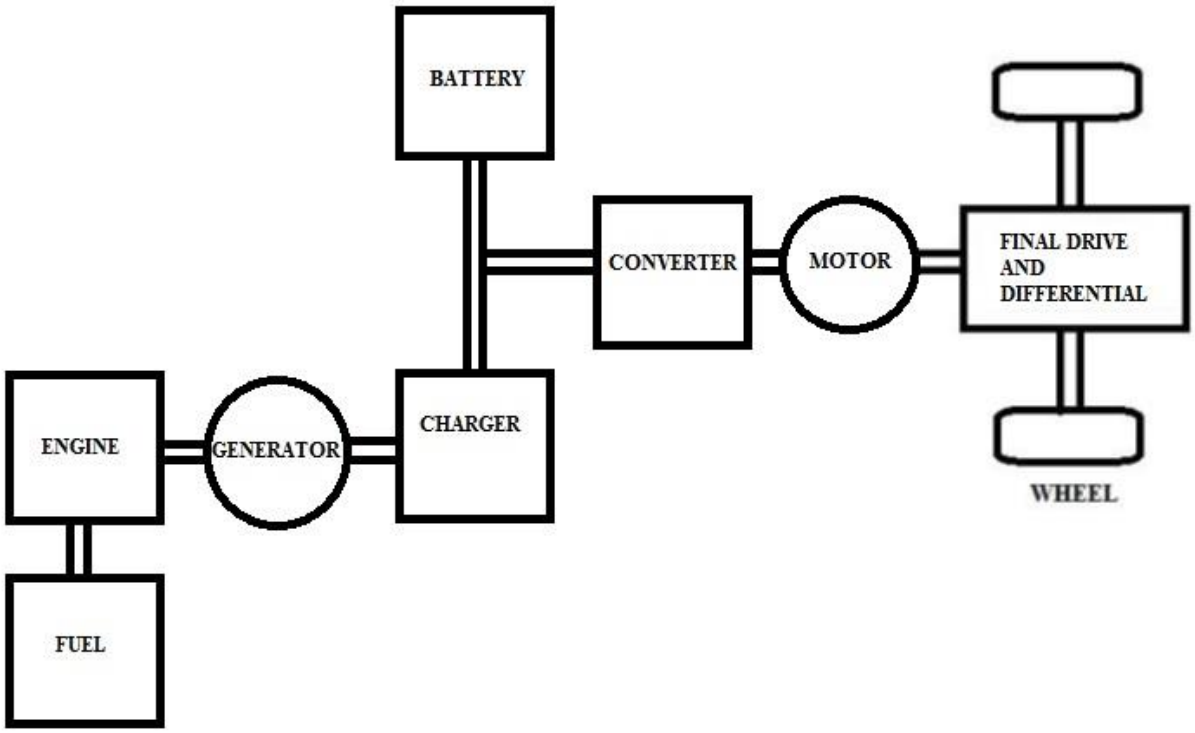
#2 Series Hybrid Electric Vehicle

Series drive-trains are the simplest hybrid configuration in terms of development and control. Hybrids that use a series drive-train receive **mechanical power** only from the **electric motor**, which is run by either a battery or a gasoline engine powered generator.

Propulsion of vehicle is attained only by an electric motor. So the motor should be capable of supplying enough power to the axles hence the **rating would be more** compared to a parallel electric vehicle.

The electric motor is powered by a generator connected to a gasoline engine or a battery.

The battery pack gets recharged from regenerative braking. IC engine-generator combo also generates electricity and recharges the battery.

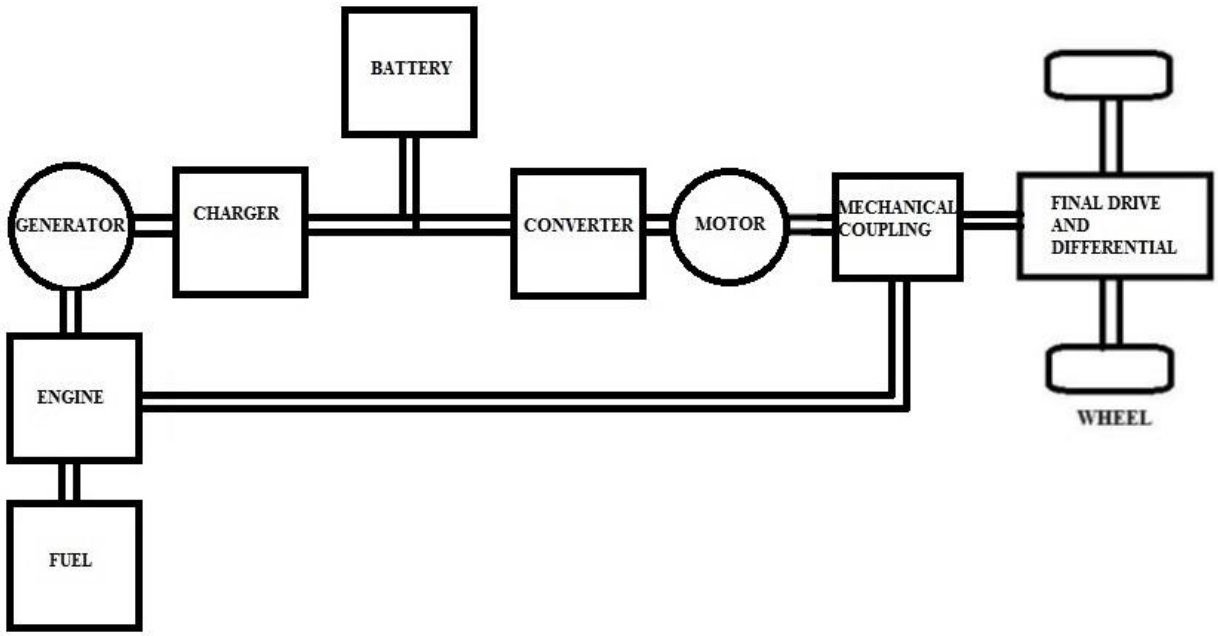


Block diagram of Series Hybrid Electric Vehicle

#3 Series/Parallel Hybrid Electric Vehicle

Series/parallel drive-trains merge the advantages and complications of both parallel and series drive-trains. IC engine operates nearly at **best efficiency region** more often with internal combustion only and electric only option of the drive.

At lower speeds, it operates more like a series vehicle, while at high speeds, where the series drive-train is less efficient, the internal combustion engine takes over and energy loss is minimized.



Block diagram of Series/Parallel Hybrid Electric Vehicle

Conclusion

We have discussed the basics of Electric vehicles, how they are classified, advantages and challenges in this article. Electric vehicles are generally classified into Battery Electric Vehicle, Hybrid Electric Vehicle, and Plug-in Hybrid Electric Vehicle. World's large automotive manufacturers started manufacturing electric vehicles. **Here** is a list of top 7 electric car manufactures.