

Alternative Energy Sources for Modern Vehicles in India: Potential Need of Near future

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ABSTRACT: This paper discuss about the potential need for alternative energy sources for vehicles in India. Petrol & diesel are two main energy sources or fuels currently used for vehicles in India. In historical days up to twentieth century coal was directly used for Railway steam engines. Now a days coal based steam railway engines are just prototype historical models kept in railway yards. After 50-100 years crude oil resources will be not in a position to extract crude oil on the commercially viable level. So, alternative energy sources for vehicles are today's and tomorrow's need. This paper focuses on the today's transition era of hybrid energy vehicles and proposes the hybrid vehicle model using IC Engine and solar powered batteries.

KEYWORDS: Alternative energy sources, hybrid vehicles, IC Engine, solar powered batteries.

I. INTRODUCTION

Potential need for hybrid energy vehicles: Recently in India middle class population with buying potential is increasing with steady economic growth. India is one of the top 10 automobile markets in the world today. Nearly 70% fuel required for Indian vehicles is imported whereas local production is around 30%. Thus, there is potential need for alternative energy sources and technologies in automobiles such as (I) Pure Battery Electrical Vehicles (BEVs), (II) Plug-in Hybrid Electrical Vehicles, (PHEVs) i.e electric plus petrol or electric plus diesel vehicles, (III) Fuel-Cell Electric vehicles, (FCEVs) (IV) Ethanol, CNG and biodiesel based vehicles, and (V) Solar-Electric Powered Hybrid Vehicles (SEPHVs). [1]

To achieve clean and efficient transportation, Electrification is the most feasible way for the sustainable development of the automobile world. In the future, FCEVs, HEVs, plug-in PHEVs, and BEVs will dominate the environment-friendly vehicle market. By 2020, it is expected that more than half of new vehicle sales will likely be EVs.

A. HISTORY OF ELECTRIC VEHICLES (EVS):

The first EV was seen on the road shortly after the invention of rechargeable-acid batteries and electric motors at the end of 19th century. [2] In the beginning of 20th century, there was a golden period of EVs. At that time the number of EVs was almost double that of crude oil based conventional fuel vehicles. However after First World War, EVs almost disappeared and gave the whole market to Internal Combustion Engine (ICE) cars due to the limitations of heavy weight, short trip range, long charging time, and short life of batteries at that time.

EV batteries are quite different from those used in consumer electronic devices such as mobile phones, computers and laptops. They are required to handle high power and high energy capacity in the range of ten to hundred KWH with a limited space and weight. Extensive research and efforts have been given to the advanced battery technologies that are suitable for EVs all over the world.

On the basis of engines used the vehicles can be classified as shown in Fig. 1:

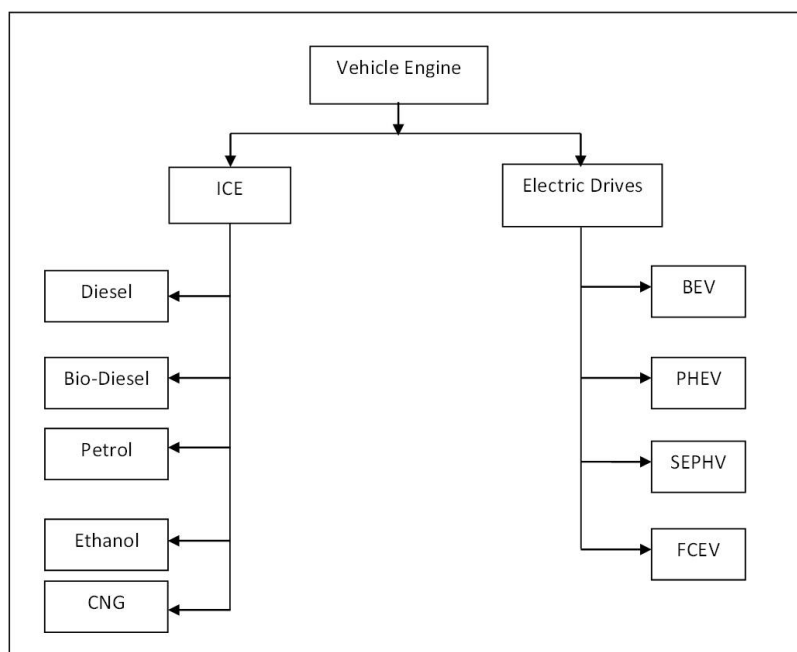


Fig. 1: Types of vehicles on the basis of engine and fuel used.

As shown in Fig.1, different vehicles are classified into two groups on the basis of engine and fuel used: Internal Combustion Engine-based vehicles (ICEs) and Electric Vehicles (EVs). ICE engine based vehicles can use the fuels: Diesel, Bio-Diesel, Petrol, and Ethanol. Electric vehicles can be classified on the basis of the system used into: BEV, PHEV, SEPHV, and FCEV.

The main energy storage systems of EVs are the electro-chemical batteries, the ultra-capacitors and the fuel-cells. The electro-chemical batteries still are the most used technology to store energy. Usually they are used in conjunction with ultra-capacitors to store energy. Ultra-capacitors are used to receive significant amount of energy in a short time and to provide this energy to the next acceleration or to help charging the batteries.

Ethanol or Biodiesel based vehicles: Central Transportation Minister, Government of India, Hon. NitinjiGadkari has announced to setup the luxury bus manufacturing at MIHAN (SEZ) Nagpur, Maharashtra, India based on ethanol or biodiesel fuel. Ethanol can be provided from the sugar industries. Separate ethanol manufacturing industries can be set up. PanjabraoKrishiVidyapeeth (PKV), Akola, Maharashtra, India had worked for sweet jawar whose stems can be used for ethanol production such variety of jawar can be used for food, cattle food as well as for ethanol production similarly maze stems can also be used for ethanol production.

Biodiesel production is commercially profitable if the chain of raw material is properly developed and used. The following non edible oil seeds can be used for biodiesel production a) Mahua, b) Karanj, c) Kusum d) Neem, e) Hingan, such non edible oil seeds are available in Indian forest and particularly Satpuda-Melghat is rich forest for such raw materials. [2]

Electric-Battery driven and Solar based hybrid vehicles: LMV (light motor vehicles) can be developed for which energy input will be Electric-Battery driven and Solar-Wind energy for battery charging. BLD motors (Brushless DC motors) can be used in such LMV's

Advanced Electric-Capacitor Based Vehicles: Nanotechnology based-ultra super capacitors can be used instead of batteries or with batteries for EV. Capacitors store their energy as electric charge while batteries work with chemical reaction

Generally batteries have been able to hold a larger amount of energy per unit weight with compared to capacitors. But capacitors can charge and discharge faster than batteries therefore capacitors are ideal for sudden high

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demand situation requiring large amount of power in a short time. So batteries with combination of capacitor system is most suitable energy source for modern electric vehicles

A fleet of buses has been running on capacitor technology in Moscow from 1995. In Asia cranes at some sea ports are using them. A couple of European Trains and even garbage trucks in USA utilize ultra-capacitors. A bus route in Shanghai runs over short distances with regular overhead recharging with capacitor technology longer sections of bus use battery power.

Hydrogen Fuel-Cell Vehicles: Hydrogen cars have not been developed to the degree that of electric hybrids have. This is due to the fact that right now it takes natural gas to produce hydrogen. This is the main limitation of hydrogen fuel cell cars. Some renowned companies have launched the hydrogen fuel cell cars such as Honda, Hyundai, Ford, Toyota, Chevrolet. Etc. Water is the free resource available on the earth but in many regions there is scarcity of drinking water, and water for the irrigation of the agricultural land. So, it is also a point of discussion whether this technology should be widely used or not.

Electric and Hybrid-electric two-wheelers: In India two-wheelers occupy around 75% of the total vehicles, consuming more petroleum fuels and emitting the lot of pollutants. Plug-in hybrid two-wheelers can have the range of around 25 km with an average speed of 30 kmph. If the use of hybrid two-wheelers increased, it can reduce the air pollution drastically.

B. BATTERY CHARGING METHODS:

For EV batteries, there are the following common charging methods: Constant Voltage, Constant Current, and the combination of constant voltage and constant current methods.

1. Constant Voltage: Constant voltage method charges battery at a constant voltage. This method is suitable for all kinds of batteries and probably the simplest charging scheme. The battery charging current varies along the charging process. The charging current can be large at the initial stage and gradually decreases to zero when the battery is fully charged. The drawback in this method is the requirement of very high power in the early stage of charging, which is not available for most residential and parking structures.

2. Constant Current: In this charging scheme, the charging voltage applied to the battery is controlled to maintain a constant current to the battery.

3. The combination of constant voltage and constant current methods: During the charging process of a battery, normally both the methods will be used [3]. Block diagram of the solar and electric charging [3] is shown in fig. 2. On the basis of the capacity of the PMDC motor or BLD motor used for the vehicle the wattage of the solar panel can be decided. Charge controller will charge the battery. It is powered by the solar panel. In the rainy season or as per the requirement the battery of the vehicle can also be charged by the AC power supply/ home charging unit.

Paper is organized as follows. Section II describes Related Work. Proposed system is given in Section III. Section IV presents merits and demerits. Discussion for proposed system is described in Section V. Finally, Section V presents conclusion.

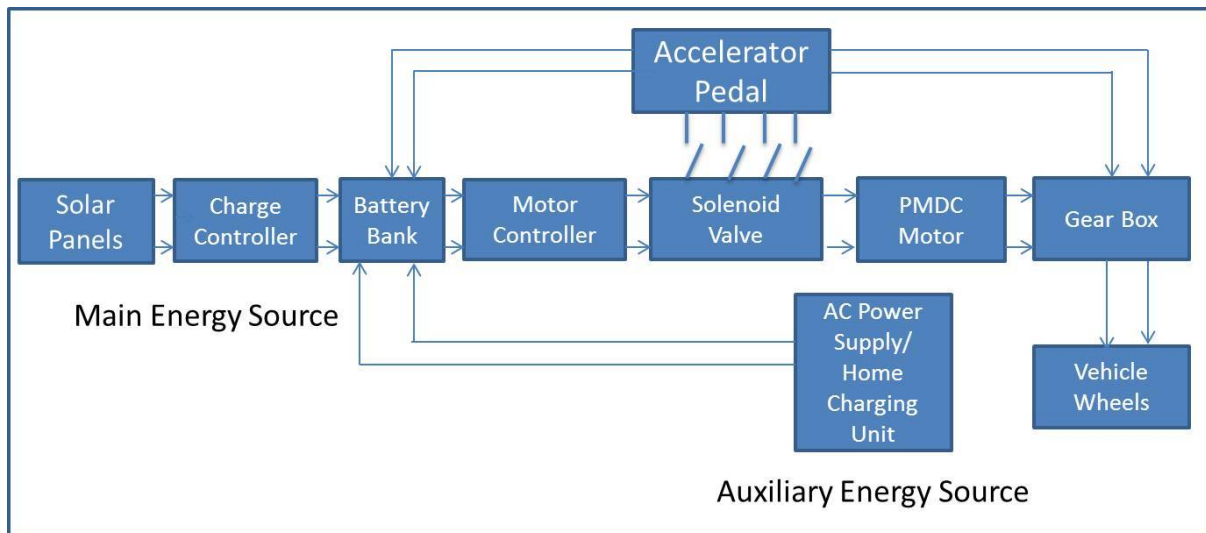


Figure 2. Solar and electric charging mechanism for BEV.

II. RELATED WORK

The proposed work by T. Balamurugan [4] demonstrated feasible solar/electric power generation system using Solar/Electric Powered Hybrid Vehicle (SEPHV). The performance of the SEPHV was found to be satisfactory for the load of four people with the average speed of 45km/hr.

Immanuel Alphonse [5] describes the study of designing a Solar Powered BLDC Motor Driven Electric Vehicle. The integrated system consisting of the solar module, charge controllers, batteries, boost converter and BLDC motor, henceforth developed into the Solar Powered Electric Vehicle. System was tested at different load condition.

Plug-in hybrid vehicles or solar powered hybrid vehicles are being manufactured by the renowned companies such as Ford, Toyota, Honda, Hyundai, Volkswagon, etc.

Ford's C MAX solar energy has both gas and electric motors. Its total range is impressive at 621 miles which includes 21 miles of all electric driving. If the sun is unavailable we can attach the C MAX solar energy to the Grid like other electric vehicles. At 195 hp and top electric speed of 85 mph Ford's C MAX is available.

Similar vehicles are launched by the other companies such as Toyota Prius, Honda Accord Hybrid, Honda Civic Hybrid, Lexus City 200h, Volkswagon Jetta Hybrid, Ford Fusion Hybrid.

Pure electric vehicles are launched by Nissan Leaf, Ford Focus EV, Mitsubishi i-Miev, Tesla Models, etc.

Need of Electric and Hybrid Vehicles

Most notably, plug-in hybrid electric vehicles (PHEV) are becoming increasingly popular. This type of vehicle carries both a conventional gasoline engine along with a battery and an electric motor, and the battery can be charged by plugging into an outlet or a charging station. As such, the PHEV attempts to use the best of two worlds: The long driving range is provided by the conventional gasoline engine, while the electric powertrain makes the vehicle efficient and clean. By using technologies such as regenerative braking and running the engine only at rpms where it has maximum efficiency give the PHEV a high mileage and low emissions. [6]

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Trains and Trams are the conventional electric well known locomotives. For the battery driven advanced vehicles the initial investment is around 1.5 times than conventional IC engine vehicles. But time has come when cost of environment is now more of concern than the cost of vehicles. The global EV outlook (GEO) finds that global EV cell has increased more than double between 2011 and 2012. Many countries have developed slow and fast non residential charging points. But in India owner of battery driven vehicles have their own residential charging points. There is a potential need of commercially available slow and fast public charging points. Such infrastructural developments of setting up of slow and fast charging points can be done at every petrol and diesel pumps in India. Availability of such charging points can be displayed online with the help of internet and GPS(Global Positioning System) so that non residential charging points can be effectively used for battery driven vehicles. Such infrastructural developments will enhance the sales of battery driven vehicles in India. [7]

Comparison between three different fuel types i.e., petrol, diesel and electricity shows the electricity is most cheaper (45% than petrol and diesel) energy source with additional advantage of pollution free environment.

III. PROPOSED SYSTEM

After performing the literature survey on vehicles available in the market and research has been performed on those vehicles, it is being observed that the vehicles with alternative energy sources [8] are being launched by the various companies. Also, it is the potential need of such environment-friendly vehicles in this modern era. Comparative study of various vehicles depicts that Plug-in hybrid vehicles [9] are found to be more suitable because of its long range use by the conventional gasoline engine [10] and for city-ride environment-friendly electric drives. Normally people goes for long drive at the week end and during the working days cars are being used for short distance upto 50 kms. This proposed hybrid vehicle fullfill such demands of middleclass people. It is not convenient and practical way to use the separate electrical vehicle for short distance and the conventional IC gasoline engine vehicle for long distance drive.

Today also purchasing and registration of electric vehicles are very less as compared to the conventional IC gasoline engine vehicles. That means still there is very large demand of conventional petrol and diesel vehicles. So, with proper innovative modification in conventional vehicles, can be result in hybrid petrol plus electric and diesel plus electric vehicles. So far short run the vehicles can be used with electric source preferably battery and for long run the conventional petrol or diesel can be used. Such two type of input energy with innovative kits and BLDC motors [11] along with IC engine is potential present need in vehicles. For the front wheel of two wheeler or four wheeler conventional IC engine (Internal Combustion Engine) can be used and for the back wheels BLDC motors (Brushless DC motors) can be used. BLDC motors may be the emerging electric drives in near future. Changeover switch can be introduced between front wheel drive and back wheel drive and any one of them can be chosen. Suggested mechanism is shown in fig. 2. In block diagram of proposed architecture of hybrid vehicle, selection mechanism of IC engine or electric batteries can be manual or automatic. In automatic selection of the one type of engine starting of one engine turn off the other engine automatically. In proposed system, IC engine control is provided to the front wheel mechanism. Whereas BLDC motor is used for the back wheels and rest of the mechanism of the vehicle is commonly used by IC engine and BLDC motor.

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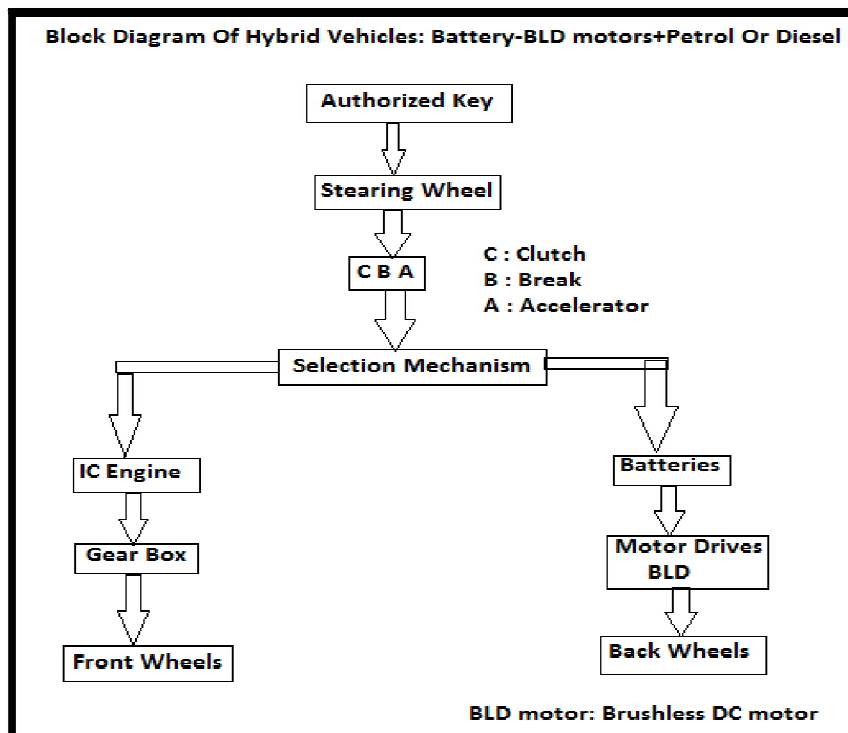


Fig. 2: Block diagram of proposed architecture of hybrid vehicle.

IV. MERITS AND DEMERITS

Merits:

1. Nearly 70% pollution is because of petrol and diesel vehicles which will be drastically reduced which is today's socio environmental requirements particularly in cities.
2. Renewable energy source[12] is used that is electricity using batteries, ultra capacitors and solar systems this is a near future requirement.
3. Import of crude oil will be reduced which can enhance the GDP and economic growth of country.

Demerits:

1. Initial cost of such modern vehicles will be high.
2. There will be difficulties in long-run route.
3. Infrastructural development to provide the charging points at petrol and diesel pumps and its working efficiency in India is a big problem.

V. DISCUSSION

After 50-100 years crude oil resources will be not in a position to extract crude oil on the commercially viable level. So, alternative energy sources for vehicles are today's and tomorrow's need. This proposed system of hybrid energy vehicles is suitable for the transition era of conventional energy vehicles and tomorrow's electric and solar based ultra-

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modern vehicles. Use of various types of alternative energy vehicles will drastically reduce the import of crude oil which can enhance the GDP and economic growth of the country.

VI. CONCLUSION

Various types of modern vehicles with alternative energy sources can reduce the petrol-diesel-crude oil import of India drastically. Proper planning of 10-15 years of manufacturing and using such modern and innovative alternative energy based vehicles can also drop the import of petroleum up to zero level and India can become self-sufficient in petroleum section. This step will help to enhance the GDP and Growth rate near to developed nations.

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BIOGRAPHY



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