

# Electric Vehicle (EV) a Sustainable Policy Recommendation for Zero GHG Emission in Pakistan

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**Abstract:** Lithium ion battery electrical vehicle, is an upgrade form of plug in hybrid vehicle which plays an important role during peak load time by supplying the electrical energy to the power grid. It also reduces the greenhouse gas emission. EV is a sustainable solution with its own power station for recharging and supporting the electrical infrastructure when needed.

**Keywords:** Electric Vehicle, Charging Station, Policy, Smart Grid

## I. INTRODUCTION

Electricity storage has been problem for last few years before the invention of electric vehicle (EV) which does not only overcome the carbon di oxide gas emission by transportation but also have its own charging station where it is connected to grid. By means of this smart technology two-way flow of energy can be made possible. Battery EV act as a distributed energy resource with reliability, security and sustainability during peak load period [1]. Charging stations of EV can easily be developed through the renewable energy technologies like solar and wind power to supply and act as an energy storage mechanism. Whenever there is need to supply energy to grid the same power stations can facilitate the need.

Similarly researches in [2] propose a charging station in parking areas where they park their plug-in hybrid vehicle during working hours and these hybrid vehicles get charged and discharge their batteries accordingly. However, research in [3] discusses about the limitations due to which EV's are still not very popular in developing world by identifying the high cost of batteries and charging infrastructure. Studied also present the charging time of batteries, different charging locations and energy supply interface. [Fig. 1] shows the integration of bi-directional charger (3 phase inverter) with motor in order to construct a light weight and cheap battery storage system. Research in [4] compares the internal combustion engine with electric motor and concludes that electric motor give high performance even at very low speed as compared to internal combustion engine. Study also shows the electric motor winding i.e. distributed and concentrated winding configuration for

different car manufacturers. Moreover, it gives the overview on different types of batteries utilized in hybrid vehicle and battery hybrid vehicle. More over research in [5, 6] simulated the model of conventional vehicle, hybrid vehicle, plug-in vehicle and battery hybrid vehicle in order to evaluate and compare the greenhouse gas emission by these models. The research used accurate performance data which is measured under standard industry test cycles by concluding that the PHEV and BHV in electrical mode has lowest GHG emissions.

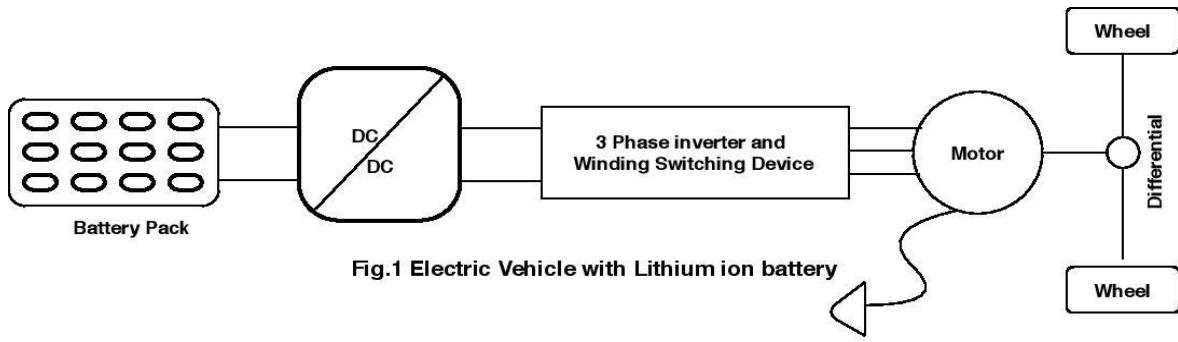
According to local newspaper report [9] of Pakistan, Motor industry have signed contracts with international organization to bring and mobilize EV in the country. To overcome the outcoming of introducing EV, countries like China have developed policy [8] to maintain the overall efficiency of such system.

## II. ELECTRIC VEHICLE TYPES

There are mainly three types of electrical vehicle i.e. 1. Hybrid electric vehicle, 2. Plug in hybrid electric vehicle, 3. Battery electric vehicle. The electric motors which are utilized in these Electrical vehicles by different manufacturers are induction motor, permanent magnet synchronous motor and switch reluctance motor.

### 1. Hybrid Electric Vehicle (HEV)

Hybrid electric vehicle consist of two major power sources of energy. It is an integration of internal combustion engine and battery pads with electric power controller to derive the electric motor of the wheel without compromising the functionality and performance of the vehicle. Toyota and Honda are interested in its mass production in order to control the greenhouse gas



emissions. HEV is further classified as series HEV and parallel HEV.

In series hybrid electric vehicle, the generator is driven through engines which energize the electric motor. SHEV which is suitable for city type drive in which the start and stop of vehicle is consistently running through internal combustion engine at lower consumption of fuel whereas PHEV is suitable for highway type derive where internal combustion engine run smoothly at lower consumption of fuel.

If the hybrid vehicle is connected to any building, grid, shopping mall or restaurant while charging/discharging the battery pads of electric vehicle, the maximum power of HEV can be calculated as:

$$\eta_{\text{other}} = \text{Loss power and battery leakage}$$

## 2. Plug-In Electric Vehicle (PEV)

An improved and advanced version of Hybrid vehicle is plug in electric vehicle in which battery pack has large capacity of energy storage and can be charged externally in order to spin the wheel longer as compared to regular hybrid electric vehicle. The manufacturer is now trying to launch the PHEV in the market by replacing the low energy battery capacity in the HEV by putting the high energy battery pack and increasing its electric range. Regenerative braking is the other phenomenon through which high capacity battery of PHEV can be recharged and can run for a longer period.

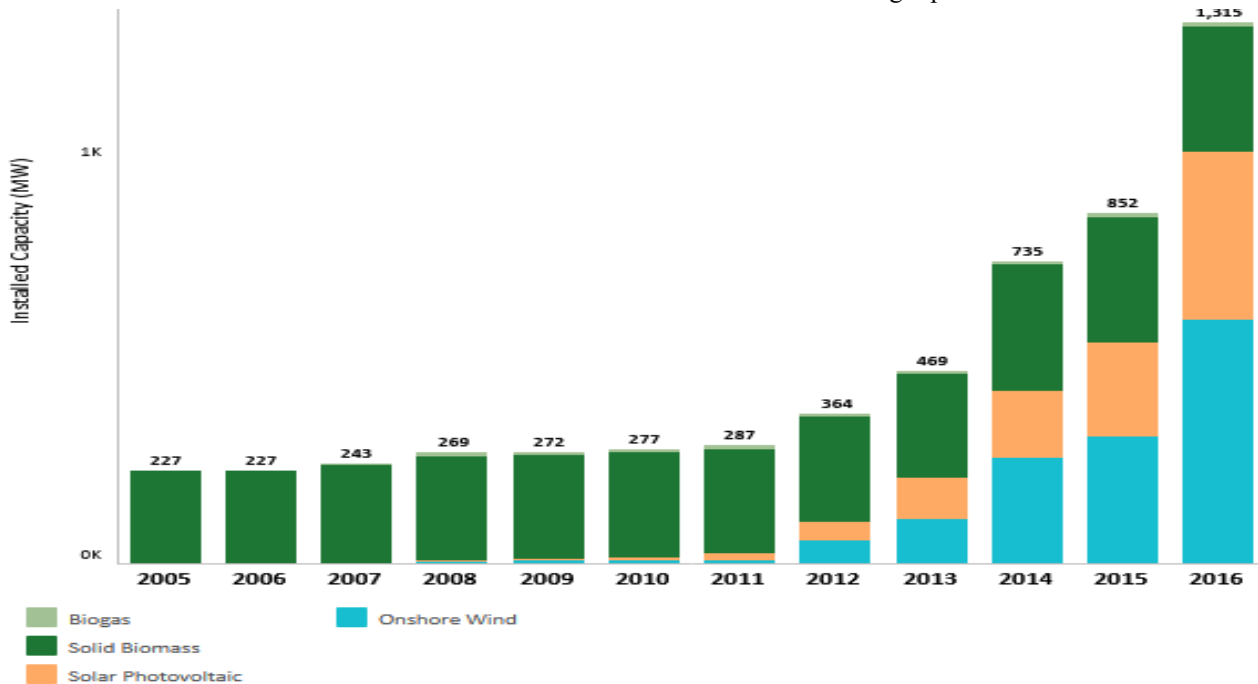


Fig. 2: Total Capacity of Modern Renewable Energy Technologies of Pakistan till 2015

$$P_{\text{vehicle}} = P_{\text{ideal}} + \eta_{\text{charger}} + \eta_{\text{inverter}} + \eta_{\text{other}} \quad (1)$$

Where:

$P_{\text{vehicle}}$  = Maximum power of V2B

$P_{\text{ideal}}$  = Actual power of charging station

$\eta_{\text{charger}}$  = Charger efficiency

$\eta_{\text{inverter}}$  = Inverter efficiency

A bi-directional dc – dc converter is used in PHEV in order to transfer the energy from battery to the electric motor system. For reliable operation of PHEV, charging station at major spot is necessary in order to charge the vehicle. These charging stations will also facilitate power factor correction, thermal management and cell balancing of high energy batteries such as lithium ion

battery and NiMH.

### 3. Battery Electric Vehicle (BEV)

Battery electric vehicle is completely free from internal combustion engine and fuel tank i.e. no oil fuel is needed to derive the electric motor of wheel. BEV utilizes different types of high capacity batteries like lead acid batteries, lithium ion batteries and nickel metal hybrid batteries. BEV is connected to grid when not in use and therefore exchanges the energies between the grid and vehicle. Its efficiency is high and zero emission of greenhouse gases. It also provides good acceleration with quick charging time. BEV can also be used as an energy storage system during low load period. It can also supply the surplus energy back to the power grid at peak load time.

There are still few challenges in the commercialization of the BEV. Like in operation of the BEV there are issues such as lack of charging station infrastructure, high cost of energy storage and shortest distance covered by the vehicle. However, the battery range can be extended by adding the fuel cell or super capacitor along with any suitable type of batteries.

### III. RENEWABLE ENERGY SCENARIO

According to Economic survey 2018, the total installed capacity of power plant (Fossil Fuel + RET) reaches to 29573 MW (117326 GW/hr.) till Feb 2018 as compared to 22812 MW (96496 GW/hr.) in 2012-13. Government of Pakistan (GoP) continues to encourage in its energy policy by bidding the IPP's to deploy solar power and wind power plants. Uptil now, bidding of 1200 MW from wind and 600 MW from solar has been announced in the year 2018. Similarly, in the last five years 18 projects of wind power plants have the total capacity of 937.27 MW

is added to the national grid and 06 solar power projects having capacity of 418 MW is commissioned and added to national grid. The overall installed capacity of renewable energy technologies is shown in [Fig. 2].

The economic survey 2018 also reveal that oil fuel consumed by transport sector is 58% compared to energy sector 33% for electricity generation as shown in [Fig. 3]. If renewable energy technologies are installed at parking area, shopping malls, hospitals and residential area which provide the supply to the charging station of electric vehicle and connected to national grid will reduce the huge burden of foreign investment on importing the fossil fuel.

### IV. POLICY RECOMMENDATION

In paper [7], three main issues regarding EV are discussed for United States and [10] have addressed four policies when deploying EV widespread and proposed remedies for each problem.

#### A. Reduce Carbon-dioxide gas emission by implementing tax

Fossil Fuel based transportation emits carbon-di-oxide which is harmful to the environment. Government of Pakistan should develop a clear policy to reduce greenhouse gas by promoting the electric vehicle which emits zero GHS and implementing tax on oil consumption-based vehicle.

#### B. Electric Vehicle manufactured in Pakistan

Government of Pakistan should make a clear strategy for not importing the electric vehicle from developed world. Instead of importing, established its own manufacturing plant in free zone area of Pakistan by top tier automobile companies.

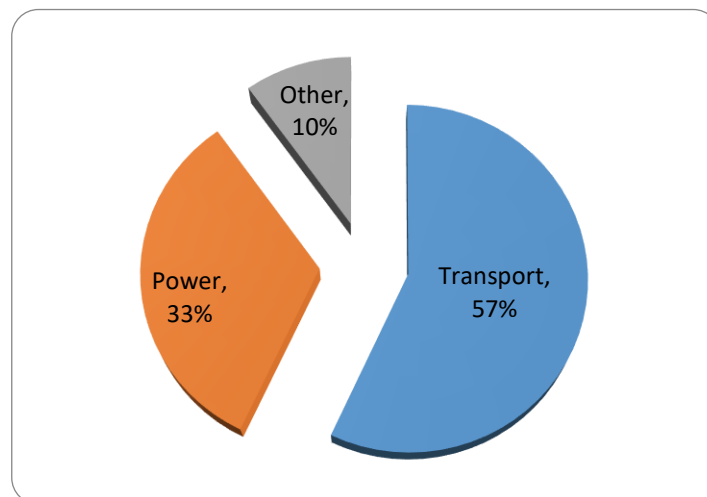


Fig. 3: Oil Fuel consumed in different sector

### **C. Established charging station at Parking, hotels, mall, commercial area and garage**

Electric vehicle charging station is separated from gas station. It should be established in parking area, shopping malls, restaurants, corporate building and in-home garage where it directly connected to grid by supplying the energy to grid when needed otherwise charge the battery bank of electric vehicle.

### **D. Photo Voltaic Plant and Wind Plant established for energization the charging station of EV**

It is viable to establish a charging station of EV through renewable energy technologies which is reliable, secure and sustain able solution.

### **E. Reduce the import of fossil fuel for transportation sector**

According to Government of Pakistan financial report 2018 (Economic Survey), that Pakistan utilizes its 57% liquid fuel for transportation sector while 33% liquid fuel for generating the electricity.

Similarly, the natural gas consumption for transport sector (CNG) is about 138 million cubic feet per day while RLNG is 53 million cubic feet per day. Government of Pakistan should make a policy to establish a charging station through RES in order to reduce the direct investment for importing the liquid fuel as well as gas fuel.

### **F. Reduce the cost of Battery's eventually reduce the EV price.**

In modern battery hybrid vehicle, Lithium ion batteries are utilized, and its price is continuously down. In order to protect our environment, EV should adopt by customer which is friendly to human nature and in this regard, Government should give subsidy for a cheaper battery of the car.

## **V. CONCLUSION**

Pakistan spends its huge investment in importing of fossil fuel which can be easily tackle and reduce by adopting the above-mentioned policies and renewable energy technologies installation in transport sector. Government of Pakistan should promote the culture of adopting electrical vehicle in Pakistan in order to improve its environment which is polluted badly due to the population increases significantly in the last decades.

Charging station of electrical vehicle can be established at various high population density zone such parking area, hospitals and shopping mall in order to

reduce the carbon-dioxide emissions.

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