A Promising Solution for Air Pollution: Hybrid Electric Vehicles

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This paper aims to highlight the role of clean energy resources for minimising air pollution through automobiles in India .In the light of mounting green house gases through various emissions particularly automotives, there emerges a grave need to control air pollution in India. The air quality has been detoriating in most of the metropoltan and major cities due to petrol and diesel vehicles. Rising demand for the diminishing non renewable energy sources lead to the escalating need for research and development for harnessing renewable energy sources efficiently. The universal raise in demand for fossil fuels for applications like transportation and the serious requirement to concentrate the green house gas emissions has fostered the impressive progress in electric and hybrid vehicle (HEV) technology. By the use of electric energy for transportation purpose will help reduce not only the green house gases but also the dependence on conventional fuels. By means of batteries as a source of electric energy along with an internal combustion engine (ICE) supplying the average power required by the vehicle is a resourceful way of using automobiles. The objective of the research paper is to identify the validity of the HEV approach towards a promising solution of clean energy source for minimizing the threat of high pollution levels in present as well as the future.

1. Introduction

According to Orlovic, 2017 pure and clean air is human right for healthy living. Worldwide, air pollution is acknowledged as one of the chief health hazards; such pollution is caused by the release of various harmful gaseous emissions and particulate matters from combustion of fossile fules that are used in trasportation, power generation, industrial sector and other economic activities. WHO, 2014 amplifies ambient air pollution, which contains high concentration of small and fine particulate matter (PM *2.5*), is the utmost risk to wellbeing causing more than 3 million premature deaths globally every year. Therefore health problems like stroke, cancer bronchitis and severe respiratory diseases are major results of such emissions.

In 2013, India launched the National Electric Mobility Mission Plan 2020, as a strategy document to attain the targets of National Mission on Electric Mobility for addressing the concerns of energy security, climate change and pollution issues in the country. Thus electric vehicles are the next generation vehicles and sustainable solution to curb air pollution.

2. Literature Review

Kroeze & Krein, 2008explain that a battery is an electrochemical device which converts electrochemical energy to electrical energy. Electrochemical batteries are used in conjunction with an auxiliary power unit (APU) to power hybrid electric vehicles (HEV). Plug-in hybrid electric vehicles (PHEV) and electric vehicles (EV) can be treated as a subclasses of HEVs in which the batteries function in different ways. According to Sharma & Yadav, 2016 many midterm and long-term battery options were investigated by the United States advanced battery consortium (USABC). A battery weighs about *25 – 75%* of the vehicle by weight, volume and cost in HEVs. The desired features for a good EV battery are high specific energy, high specific power, high charge acceptance rate, long cycle life, long calendar life, low self-discharge rate, low cost, and recyclability. Initially, HEVs used lead acid batteries, but with recent advancements in technology NiMH and Li-ion batteries are being used predominantly.

Current Status of India among Global Carbon Emissions

PBL Netherlands Environmental Assessment Agency European Commission, Joint Research Centre (EC-JRC), 2016 in their report brought forward that India resides among the five major carbon emmiting countries, along with China, United States, Russian Federation and the European Union.

In the EC-JRC report, if India continued to grow with their carbon emmisions with an average rate of *6.8%* which was found in the previous trend for the 2006-2015 period. They will superseed the European Union's total emmisions by 2020 in consideration with the decline of European Unions emissions with the average rate of *1.9%* annually. According to the figure below India has already outgrown the Russian Federation in 2009. The main causes according to BP 2016 for the incerase in the CO2 emmisions in 2015 were because of incerease of *5.1%* in Total Primary Energy Supply, which are *8.1%* increase in oil consumption and *4.8%* increase in oil consumption.

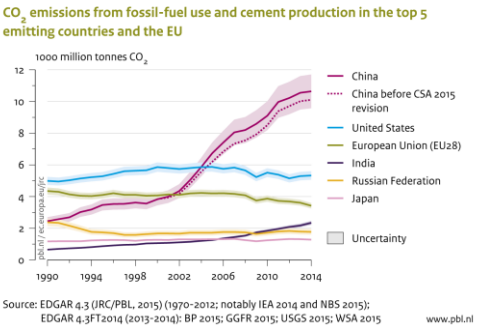

Figure 1.1

Source: PBL Netherlands Environmental Assessment Agency European Commission, Joint Research Centre (EC-JRC). (2016). Trends in Global CO2 emissions: 2016 report (pp. 14 /30-32). Netherlands: PBL Publishers. Retrieved from http://edgar.jrc.ec.europa.eu/news_docs/jrc-2016-trends-in-global-co2-emissions-2016-report-103425.pdf

Global Practice for Adoption of EV's

A study conducted by India Smart Grid Forum (ISGF), 2017shows the global sale of Electric vehicles, where elecrification of transport and four wheelers are a traget to drop down carbon emmissions by 2030, with such strong policies and benefits for adoption of electric vehicles, the four wheeler sale in 2016 in the United States, Europe and Asian countries crossed 2 million mark in 2016 whereas India lies in the nacent stage with the least per-capita Electric Vehicle adoption.

Indian Policies Reguarding Electric Vehicle adoption:

The Indian government seeks to reach a *100* percent electric vechile nation by 2030, with this vision the government launched NEMMP (National Electric Mobility Mission Plan 2013) and also FAME(Faster Adoption and Manufacturing of Hybrid and Electric Vehicles,2015) according to the NEMMP mission by 2020 deployment of *6-7* million EV's or Hybrid vehicles have been anticipated, on the other hand FAME operates in funding the purchase of EV's annually and as for the year 2017-2018 the government allotted Rs. 175 crore for this project. Mandal Sarkar, 2017 reported that in March 2016 four lakh EV's were sold in India. The sales figure of the Indian electric vehicles grew by *37.5* percent in the financial year 2015-16, with the critical analysis of the sales Mandal Sarkar added that the target under NEMMP of 6-7million vehicles by 2020 was seemingly difficult as per certain drawbacks with the less charging station options which was reported to be 206 community charging stations according to a study conducted by CSTEP, and undefined load requirements of EV's.

Validity of EV's on Environmental Concern

The concept of switching to hybrid electric vehicles can positively impact global warming. According to Energy Information Administration US, 2016, 20 pounds of carbon dioxide is emitted by buring of each gallon or *3.79* liters of fossil fuel or gasoline, which amounts to 300 million metric tons of carbon dioxide gas every year only by use of cars and trucks. To reduce such risk of high emissions, the car manufactureres will have to work on by increasing the average fuel mileage by 10 kilometers per liter which would in turn save 1.5 million liters of oil per day which in return will reduce carbon emissions by 450 million kgs every day. If practiced over the year will result in reducing carbon emissions into the air in billions. However, it is only a faction of a change in global air quality which is not enough, as greater industrialisation of many countries brings up or covers up the minimal change.

Gerstenfeld, 2010 in his study clarifies that one gallon of gasoline produces *19.564* pounds of carbon dioxide. If an average gasoline powered vehicle in the United States gets 17 miles per gallon, then it would emit *115* pounds of carbon dioxide per 100 miles driven. A plug in electric vehicle requires about 30 kilowatt hours of electricity to cover a 100 mile distance. One kilowatt hour of electricity produces *1.55* pounds of carbon dioxide to generate, meaning an electric vehicle will produce about *45.5* pounds of carbon dioxide per 100 miles driven. Looking at these numbers one can see that an electric vehicle has much less of a negative impact on the environment than a fossil fueled vehicles.

Tonachel, 2015 found that the reduction in NOx and VOC emissions reduced the pattern of fine unhealthy particulate matter (*PM2.5*) pollution. Again, these reductions were most significant near dense coastal port areas where non-road equipment could be electrified. The Electric Power Research Institute-NRDC analysis confirms that transitioning our transportation sector from its near sole reliance on lubricants to electricity can lead to big reductions in carbon pollution along with improvements in air quality. Meeting long-range climate targets also requires that we carry on to clean up the electric sector. We must implement the Clean Power Plan and follow it with even stronger climate-protective policies. We can, and should, electrify transportation and further clean up the electric sector in parallel. Turning over the fleets of cars, trucks and power plants to cleaner energy sources will take time and we should resolve to make sure it happens.

As shown below, a PEV currently has 54 percent lower lifetime carbon pollution today. In 2050, the reduction could be larger, as much as 59 to 71 percent compared to a more efficient CV that achieves 48 miles per gallon in real-world driving, depending on the electricity grid carbon intensity.

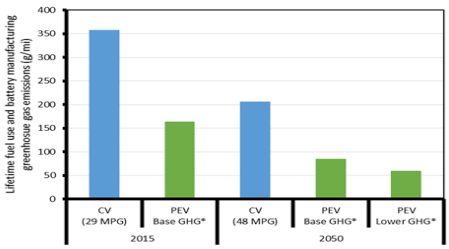

Figure 1.2

Source: EPRI, NRDC, Environmental Assessment of a Full Electric Transportation Portfolio, 2015. When the transportation sector is electrified in the Base GHG Scenario, 2050 emissions are reduced by 48 percent from 2015 levels. In the Lower GHG Scenario, total emissions are reduced by 70 percent from 2015 levels. Combined emissions for the modeled electricity and transportation sectors.

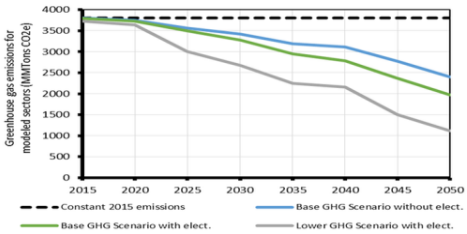

Figure 1.3

Source: EPRI, NRDC, Environmental Assessment of a Full Electric Transportation Portfolio, 2015.
The Electric Power Research Institute-NRDC analysis found that electrification reduces harmful ground-level ozone, the principal component of smog, because it lowers net emissions of nitrogen oxides (NOx) and volatile organic compounds (VOC)

3. Conclusion

Electrification of transportation system or introducing electric vehicles could be the only major step worldwide for controlling the pollution caused by automobiles in cities. Although the government has introduced major mission plans to achieve the pollution reduction strategy but to make it possible the interdependent varibales like deploying power stations or charging stations should also be taken under consideration. Such strong step in the Indian scenario will not only reduce the air pollution but also improve the security of energy, economic development as a whole and also bring in innovation in the automobile, transportation and electricity sector. Thus, use of electric hybrid vehicles not only minimises the air pollution levels but also proves to be a sustainable step towards a resolving clean energy resource.

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