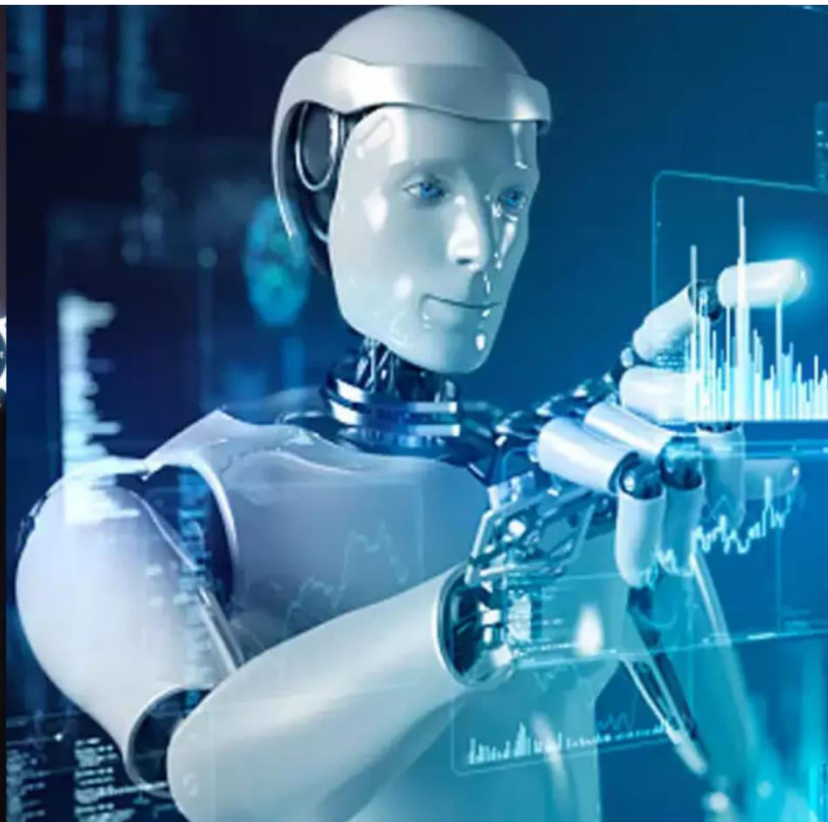




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# **Are Electric Vehicles a Safer Alternative to Fossil Fuel Vehicles- A Critical Analysis**

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**ABSTRACT:** We are increasingly becoming aware of the impacts of heating up of the world due to greenhouse gases through various natural disasters like increase in the world temperature, rise in sea water levels and melting of glaciers at the polar region etc. Largely the whole world is looking out for a better alternative and it happens to be the replacement of conventional vehicles with electric vehicles. This research tries to throw some light upon the fact that electric vehicles are also equally polluting if the power requirements are satisfied with the electricity generated from the fossil fuels and the renewable energy sources are also not equally pollution free. The paper also tries to come out with certain solution to the problems at the community level like using carpooling and improving the public transportation system etc. Similarly, the policy level decision like reduction of transmission loss of electricity is also suggested. The research is based on the reports and the research articles and the researcher also suggests for conducting detailed empirical research in these lines to find a better solution to the global warming crisis.

**KEY WORDS:** Renewable Energy, Electric Vehicles, Global Warming, Greenhouse Emissions.

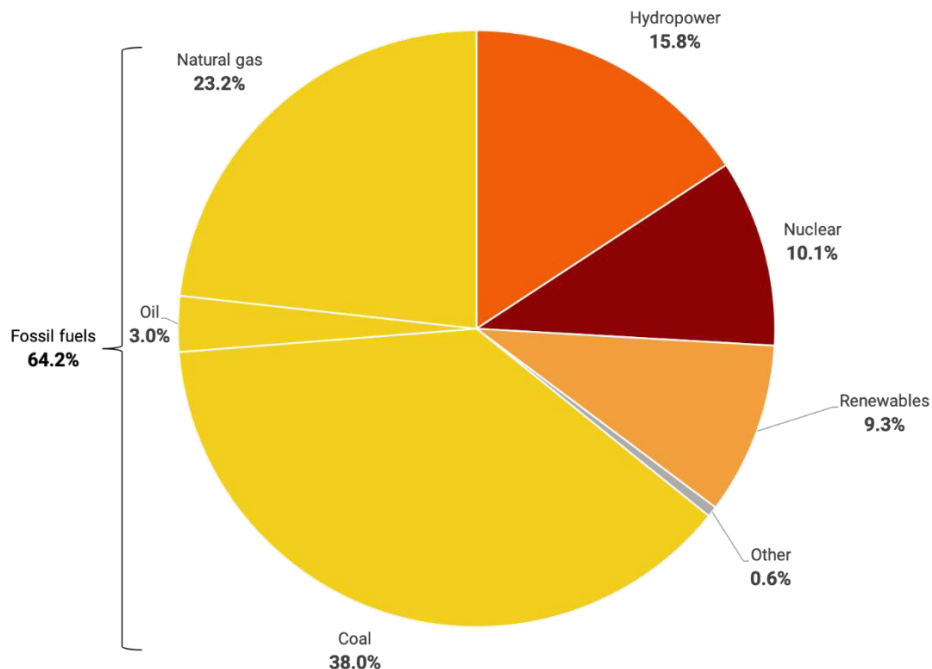
## **I. INTRODUCTION**

One of the major problems faced by the world today is global warming which refers to the rise in the temperature of the world due to the carbon emissions. While we look at the major sources of carbon emissions, the emission from the vehicles is the first and foremost source. According to the statistics by US Environment Protection Agency (EPA), the major contributors for GHGs in 2019 are transportation sector amounting to nearly 29%, burning the fossil fuel for electricity 25%, and industry amounting to 23% (EPA, 2021). As we look deep into the data, the second area where most carbon emission takes place is in electricity generation. However, the entire world is more positive about the fact that the use of electric vehicles (EV) will decrease the greenhouse emissions and decrease the global warming conditions. If production of electricity is the second largest emitter of greenhouse gases, how the usage of electric vehicles is going to reduce the greenhouse gases and consequently in overcoming the global warming. In a rush to reduce emissions, one cannot select an alternative which is equally worse as that of the fossil fuels. Of course, the electric vehicles have zero tailpipe emissions, but while making an electric vehicles equal amount of greenhouse gases are released resulting in high carbon footprint. Certain studies also found out that electric vehicles also produce 2-5 times smog than the gasoline powered vehicles if coal is used for the production of electricity (Bird. L and Norma, 2019). Hence, the researchers are trying to find out alternate sources of charging electric vehicles with renewable electric sources like solar energy and wind energy which would really make the electric vehicles a greener source of mobility.

In this research paper, the introduction chapter is followed by finding the alternate options to the fossil fuel usage that is tried and tested in other parts of the world. It is subsequently followed by the analysis of the potential challenges in using the renewable energy resources. The research also outlines the potential solutions to overcome the current fiasco.

## **II. ALTERNATE MODELS FOR FOSSIL FUEL USAGE**

The major challenge faced in using electric vehicles is that largely the electricity that is going to be used in the electric vehicles is generated from the fossil fuels. A look at the data of what are the major sources of power generation in 2019 shows that fossil fuels dominate the list. Around 64.2% of the electricity is generated using fossil fuels.



Source: BP Statistical Review of World Energy, 2019

The installed capacity of power generation in India is 260 gw which is largely satisfied from fossil fuels whereas peak demand for electricity is only 140 gw. The Indian government is planning to set up a 100gw solar power production and 140 gw wind energy production by 2022 (Sustainable development goals, 2021). Let us have a detailed look at the various alternative models followed in and around the world to overcome this problem of production of electricity from fossil fuels.

### 2.1. Renewable Energy Source Networks

The companies that produce the electricity through renewable sources form a network and make it available to their consumers for distribution. The 'Plug in Austin Electric Vehicles' grid developed by Austin Energy helps their customers to plug in the EVs with renewable energy generated from the wind energy (Austin Energy, 2019)

### 2.2. Charge Forward

The BMWs 'Charge forward' program let the consumer delay the charging of their electric vehicles as per the availability of the power in the grid (BMW (n.d.)). The customers can delay their charging up to an hour to get the discounted rates for their charging. As the supply of electricity from renewable sources are erratic, this type of models and plans help the companies to manage the demand and supply from renewable energy resources like wind energy as per the availability in the grid.

### 2.3. Onsite Production Of Electricity With Renewable Energy Sources

Here, the companies manage to generate solar and wind energy on-site to help their customers to charge their EVs. San Diego gas & electric generated solar energy in the San Diego Zoo using photovoltaic cells which helped the visitors of the zoo with charging points and the excess electricity generated is stored in the batteries for future use (Sempra, 2012). Google also helps their employees to charge with the solar energy generated at its sites.

### 2.4. Solar Powered Cars

In a recent virtual consumer electronics show, Sono showcased car that is fully fitted with 248 solar cells named 'Sion'. In Munich, the Sion can generate 1.2 kw per day and can drive upto 21 miles a day whereas in a sunny country or region it would be able to generate more electricity. The average commute in Europe is 11 miles a day and hence 21



miles is a sufficient amount of fuel generated. It's also fitted with the li-ion battery with which Sion can run upto 155 miles in a single charge reaching upto 140Km/hr (Bellan. R, 2021).

### **III. CHALLENGES IN USING THE RENEWABLE ENERGY RESOURCES**

Even though the emission efficiency of electric vehicles improves upon using the renewable energy resources, these resources pose several challenges to produce and use. Let us discuss those challenges in the following section.

#### **3.1. Extraction of the raw materials required to make PV cells**

The power generation and transportation sector are considered to be the major polluters of the environment as per EPA data (EPA, 2021). Hence, in order to reduce the pollution levels, the alternative suggested is the electric vehicles and to produce electricity, renewable energy sources are suggested as the viable alternatives. However, the challenges faced in generating electricity from the renewable energy sources had to be pondered over. The major challenge with this technique is that these techniques are not energy efficient. The silicon-based modules are used in the conversion of solar energy in to electrical energy which involves the usage of silicon, aluminium, copper and other minerals (Hetsch, F & et al, 2011). Extraction of these minerals and the use of these minerals are not energy efficient which beats the sole purpose of producing the photovoltaic cells (PV cells) which is a major component that trap the sunlight and convert it into electrical energy. Information regarding the production of the components that are used in the production of PV cells are not available in the public domain and the greenhouse gases generated in this process is also not made public except for few studies.

India is planning for an installed capacity of 100-gigawatt electricity production by photovoltaic cells by 2022 (Sustainable development goals, 2021). A 100gw electricity which is produced using a photovoltaic cell will release a 1.024 Gtons of CO<sub>2</sub>. The generation of 100 GW of electricity using solar panels may result in the CO<sub>2</sub> emission of 0.256 Gtons and a 100GW solar panel would be able to produce only a 25gw usable energy (Yang, H., 2014). Hence the production of electricity with renewable energy resources like solar energy, are they really energy efficient? is a question again.

#### **3.2. Battery For The Storage Of Electricity Generated**

Another challenge with the electric vehicles is that the engine needs to convert the electric energy to propel the vehicle forward which is powered by the electric energy that is stored in the battery. For this, the engine needs to be high powered which is generally obtained using 'rare earth magnets', the production of which involves the mining activity and purification process which is considered to an energy intensive activity (Han, J., & et al, 2019). If the engine could not satisfy this condition, then the battery which is the powerhouse of energy needs to be highly energy intensive and compact. Largely this requirement is satisfied with the Li-ion batteries. The problem with these batteries is that the production process of these 40 Kilowatt-hour battery releases 3000kg of CO<sub>2</sub> into the atmosphere (Mohr, S. H., & et al, 2012).

In a country like India in order to convert all the Internal combustion engine vehicles to the electric vehicles, if we follow the above said arithmetic, the carbon emission would not reduce instead it will increase predominantly.

#### **3.3. Irregular Supply Of Renewable Energy Resources**

As we all are aware the solar energy cannot be produced at night time as the generation of solar power requires a photon with wavelength greater than 1120nm which would be able to free an electron from a silicon particle to generate electricity. Similarly, the wind energy is also climate specific as we get high powered winds during a particular season and not throughout the year. Because of this the solar energy cannot be produced during night and during rainy days and wind energy cannot be generated when there is no wind or when the wind velocity is too high like cyclonic situations. Hence, the excess electricity produced had to be stored to supply power when there is no generation from wind or solar energy. Real time production and consumption is possible only with the use of fossil fuels.

#### **3.4. Disposal Of The Worn-Out Batteries:**

Lithium-ion batteries are the most commonly used batteries today in electric vehicles. Lithium mining and lithium waste will increase as a result of increased use of electric vehicles. The lithium production and extraction too cause air pollution and subsequently the lithium battery production process is also equally polluting (Girardi, P., & et al, 2015). It is estimated that less than 1% of the lithium is recycled today and it is also estimated that around 40 % of lithium is

recyclable by 2050 (Mohr, S. H., & et al, 2012). However, the lithium that is not recycled will have adverse effect on the environment, ecosystem and on human being.

Apart from the pollutants from the EVs, the solar panels and PV cells also use toxic chemicals which ultimately end up in landfills after their useful life which release harmful chemicals in the soil that ultimately gets leached out by the rainwater to the water bodies and ends up in the food chain. It is equally challenging to recycle the wind turbines which again pollutes the environment. Increased use of these renewable energy resources may reduce the tailpipe carbon emission but alternately adds up to the solid waste.

### **3.5. Design Problems**

Solar vehicles require a large area to mount the solar panels which makes the design problematic. Hence a lot of compromise is done like no safety features, no rear mirror, wipers etc. The battery and the solar panels' lifetime are short and the replacements are costlier which makes solar cars a costly affair. While looking at the efficiency part as well the solar panels or PV cells can convert only 15 to 30% of sunlight into electricity (Grätzel, M., 2005).

## **IV. DISCUSSION AND SUGGESTIONS**

In this section, let us discuss the potential solutions to the challenges faced in using alternate fuels and the emission issues.

### **4.1. Promoting The Quality And Use Of Public Transport System**

In India, the lower income people who were using the public transport system like buses and trains or bicycle for their daily commute, when their income improved, moved on to purchase the two-wheeler to make their commute convenient. Generally, this category of people are price sensitive to the petrol and diesel prices. When these prices become unaffordable, they will revert back to their earlier means of commuting. The government may have to look at the alternative where the public transport system is effective and convenient for the commuter. The government may invest in metro and also try to improve upon the existing means of transportation.

### **4.2. Reducing The Individual Transportation**

Since the two-wheeler segment is price sensitive, an alternate cheap, and convenient public transport system will give an impetuous to the segment. However, the people who use car for their daily commute may not be as sensitive as the two-wheeler owner's and hence a different strategy need to be adopted. The governments can promote car-pooling activities and use of green energy transportation modes like bicycle or walk to workplace if it is nearby will elicit a proper response. Community activities and social media campaigns and challenges will evoke the desired response.

The air quality in Beijing improved when the government allowed even numbered cars to run on even dates during the Olympics in 2018. Taking a lead from the incident the Delhi government also followed suit which improved the air quality in Delhi as well (Pai, 2021) Reducing the fossil fuel consumption would be a best viable solution to the carbon emissions and global warming.

In addition to that, the replacement of conventional vehicles with electric cars, which are considered to be the panacea for the global warming issues, has to be implemented in a slow and phased manner understanding the challenges and solving most of the pressing issues so that at one point of time we should not think to replace EVs with some new alternative. The environmental costs of implementing EV on mining, waste disposal etc needs to be thought over.

### **4.3. Reducing Transmission Loss**

The power lost in transmission process amounts to 20% in India which means out of the 1400 GW power generated during the year 2019-2020, 280 GW is lost in transmission. The international average transmission loss is 8% (Jaganmohan, 2021). If India could do something to reduce the transmission loss from 20% to 8%, it would save 168GW of power without even investing in solar panels and photovoltaic cells and associated carbon emissions.

### **4.4. Storage Infrastructure**

In order to mitigate the problem of irregular supply of power from renewable energy resources viable solution to store the excess electricity generated during the peak period has to be developed. High storage power grids need to be developed to store the power and distribute it as and when it is needed.

## V. CONCLUSION

Even though electric vehicles are considered to be the one stop solution to the problems of carbon emissions, the research contributes by analysing deeply the problems associated with its use like lithium usage, production of photovoltaic cells and solar panels which involves a lot of mining activities and the recycling of wastes that are generated from the batteries, solar panels, photovoltaic cells and wind turbines. As per the opinion of the researchers and scientists, various researches are going on to improve the lithium recycling and in similar domains. Hence, it can be a wait and watch approach or a phased implementation of electric vehicles. The research also tries to promote and propagate the reduction of usage of fossil fuel as well as electric vehicles with the suggestion to improve the public transport system and several other greener options like usage of bicycle, carpooling and walking as an alternative. However, the research is based on the facts that are presented in various technical research paper and reports which is considered to the limitation of the study and hence in future empirical researches can be conducted by getting the opinion of the scientists to evolve workable solutions to the problems of carbon emissions.

## AUTHOR'S PROFILE

The author is Assistant professor in 'The Tamilnadu Dr Ambedkar Law University' for the past 6 years teaching Marketing and Human Resource Management subjects. She has inclination towards sustainability related titles and had already published few papers in the similar topics.

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