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Solar Electric Vehicle: Need, Working, Advantages and Challenges

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Abstract: ***The cooperation of around 200 countries agreed on climate with goal of keeping global warming below 2°C in the COP21 known as 2015 Paris Climate Conference held in Paris in year 2015. Many conditions were imparted on developing countries like India to reduce emission of Carbon Monoxide (CO). Therefore use of renewable energy has become great option to reduce CO emission with zero harm to development. Renewable energy is becoming more important for today's world because the non-renewable energy sources we use are going to be exhausted in near future. Solar vehicles are the step towards conserving conventional energy sources. The use of electric energy which is stored in battery during and after charging from solar panels is the key principle of solar vehicle. This idea will help in saving our fuels from being terminated as well as controlling global warming. This paper gives a review over this technology. Functionality, efficiency, key principles, advantages, disadvantages and challenges of Solar Electric Vehicle are discussed in this paper.***
Keywords: Solar car, PVC, Electric Power

I. INTRODUCTION

The energy is one of the most vital needs for survival of humans on earth and eventually on every other planet. We are relied on one form of energy or other for fulfilling our needs. We are using fossil fuels for running our automobiles from hundreds of years. The countries like China, U.S., India consume 70% of fossil fuels for transportation vehicles. But main disadvantage of these fuels is that they are not environment friendly and are exhaustible. To deal with these problems of fossil fuels we need to look at renewable sources of energy. With regards to this people are moving towards solar electric vehicles.

The solar electric vehicle is primarily powered by solar energy directly. Solar energy is collected and converted into electric energy by installing Photovoltaic Cells (PVC) on vehicle. Solar electric car is widely used solar electric vehicle nowadays for land transport. Solar electric vehicle includes combination of technologies used in automobile industries, aerospace, alternate energy and bicycle. The major reason of production of solar cars is to race in solar car races. As most of the solar cars are built for racing on the racing tracks, proper attention is given to weight of vehicle and efficiency. This trend is bringing opportunities to develop new technologies in vehicle. Also electric vehicles are creating additional economical development opportunities by taking quality of life to next level and decreasing rate of reliability on fossil fuels.

A. Why we need Solar Electric Vehicle

The pollutants from automobiles are warming the earth. Automobile pollutants are the 23% of the total air pollution. The imbalance between public transport and increasing population is resulting in the tremendous amount of air pollution. This is one of the biggest problems faced by urban areas throughout the world.

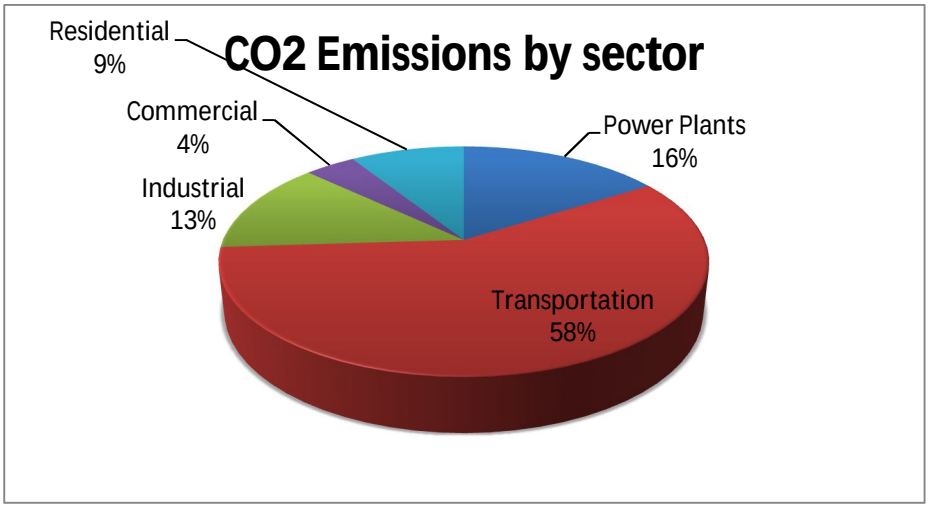


Fig.1. Different Sectors of CO2 Emissions [1]

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The numbers of vehicles is increasing with the increasing population and due to these imbalanced factors the air pollution is also increasing. In the last two decades many experiments are done to control the air pollution caused by the automobiles and fossil fuels. The earth is having restricted amount of energy sources which as per the research are going to be terminated in near future. The need of people is increasing day by day. Meanwhile the biggest question is whether the resources of earth are adequate to consummate the humans at high standards of living for all. In this crucial issue is energy.

Also these days the tradespersons of the natural resources like fuel, gas, coal, etc. are suffering to keep up with the increasing ultimatum. So it is clear that the current swings in consumption of the energy, especially oil, cannot be sustained much longer. Also the fossil fuels are responsible for global warming, ozone layer depletion, etc.. Therefore consequently, it is obligatory to make new explorations of natural resources of energy and power. With respect to this solar energy is most effective, less expensive and endless source of energy till the date which can be used to power the automobiles.

B. Working/Functionality

A solar vehicle is a electric vehicle powered by direct solar energy completely or significantly. The term “Solar Vehicle” simply illustrates that solar energy is used to run all or part of vehicle operations. A solar vehicle gets energy from sunlight it needs to move. The surface created by solar panels absorbs most of the light that falls upon them. The black colored objects just get hot in the sun. But in solar vehicles, the sunlight gets converted into electricity by a device called a “Solar/Photovoltaic cells.” Technically when the sunlight falls on these cells, photons of sunlight it excite the electrons. This causes flow of electrons which in responsible for current flow in the process. The flow of current works as a fuel for solar vehicle. Each of the dark colored panels mounted on the solar vehicle contains many such solar cells. This converted electricity is used to drive the car’s electric motor. Remaining excess electricity is stored in a battery for cloudy weather conditions.

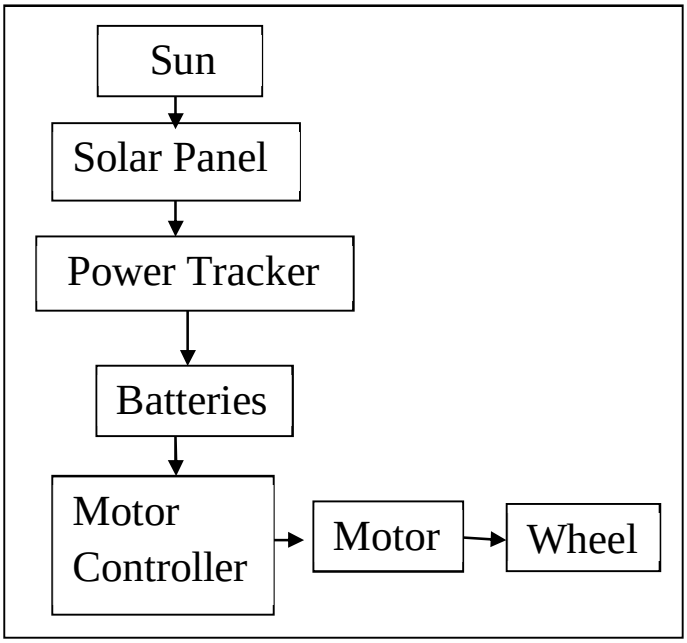


Fig.: Working principle of solar electric vehicle.

The above figure gives an overview of the working of solar vehicle. Sun is the main source of the energy of the vehicle. Energy from sun in captured by the solar panels and is converted into electricity. The electricity thus formed is being fed to batteries to get charged. This helps in completing the charge-discharge cycle of battery and improves the battery life for better working.

The surface of earth receives approximately 1 KW of solar energy per square meter on a clear day. If we could make perfect solar cells that convert all the solar energy emitting on panels which are used in average sized vehicle then its engine would go till 10 horsepower. But even the best and most efficient solar panels available nowadays can only convert 20% to 24% of the solar power into electricity. Therefore in full sunny condition, the motor puts out about 2 hp. With the help of the charged battery motor can put out about 8 hp for short time. With regards to this if we use highly efficient 4 square meter panes then they will generate 15KW of energy roughly. This could run a average sized and weighed vehicle around 60 to 65 KM.

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Solar modules mounted on the top of the vehicle are usually used to charge the battery through the charge controller. The batteries are initially fully charged and then they are connected to the solar modules for charging so that batteries will always keep charging. This is also done as the function of the solar module. In this case battery will be fully charged again in 3 to 3.5 hours. The batteries are charged from the solar panels and therefore it drives the electricity continuously through the circuits. The motor must be started on top gear to lift the entire load to maximize the torque and speed. The speed can be controlled as per the requirement of the drivers. As the change in speed results in change in current, speed must be low in order to last the battery charging for long period of time. The mechanical breaks can be implied in order to stop vehicle immediately in case of emergency. But this should be avoided wherever possible because it can damage the motor and also create unnecessary back E.M.F..

II. ADVANTAGES

As solar powered vehicle is the need of hour, it has wide range of advantages considering its working, maintenance cost, emission levels, etc.. Some of the major advantages are listed below.

A. In contrast to other regular vehicles, solar powered vehicles are compatible of utilizing their full power at any speed.
B. Solar electric vehicles don't require any expenses for their fuelling.
C. Maintenance required for solar electric vehicles is very low.
D. The solar cells generate electricity in solar vehicles therefore it does not emit any harmful gas or any other pollutant. Solar vehicles are environment friendly and in the current situation this is the only answer to the rising pollution level due to automobiles.
E. Due to use of the electric motors it does not generate any noise.
F. Solar cars are drive the power from sunlight, as sun always shines and provides energy availability of energy is a great advantage and by harvesting renewable energy, we are helping to sustain unconventional source of energy.
G. The efficient solar panels can be used in order to create more amount of power and store it for driving the vehicle.
H. Fuel losses are very low as compared to regular vehicles.
I. Solar electric vehicles are more smooth and faster than petrol/diesel engine vehicles.
J. Solar vehicles are the future of the automotive industry. They are highly viable and can be easily produced.

III. CHALLENGES

As the wide range of advantages solar electric vehicle comes with some challenges too. Following are the some of the major challenges for solar electric vehicles.

A. As the solar panels available in market are not highly efficient, we need large surface are on the roof of vehicle for fixing the solar panels.
B. Most of the times it is restricted to fix the solar panels on top of vehicle in order to have low wind resistance.
C. The highly efficient solar panels and the batteries required in solar vehicles are way too expensive. That increases the initial price of the vehicle.
D. The solar panels available nowadays are only able to convert the 20% to 24% of the sunlight they absorb in the electricity.
E. The secured arrangement of the solar panels, batteries and all the connections needs more attention as it is having electricity running through it all the time.
F. The only thing comes to mind of people living in dark and wet region whenever they hear a term 'Solar Powered Vehicle' is "It's great, but we never get any sun", and that's the major issue that industry needs to tackle.
G. The solar electric vehicles are built light weight and low to ground and that makes them unsafe for commercial use.

IV. CONCLUSION

The objective of this research is to study the recent trend in automobile industry. Solar vehicles are answer to many questions related to environment and this technology is the best option for controlling the pollution. We need to adapt this innovation in order to reduce our dependence on fossil fuels and save them. There are some disadvantages but looking after the advantages solar vehicles are the future of automobile industry. So the solar powered vehicles can be used as the green vehicle in developing countries due to its zero pollution effect nature.

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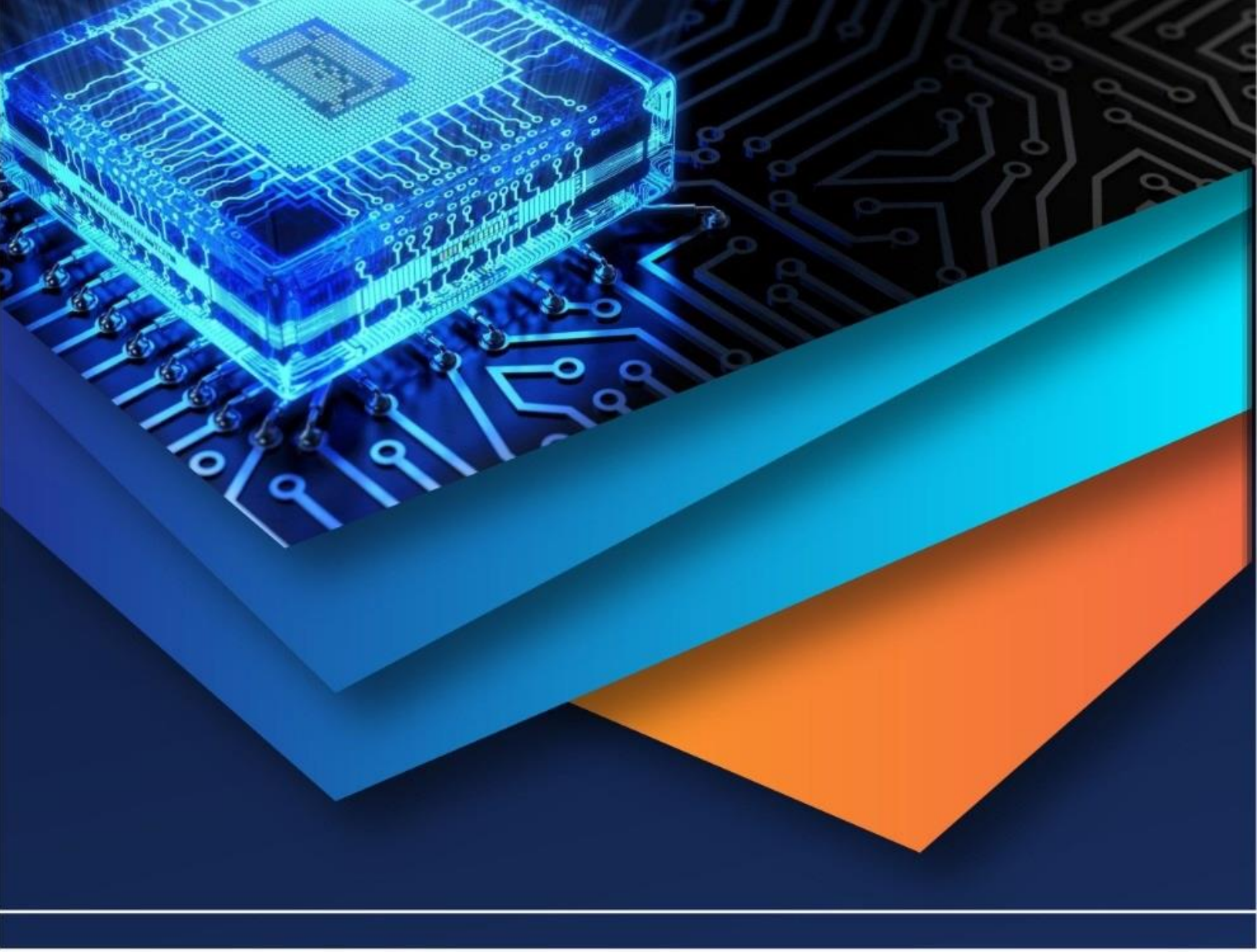
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