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# Study of a New Type of Electric Car: Solar-Powered Car

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**Abstract.** This article shows the difference between solar-powered cars and pure electric cars, the advantages of using solar panels to provide electricity as well as the distance range increased by converting sunlight into electricity. I also discuss and give some reasons that solar-powered cars can be expected to become widespread in the future.

**Key words:** Solar-powered car; Solar energy; Solar panels; Range of distance; Lightyear One.

## 1. Introduction

Solar energy is becoming more and more important in recent years, as an alternative to fossil fuels. Solar energy is also one of the renewable clean energy resources. It can be used to generate electric energy into the car via solar panels. Also, there are no pollution and greenhouse gases released when solar energy is converted into electric energy. This new transportation technology will improve environmental problems effectively. This world's first long-range solar-powered electric car called Lightyear One was produced on 25th June 2019, which was predicted to start the production in 2021. This essay analyzes the trend of whether solar-powered cars are possible to be widespread and to take first place among different types of electric cars in the future

## 2. Ideal Energy: Solar Energy

One obvious difference between solar cars and electric cars is the initial energy resource. Solar cars use electricity that is transformed directly from sunlight, which can be achieved by using solar panels consisting of many individual solar cells. In the following picture, which is the image of Lightyear One, we can see that the solar panels have covered its whole roof and hood consisting of 16 square feet in total, to charge the car, whenever there is light radiation shining on the top [1].

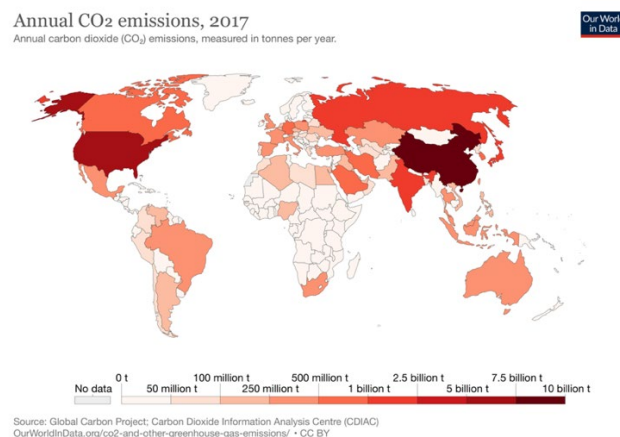


**Figure 1.** Lightyear One [1]



The solar panels, consisting of many solar cells, can absorb the light radiation to generate the electric energy which can be stored in the car's accumulator so that a large amount of electricity is saved for recharging the cars. The importance of solar cells, moreover, can be found especially when the electric energy completely runs out, in that scenario, the cell-powered energy storage can continue supporting the car to drive for a long range without recharging. Therefore, the solar panels on the roof and hood of the cars are used for not only an increasing driving distance but also to decrease the amount of fossil fuels burnt for providing the electricity. Without a doubt, it is possible for solar-powered cars to have a total, final amount of energy is much larger than the initial energy despite already driving for a while.

Compared with the pure electric cars, the solar-powered cars may reach a level of zero carbon dioxide emission in a strict sense, while the pure electric cars do not. In fact, all-electric cars do not have tailpipes, so obviously, there is no pollution released as they are driven. However, the main which causes only a small portion of people who desire electric cars is the limitation of driving distance due to a small electric energy storage capacity. This means that consumers have to look for a charging station to power their cars with enough electricity after driving for a period. Most of the electric energy supplied by the charging stations is provided through burning the fossil fuels. As a result, with the increase of electric energy used and a growing number of populations driving electric cars, more fossil fuels will be burned to supply the electric energy, which will cause more carbon dioxide to be released from the heat power plants across the world. However, if it is possible to achieve the production of solar-powered cars, the problem that there is an increasing amount of carbon dioxide emission will not happen anymore. This also means the environmental problems caused by global warming will be improved.



**Figure 2.** 2017 annual CO<sub>2</sub> emission [2]

It is clearly seen that the carbon dioxide emission in China is the most, and the environmental problem is still serious in America. Considering the positive influence on the environment, it is speculated that the China and America might think about carrying out solar-powered cars firstly.

Solar energy is the fastest growing energy resource and it has supplied about 2% of the electric energy in the whole world. Even though that sounds not too much, it represents a 50-fold increase over the past decade [3]. We can calculate the sun's insolation to show the solar energy is sufficient for human's daily use according to the following equation.

$$P = \pi R_E^2 S \quad (1)$$

$R_E$  is 6.37 Mm, and  $S$  is measuring the rate at which solar energy absorbed by the surface of the earth per area. [3] By this calculation, we can know the total solar energy input power is 173PW, while humankind uses energy at the rate of 18TW.[4] Comparing these two figures, we can clearly see that

solar energy is much more than the energy we used in our lives. Moreover, it is found that the rate at which solar energy reaches the earth, in a round number, is about 10000 times as much as the energy rate needed in our daily lives. Therefore, using solar energy to supply electricity will be a good choice considering the environmental problems and the amount of the rest of fossil fuels.

### 3. The Ability of Energy Storage

When it comes to solar cars, solar panel efficiency is the most worrying problem among the public. According to a journal reported in Boston Solar Blog, in fact, the efficiency of solar panels depends on the temperature and the shaded area. Generally, there is a peak solar efficiency between 59 Fahrenheit and 95 Fahrenheit (which is between 15 Celsius and 35 Celsius.) If the temperature of the solar panels continues rising up to 144 Fahrenheit which is about 62 Celsius, the efficiency will be declined a little bit.[6] However, all countries in the world are hardly ever hotter than 62 Celsius, including the Sahara Desert whose temperature is closer to be the highest in the world. As for most countries in the world, the temperatures are in the range from 15 to 35 Celsius in the whole year or apart from winter. Another problem is that how much the shade or cloudy weather can affect the amount of electric energy stored. As a general rule, the energy produced through the solar panels under the clouds and the shades is as half as that under the sunny days. [4] The shade caused by the trees or high buildings on the roof or hood of the car, where the solar panels are installed, will disappear after a period because the earth is rotating around the sun all the time, so there would not always be shade on the solar panels. Besides, the cloud changes its place any time no matter when the car is stopping on the road or a person is driving it, there are always some gaps that allow the sunlight to irradiate on the top of the solar panels. This amount of energy is sufficient for a short journey.

According to the announcement from the Lightyear company, we can know the driving mileages of Lightyear One is about 450 miles (725km) with one single charged battery, which is much longer than the other electric cars (compared to the tesla model S's 379 miles). And on average, the mileages can increase by about 7.5 miles per hour only converting the solar energy when the owners just stop their cars outside. [5] Therefore, by assuming the solar panels of the cars working for eight hours per day, the total mileages will increase by 60 miles per day, which is enough for those people who drive their cars for a short journey. When it comes to the total distance traveling only based on solar energy, it is assumed 60 miles increased per day will only be powered for 100 days in a year, only 100 days can get to 60 miles per day by solar energy, which means there will be about 6000-mile range only powered by solar cells in a year. As a result, regardless of the charged electricity, this range in miles can be satisfied with the request for short traveling, what's more, there will be no extra money paid for the electricity.

#### 3.1. Individual Economy

Here, take Lightyear One for example. The reservation price is 135000 dollars, and it is predicted to rise up to 170000 dollars. However, the price of a new pure electric car, Tesla Model S, is between 75000 and 100000 dollars. By comparing to these two types of electric cars, it is obviously shown that solar-powered car is much more expensive than pure electric car. For the reservation price of Lightyear One, people might think it is too high to own one. But when you consider the recharging energy, you might not believe the total money saved by solar cells. By thinking about the Lightyear One, the total traveling distance generated by solar cells is about 20000 kilometers (12400 miles) each year. [6] It is known that filling with 80-liter storage of gasoline needs around 500RMB according to the price of gasoline in China, and it can support the car to drive about 600 kilometers. So, if a person drives a solar car instead of a car powered by fossil fuels, it will save 16667 RMB each year on fossil fuels. Therefore, even though the price of a solar-powered car is a little bit more expensive than the others, the money saved is not a small figure. As we can see there are a lot of vehicles on the road which are worth over 100 million RMB and similar to the price of solar cars of tesla and lightyear, this means a part of people can afford solar cars. Besides, with new material science breakthroughs, the cost of solar panels will decrease, and the solar cells will be more efficient in the next years [7], which leads to the decrease of the solar-powered cars' price so that more people can afford them.

#### 4. Conclusion

Firstly, because solar energy is a renewable and clean energy resource, solar energy will be paid more attention by the government in the future rather than the traditional fossil fuels. This means installing the solar panels on the roof and hood of the cars is an expected trend. Secondly, comparing with other types of electric cars, such as pure electric cars, the range of the solar-powered car is much larger, and it also can continue being increased by the solar cells. Thirdly, there will be a large amount of money that can be saved, as a result of less charging electricity. Moreover, the cost of solar-powered cars will decrease due to the price-performance ratio of solar cell technologies. Finally, if the positive influence on the environment is considered, two countries of America and China should think about solar cars earlier than other countries to achieve less pollution. Therefore, in my opinion, it is achievable that solar-powered cars would be widespread in the future because there are enough a lot of advantages to driving a solar-powered car.

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