Comparison of Several New Energy Vehicles and Gasoline Vehicles During the Same Price Range

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ABSTRACT

Consumers frequently consider the advantages between traditional gasoline vehicles and new energy vehicles. This experiment compared NEVs and traditional gasoline vehicles in aspects of carbon emissions, daily consumption, and value preservation rate. Traditional gasoline vehicles have a higher value preservation rate than new energy vehicles on average. However, NEVs have better environmental protection and money-saving properties. What is more, if the governments and companies use some new energy sources such as nuclear and wind as the electric supply, it will be more environmental-friendly, and help consumers save more money on daily driving. In summary, if consumers do not have plans to sell their cars, it is better for both daily use and environmental protection to buy a new energy vehicle. This experiment can help customers have a reference standard when choosing a car. However, many factors were not considered in this experiment, such as the life of the battery and engine and the impact of the customer's car habits on the car. The experimental results are only for reference.

Keywords: *New energy vehicle, Carbon emissions, Carbon neutrality*

1. INTRODUCTION

Carbon peaking and carbon neutrality have become the goals pursued by various countries in recent years. The new energy industry has become the hottest topic. Some researchers have studied the evolution of the new energy industry in different regions and the impact of policies on new energy companies [1,2]. In segments of the new energy market, new energy vehicles are one of the most important parts. Various studies have made multi-faceted analysis of new energy vehicles: how car manufacturers allocate the proportion of new energy vehicles to traditional gasoline vehicles, how to view the innovation network of the new energy vehicle industry from the perspective of social networks, and how the spatial network of innovation efficiency affects the new energy vehicle industry [3-5]. In addition, researchers have even examined the advantages and disadvantages of hydrogen as a potential fuel, the challenge of launching coordination between competing groups such as automotive groups and energy companies in 2016, and the failure of previous policy interventions [6,7]. At the same time, due to the continuous expansion of the industry, upstream and downstream related industries have also received attention. For example, Liu and Wang studied the decision of upstream power battery suppliers to decide whether to encroach on recycling channels under three different government subsidy models (no subsidy, new energy vehicle manufacturer subsidy, and consumer subsidy) [8]. In general, as the most popular industry, new energy vehicles still have considerable research space.

Previously, Wu et al. studied the data of 22 typical new energy vehicles in China; Mao and his colleagues studied a new energy vehicle energy demand prediction model under marine energy [9,10]. Today, the following experiment will compare new energy vehicles and conventional gasoline vehicles for research. The experiment compared the energy consumption, daily cost, and value preservation rate of two kinds of vehicles at different price ranges. In addition, the experiment discusses the carbon emissions of some new energy sources as electricity supply and how many kilometers are needed if two kinds of vehicles are wanted to keep the same value preservation rate.

2. DATASET

In this paper, the data is selected from ATHM (www.autohome.com.cn). Under four price ranges, the popular fuel vehicles and new energy vehicles were collected in the experiment, i.e., Song Plus, CIVIC, Model3, 320Li, ES8, QX60, ModelS, 730/740Li. What is more, in order to facilitate more intuitive observation, the above information is listed in Table 1.

Table 1. The price of selected cars

Price Range(kRMB)	150-200		250-350		450-650		900-1100	
Car Name	Song Plus	CIVIC	Model3	320Li	ES8	QX60	Model S	730/740Li

In the following experiment, this experiment will analyze these eight models from the perspectives of environmental protection, cost consumption, and value preservation rate. Finally, this study would like to get the main benefits of new energy vehicles compared to traditional fuel vehicles.

3. ENVIRONMENTAL PROTECTION

The most important feature of new energy vehicles (NEVs) is that NEVs allow consumers to minimize pollution emissions, particularly carbon emissions, by switching from traditional fuel cars to NEVs. This study calculated each model's carbon emissions per 100 kilometers in the following way. Two crucial parameters must be obtained: each model's energy consumption per 100 kilometers and the carbon emissions produced by each unit of energy consumption. Because coal-fired power generation is the primary source of electric power, and nuclear power, hydropower, and other renewable energy sources account for only a small portion of total power generation, this study calculated carbon emissions per kWh of electricity using the average value of carbon emissions provided by www.tanpaifang.com. Because of the varying quality of gasoline, this experiment did not incorporate non-human controlled aspects such as the quality of gasoline in our calculations and instead used the average statistics supplied by www.tanpaifang.com. In addition, we received objective data from official data and ATHM for the acquisition of energy consumption per 100 kilometers for each model (www.autohome.com.cn). Finally, this study calculated the carbon emissions per 100 kilometers by multiplying the energy consumption per 100 kilometers by the carbon emissions created by each unit of energy consumption. Table 2 contains the described data.

Table 2. The comparison of carbon emissions per 100 kilometers

Price Range(kRMB)	150-200		250-350		450-650		900-1100	
Car Name	Song Plus	CIVIC	Model3	320Li	ES8	QX60	Model S	730/740Li
kWh & L/100km	18.2	7.6	13.7	10.4	20	12.6	15.3	12.9
Carbon(kg)/kWh & L	0.785	2.3	0.785	2.3	0.785	2.3	0.785	2.3
Carbon(kg)/100km	14.3	17.5	10.8	23.9	15.7	29.0	12.0	29.7
Emission Reduction Rate	18.3%		55.0%		45.8%		59.5%	

The experimental results were quite obvious through the data displayed in the above table. Although new energy vehicles use energy supply mainly composed of coal power, NEVs can still have fewer carbon emissions than gasoline vehicles of the same price range. The above data shows that, among the cars at various price levels, the highest carbon emissions could be reduced by 59.5% compared with identical price fuel vehicles, and the minimum carbon emissions can be reduced by 18.3%. On average, NEVs at the same price will reduce carbon emissions by about 45% compared to fuel vehicles when the power supply is mainly coal-fired.

Switching from conventional gasoline vehicles to electric vehicles is the beginning of the carbon reduction revolution. Coal power needs to be replaced by other energy sources such as nuclear power and hydropower to achieve carbon neutrality truly. The following experiment will measure how much carbon emissions will be reduced if other energy sources are used to generate electricity. Nuclear power generation, Solar PV-rooftop, Wind-Onshore, and Hydroelectric were used in the experiments. Experimental data used Solar PV-rooftop, which produces 34 grams of carbon emissions per kWh, Nuclear, which produces 70 grams of carbon emissions per kWh, Wind-Onshore, which produces 10.8 grams of carbon emissions per kWh, Hydroelectric, which produces 22 grams of carbon emissions per kWh. The data were calculated by Stanford professor Mark Z. Jacobson, of which the maximum value was selected for the calculation of this experiment. The Emission Reduction Rate was calculated by dividing the carbon emissions per 100km of gasoline vehicles minus the carbon emissions per 100km of electric vehicles under different energy sources by the carbon emissions per 100km' of gasoline vehicles.

Table 3. The comparison of carbon emissions per 100 kilometers under different energy

Price Range(kRMB)	150-200		250-350		450-650		900-1100	
Car Name	Song Plus	CIVIC	Model3	320Li	ES8	QX60	Model S	730/740Li
kWh & L/100km	18.2	7.6	13.7	10.4	20	12.6	15.3	12.9
Solar PV-rooftop & Gasoline	0.62	17.48	0.4658	23.92	0.68	28.98	0.5202	29.67
Emission Reduction Rate	96.5%		98.1%		97.7%		98.2%	
Nuclear & Gasoline	1.27	17.48	0.959	23.92	1.4	28.98	1.071	29.67
Emission Reduction Rate	92.7%		96.0%		95.2%		96.4%	
Wind-Onshore & Gasoline	0.20	17.48	0.14796	23.92	0.216	28.98	0.16524	29.67
Emission Reduction Rate	98.9%		99.4%		99.3%		99.4%	
Hydroelectric & Gasoline	0.40	17.48	0.3014	23.92	0.44	28.98	0.3366	29.67
Emission Reduction Rate	97.7%		98.7%		98.5%		98.9%	

Indeed, the experimental results show that if the energy is replaced by new energy sources such as nuclear, the carbon emissions of electric vehicles will be reduced by more than 95% compared to traditional fuel vehicles. However, this result needs to be verified repeatedly because of the small sample size, different car habits, seasons, and other factors. Related research needs to be continued.

4. DAILY COST CONSUMPTION

Another problem that buyers are concerned about is the vehicle's daily cost. In the following studies, this experiment looked at each model's cost per 100 kilometers. Due to the differences in maintenance items and the degree of maintenance, it is not easy to compile statistics on the cost of daily maintenance and repair. Thus this study did not draw comparisons here. The following step of the experiment needed two parameters to calculate each model's cost per 100 kilometers: the car's energy consumption per 100 kilometers and the cost per unit energy consumption. The energy consumption per 100 kilometers of the car will also vary due to different usage methods, so this study continued to use the data provided by the official data and ATHM (www.autohome.com.cn) mentioned above. For the cost per liter of gasoline, this study used the price of gasoline 92 in Zhengzhou (a city in China) at the time of reporting. For the cost of electricity per kWh, this experiment considered the per kWh cost of household electricity and public charging piles and calculated the average value. Finally, the cost of each model per 100 kilometers was obtained by multiplying the energy consumption per 100 kilometers by the cost of unit energy consumption. The data mentioned above is in Table 4.

Table 4. The comparison of the cost per 100 kilometers

Price Range(kRMB)	150-200		250-350		450-650		900-1100	
Car Name	Song Plus	CIVIC	Model3	320Li	ES8	QX60	Model S	730/740Li
kWh & L/100km	18.2	7.6	13.7	10.4	20	12.6	15.3	12.9
RMB/kWh & L	1	7.84	1	7.84	1	7.84	1	7.84
RMB/100km	18.2	59.6	13.7	81.5	20.0	98.8	15.3	101.1
Cost Reduction Rate	69.5%		83.2%		79.8%		84.9%	

By observing the above table and calculations, the results are clearly presented. In the case of coal power as the main energy source, the cost per kilowatt-hour of new energy vehicles is about 1 RMB. The price of gasoline per liter of traditional oil cars is about 7.84RMB. This part of the data shows that, at the same price, new energy vehicles could save up to 84.9% and at least 69.5% in energy costs than fuel vehicles. On average, new energy vehicles will save 79.4% of energy costs compared to traditional gasoline vehicles when the primary energy source is coal power.

The experimental results clearly show that new energy vehicles are cheaper than traditional gasoline vehicles in daily traffic. However, the experiment has many flaws, such as not taking into account everyone's car habits, accident maintenance, and other possible factors. Therefore, experiments need to continue, and better experimental platforms and funds are needed.

5. VALUE PRESERVATION RATE

The car's value preservation rate is also a significant reference point for customers when making a purchase. This study calculated the preservation rate of each model after one year and three years in the following tests. Models that have recently been released or have some missing data were not counted. This study used the same kilometers and models from the same year to calculate the models of used automobiles that did not have an accurate three-year history. In order to acquire the most accurate statistics, this study had matched the controllable elements such as year, kilometers, and vehicle condition. All the data this experiment used came from ATHM (www.autohome.com.cn). This study determined the preservation rate by dividing the cost of the old automobile by the cost of the new car with the same condition which means the same mileage and same years. The purchase price will alter because of the various automobile combinations, but the overall impact will be minimal. Table 5 contains the data described above.

Table 5. The comparison of the car's value preservation rate

Price Range(kRMB)	150-200		250-350		450-650		900-1100	
Car Name	Song Plus	CIVIC	Model3	320Li	ES8	QX60	Model S	730/740Li
Buying	177	156	300	319	508	445	905	949
1 Year	159	139	266	298	357	368	688	787
Percentage	90%	89%	89%	93%	70%	83%	76%	83%
Buying	NA	158	317	358	595	618	797	899
3 Year	NA	128	200	296	298	328	484	662
Percentage	NA	81%	63%	83%	50%	53%	61%	74%

Although there may be some errors due to factors such as too small samples or insufficient diversity of samples, the above table intuitively shows the comparison of the value preservation rate of new energy vehicles and traditional fuel vehicles. The average preservation rate of new energy vehicles that have been used for one year is 81.25%, while the average retention rate of gasoline vehicles that have also been used for one year is 87%. The average retention rate of new energy vehicles that have been used for three years is 58% (excluding vehicle's model without data), while the average retention rate of gasoline vehicles that have also been used for three years is 72.75%. It can be concluded from the above table and calculations that, except for cars in the range of 150-200kRMB (there is an outlier because the vehicle conditions are different or other factors), traditional gasoline cars had a better value preservation rate than new energy cars at the same price.

The experiment calculated the value preservation rate and daily consumption of new energy vehicles and traditional oil vehicles. The following experiment will calculate how many kilometers after the new energy vehicle can make up the gap of the value preservation rate with the traditional oil vehicle. The experiments calculated the number of kilometers required for one year and three years. Since song plus had been listed recently, which means a lot of information was missing, the experiment did not perform the data calculation of the first group. In order to facilitate the calculation and improve the accuracy of the answer, the experiment assumed that the models in the same price range were the same price which was the average value of the range. In the experiment, the price was multiplied by the difference of the value preservation rate between the new energy vehicle and the traditional oil vehicle and then divided by the cost saved by the new energy vehicle per 100 kilometers. Finally, the results were multiplied by 100 to get the number of kilometers.

Table 6. How many kilometers are needed if two kinds of cars want the same price

Price Range(kRMB)	300	550	1000
Car Name	Model3	ES8	Model S
	320Li	QX60	730/740Li
Save kRMB/100km	41.4	67.8	78.8
1Year(km)	34435.5	100707.2	87673.9
3Year(km)	142012.0	22041.4	163861.3

The results show that the new energy vehicle needs to run a considerable number of kilometers to make up for the difference in the value preservation rate with the traditional oil vehicle. However, there were many factors that the experiment did not take into account, such as how much people love the car, which can also affect the value of the car.

6. CONCLUSION

To sum up, new energy vehicles are better than traditional fuel vehicles in aspects of carbon emissions and daily consumption. If the power supply energy is replaced by nuclear energy in the future, these two advantages will continue to expand. However, the value preservation rate of new energy vehicles is lower than that of traditional fuel vehicles. Even if the difference in daily consumption is counted, the gap in the preservation rate can still be hard to be made up. Therefore, if second-hand sale is not considered, new energy vehicles will have advantages in terms of environmental protection and money-saving. Due to the small sample size and many uncontrollable factors in this experiment, there may be errors, and the results are only for reference.

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