A Cost model for Battery Chargers over Energy Optimisation and Social Results

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Abstract: The electricity demands from battery charging of an increasing number of electric cars and 5th-generation smartphones produce a huge cost. Thus, a cost model [1] is desired with respect to solving the four emerging issues as follows: Problem 1. We analyse the recent data from electricity consumption in the United States and synthesise the development process of 5G technology with the market occupation ratio of electric vehicles. We make predictions on the requirements of energy and electricity in the following five years in the United States through the data regression by curve fitting using Matlab. We will discuss the impact from economic and social aspects. Hence, we may conclude that, we should install wireless charging devices and fast charging devices in the public spaces [5] in a stage-by-stage fashion based on the growth rate of charging devices. Problem 2. It is reasonable to assume that the cost of charging is the union of economic cost [2] and social cost. For economic cost, we separately establish the cost model for small and big charging devices [6] using linear regression. For social cost, we collect the data by questionnaires with Likert scale so as to quantify the costumers satisfaction. Lastly, we conclude that the proportions of cost [4] paid by different objects should be determined based on the different social benefits of charging devices by building market-oriented complementary model under the cost limitations. Problem 3. We introduce the use frequency of the devices in public. We use Simulation Model to obtain the data of the number of people across, the rate of device depreciation and that of the device public usage. Based on the second model, we establish a function model of the distribution of mobile devices and non-mobile devices in different types of public places. Problem 4. About economic cost model, we introduce advertisements and mechanism of market incentives and punishments. We reduce the intentional attrition rate, and purchase cost. Then we build cost function model based on the original one so that in general, we introduce weight to convey the relationship between variables and reduce the waiting

Keywords: Linear Regression, Likert Scale, Market Complementary Model, Single Objective Planning Mode

1. INTRODUCTION

With the proliferation of electronic products, there is a corresponding surge in electricity demand, weaving a complex tapestry of energy consumption patterns across various settings. Within the confines of our homes, individuals are accustomed to shouldering their own electricity expenses, maintain a clear and direct relationship between usage and payment. However, this paradigm shifts dramatically as we step into public domains [3], where charging facilities are generously offered at no cost.

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This brings us to a critical juncture, promoting us to ponder over the ramifications of “free charging” on our equipment across diverse public spaces. A pivotal question arises: Who is ultimately responsible for footing the bill for these charging costs?

In this context, it becomes imperative to scrutinize the prevailing trends in the utilization of charging ports, delving into the intricate web of impacts and prerequisites these trends usher in, particularly within public arenas [2]. This includes a thorough examination of energy growth trajectories, as well as the burgeoning demand for charging facilities. The exploration of these trends will not only illuminate the current state of affairs but also pave the way for informed discussions and strategic planning in addressing the challenges and opportunities that lie ahead.

2. ANALYSIS OF THE PROBLEM

In order to establish and optimise the cost model, the following three issues need to be analysed.

2.1. Problem 1

We separately discuss the changes and future trend of how small charging devices (mobile phone) and big charging devices (electric vehicle) consume energy over time. Therefore, we collect the data of phone holdings and electric cars in America. We utilise MATLAB to fit and get the conclusion. In terms of economic cost, we deeply analyse the ratio of devices, purchase fees, increasing electricity fees and scrap rate. In terms of social cost, we expressly analyse the indirect loss brought by unsatisfied requirements and long waiting time. Then, we analyse financial cost and financial cost. Finally, we elicit the number of charging piles, which have to be installed in a specific range. (See Figure 1)

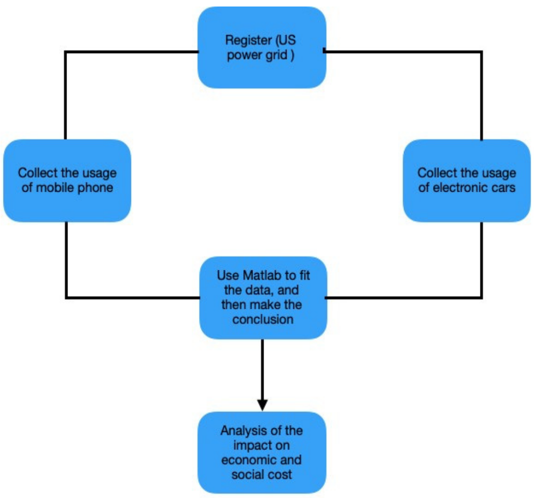

Figure 1.Solution Planning Chart.

2.2. Problem 2

First, we discuss two types of public places, including profit public places and non-profit public places. In our discussion, we set up cost model which is based on financial cost [2] and social cost. During the process of building model, we quantify every necessary factor. What is more, we also discuss the impact of phone holdings and the growth rate of electric vehicles have on the cost of energy sources and the construct of free charging electric devices. Lastly, we conclude the taker of economic and social cost. Also, we discuss the cost-bearing ratio of fees both in profit public places and non-profit public places.

2.3. Problem 3

We continue to talk about two types of public places and analyse the special property of public places. We use the distance from one particular place to city centre, the level of city and the type of places to analyse the flow of population. To find the type of electric devices owned by people, we take the education level, employment level and the requirement of employee into consideration.

2.4. Problem 4

Based on model, we reduce the cost by balancing economic cost and social cost. Specifically speaking, we charge in a regular time by using advertisements and setting up award and penalty systems in non-profit public places. At the same time, we choose to provide high-efficient charging devices and increase the number of charging equipment to change the ratio of power supply. Finally, we use these measures to reduce cost and improve our model.

3. THE SOLUTION OF PROBLEM 1

3.1. Small Charging Equipment

In this essay, we take small charging device as a typical example to discuss. According to researches, we find that the consumption of mobile phones is related to phone holdings and the type of mobile phones. In this case, we search the amount of phone holdings in America online. Besides, we also look for the trend of phone holdings in the past years and phone types in the future. (See Figure 2)

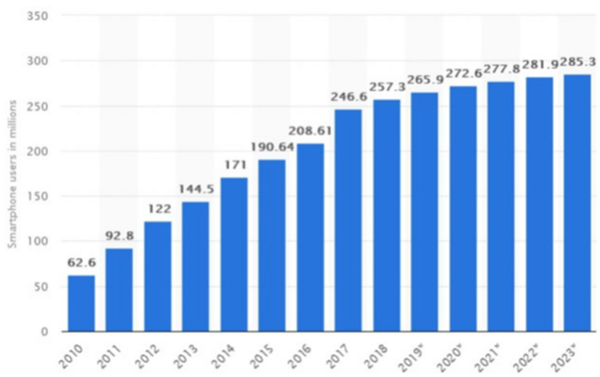

Figure 2. Mobile Phone Holdings

By using MATLAB to fit, we find that phone holdings increases in the mode of Scurve. Recently, due to certain amount of users, when the amount of phones reach a certain point, the speed of increasing will slow down and finally reach saturated. As a consequence, we believe that the increase of phone holdings has small influence on electricity consumption of charging equipment. In the future, however, due to the spread of 5th generation mobile networks, the speed of consuming will constantly develop. There are two main reasons. First, the ability in dealing with functions of 5th generation mobile phones will be improved greatly. Hence, 5th-Generation can deal with more tasks simultaneously than old generations. To achieve this goal successfully, 5th-Generation needs bigger electricity consumption. Secondly, 5G terminal device adopt using Massive MIMO antenna technology. This technique needs eight antennas in phone built. Each antenna has special mechanism to enlarge power. As a result, the electricity consumption of small charging devices will constantly increase.

3.2. Large Charging Equipment

From our perspective, charging demands of large charging devices are largely related to the amount of these devices. In order to understand the trend of charging demands comprehensively, we use two types of cars as ideal instances to count the amount over years. One is hybrid electric vehicle and the other is battery electric vehicle. Based on all data we have, we use MATLAB to fit. Then we get the future trend of big charging devices. What must be illustrated is that the amount of mobile vehicles is hugely related to policy of the U.S. government. We can discover that the amount of mobile vehicles is constantly going up. As a consequence, we believe that the electricity consumption of big charging devices will go up in the future. Besides, they will not reach saturated in short. (See Figure 3)

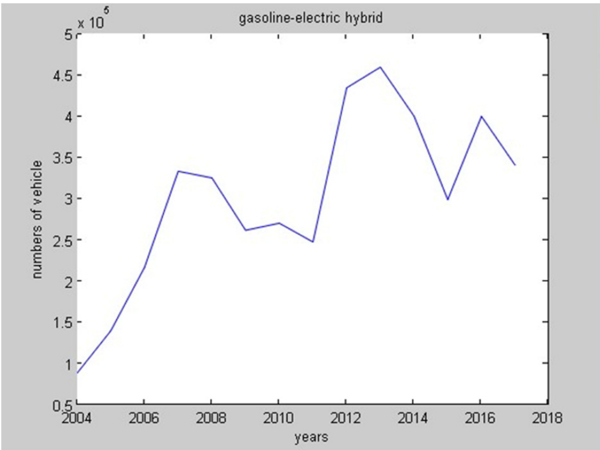

Figure 3. Hybrid Car Growth Trend

3.3. Impact on Public Places

What must be illustrated is that the amount of mobile vehicles is hugely related to policy of the U.S. government. We can discover that the amount of mobile vehicles is constantly going up. As a consequence, we believe that the electricity consumption of big charging devices will go up in the future. Besides, they will not reach saturated in short. Economic cost is the ratio of original charging type and the fee of purchasing charging piles. Because the demands of charging are increasing, profit public places and non-profit public places will consume electricity greatly. Besides, the scrap rate of charging piles will also hugely go up. In this case, we are considering who will pay for the loss. What is worth mention is that after increasing charging demands, original devices cannot satisfy users, so it will lead to indirect loss. In this case, social cost will also go up by this reason.

3.4. The Demand of Public Places

In the future, 5th-Generation will be get wider application; the demands of charging will continuously increase. Fortunately, with the development of technique, the charging speed of 5th-Generation mobile phones will be immensely develop. Meanwhile, charging cars will be developed greatly. Users will have higher requirements of charging cars. We have to ensure that charge electricity cars is as easy as charge common cars nowadays. Therefore, we have to build wireless charging equipment and quick-charge devices in advance. To build these devices in advance, public places can develop the quantity of wireless power banks and charging piles at the condition that maintain the number of wire power banks and charging piles. 5th generation mobile networks represent high efficiency. It means slow charging will be replaced in the future. Consequently, public places need to replace old generation devices. Additionally, public places are supposed to gradually provide advanced equipment by batch.

4. SIMPLIFYING ASSUMPTIONS

- Neglecting the assistance of social organizations and other non-labor funds to charging devices.
- Labor costs are certain.
- The expenses of installing charging piles are certain.
- The income of charging piles' advertisements is certain.

5. SYMBOL DESCRIPTION

There are some major symbols appear in the model, which are: P represents total cost. P_1 represents Personal Expenses. P_2 represents Government Borne Costs. S represents Social Benefit.

6. THE MODEL

In order to categorise and talk about big charging devices, small charging devices, profitable charging devices and non-profitable charging devices, we establish a charging cost model [1] for small devices, such as phones and model for large equipment, such as electric cars based on linear regression. In addition, we establish a market complementary model under cost limitations to talk about takers who pay fees in non-profit public places.

6.1. The Economic Cost Model of Electric Vehicle Charging

6.1.1. Symbol Descriptions

See figure 4:

Symbols	Definition	Symbols	Definition
C	Cost per charge point	C_{ii}	Cost of equipment installation
C_{ic}	Allocation cost	λ_{pr1}	Electricity price within 500kwh
C_{mc}	Later maintenance cost	λ_{pr2}	Electricity price beyond 500kwh
C_e	Electricity fees	c_{bc}	Battery capacity of electric vehicle
C_{emp}	Labor management cost	n_{ci}	Charging times of charging post
C_{ie}	Cost of equipment acquisition		

Figure 4.Symbol Description

6.1.2. Data Processing

We compare three kinds of batteries based on their longevity and durability.

They are lithium Cell, acid storage battery and Ni-MH battery. Here are the results: (See figure 5)

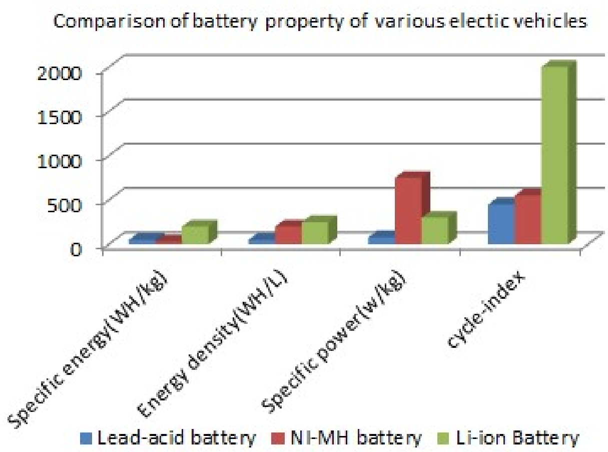

Figure 5.Comparison of Battery Performance

Based on the form, we find that most parameters of Li-ion battery are better than other two kinds of batteries, and Li-ion battery can be used repeatedly and has good durability. In the future, more and more lithium Cell will be used. Therefore, in the following steps, we choose to use the fundamental parameter of lithium Cell as the basis for model establishment and solution.

6.1.3. The Model Construction

Economic cost of charging piles id mainly divided into configuration costs, electricity and late maintenance cost: Economic cost of charging piles is mainly divided into configuration costs, electricity and late maintenance cost: $C = C_{ic} + C_{mc} + C_e + C_{emp}$

Configuration costs are divided into the expensed of purchasing devices and installing devices:

$$C_{ic} = C_{ie} + C_{ii}$$

Electricity charges based on the normal price of electricity (i.e. the local price of electricity in the United Stated), Before using 500kwh, the unit price of electricity is λ_{pr1}. So the electricity C_e is equal to the product of electricity price λ_{pr1} and battery capacity C_{bc} of electric vehicles and multiply by how many times charging piles are used n_{ci} . After using 500 kwh, the unit price of electricity λ_{pr2} , the electricity fee

C_e is equal to the sum of the electricity price of using 500kwh ($500\lambda_{pr1}$) and the electricity price of after using 500kwh ($\lambda_{pr2} \times (C_{bc} - 500)$), multiply by how many times charging piles are used n_{ci}.

$$If\ cbc \leq 500kwh, Ce = \lambda pr1 \times cbc \times nc \tag{1}$$

$$If\ cbc > 500kwh, Ce = \lambda pr1 \times cbc \times nc \tag{2}$$

6.1.4. To Solve the Model

According to the market survey, we can conclude that: when electricity consumption is $E \leq 500$, the price of electricity is λ_{pr1} =1 \$/kwh. When electricity consumption $E \geq 500$, the price of electricity is λ_{pr2} =1.5 \$/kwh. Also, I can get the battery capacity of electric vehicles is C_{bc} : (See figure 6)

Charging times of charging post n_{ci}	Cost of equipment acquisition C_{ie}	Later maintenance cost C_{mc}	Cost of equipment installation C_{ii}	Labor management cost C_{emp}
174	13.7	0.06	0.3	9.6

Figure 6. Basic power data

Substitute into the function, then we can get: *C*= 24.0526

6.2. Economic Cost Model of Small Charging Devices

To solve the demands for people charge in public places conveniently, the development of "sharing power banks" industry in developed regions is driven by the hot spot of sharing economy. Third party manufactures or governments solve the difficulties to charge outside successfully by providing sharing power banks in profit public places and non-profit public places, such as airports, markets, and subway stations.

6.2.1. Symbol Description

See figure 7:

Symbols	Definition	Symbols	Definition
Q_S	Number of devices put in (shared power bank)	T_H	Usage time of each time
P_1	Equipment cost	Q_P	Hourly rental fee (user)
P_2	Personnel maintenance cost	N	Usage frequency
P_3	Venue rental costs	k_1	Monthly rental price(Public place)
T	Days of release	k_2	Monthly maintenance price
T_D	Total usage time per day		

Figure 7.Symbol Description

6.2.2. The Model Construction

According to the survey, operator should cover three parts of costs, which are P_1, P_2, P_3 ,we get: $P = \sum_{i=1}^{3} P_i$

Among this, P_1 represents the cost of device. P_2 represents maintenances cost. And P_3 represents rent cost of places.We use K_1 to represent the monthly rent cost, K_2 represents maintenances cost of each charger,

Q_S indicates the amount of provided devices, T means release days, then P_1, P_2 can be shown as:

$$P_2 = K_2 Q_3 T \div 30 \tag{3}$$

$$P_3 = K_1 T \div 30 \tag{4}$$

6.2.3. To Solve the Model

Based on big data, in a specific city, each moveable sharing power bank is used between 0.7 ~ 0.8 times per day on average. And each power charger is rent for 3hours on average. According to it, the formula can be concluded as: $T_D \approx 3$. Big data shows that there are 40 power banks in one public places usually. The formula is: $Q_s = 40$. The price of power bank in unit time is around $1, so the formula is: $Q_P = 2$.

In cities with lower Engel index per capita (i.e. relatively richer cities), the rental price of a power charger is about 750$ per month. The formula can be inferred as it: $k_1 \approx 750$.

In the aspect of hard cost: $P_1 \approx 1050$.

In terms of maintenance cost, statistically, one maintainer can repair 50 devices and 200 power banks in 4000 charging points. We can get the result that: $k_2 \approx 1.5$, $T = 3.5$.

Through calculating, we get$P_1 = 1500$, $P_2 = 725$, $P_3 = 1800$, $\mathrm{P} = 20250$.

6.3. Social Cost Model of Charging Devices

Except the direct payment brought by economic cost, the cost brought by public charging equipment is significant for improving convenience, residents' satisfaction and life happiness. Public places can use the improvement of satisfaction to make up for excessive economic cost.

6.3.1. The Model Construction

The increase and reduction of social cost is related to users' satisfaction. In order to quantify users' satisfactions, we establish an evaluation of metric level *V* and introduce *i* as the level of satisfaction, which is:

Among it, if *i* is closer to zero, consumers' will feel more satisfied and social benefits will be more.

We believe that we can use Likert scale to investigate the altitude of consumers toward charging satisfaction. We believe that we can use Likert scale to investigate the altitude of consumers toward the level of satisfaction about charging. In this essay, we use Likert five-point scale to improve.

6.3.2. To Solve the Model

Contrapose different choices users made in this questionnaire, we quantify the satisfaction of users and obtain approximate social cost .

6.4. Market-based Complementary Model Under Cost Constraints

6.4.1. About Yin and Yang

In ancient times, Chinese philosophers consider the whole world as "one", which consists of black and white. Black and white are two complementary composition. Tai Chi diagram contains these two elements. It conveys that the rotation of white and black is the origin of changes. Tai Chi diagram shows people a profound beauty of mathematics

6.4.2. The Model Construction

The market-oriented complementary model with cost limitations can be illustrated by Tai Chi diagram.

We know that the cost of charging will change within a specific range.

Therefore, the amount of personal fees and government payments is certain.

The more individual pays, the less government will government undertake. (See figure 8)

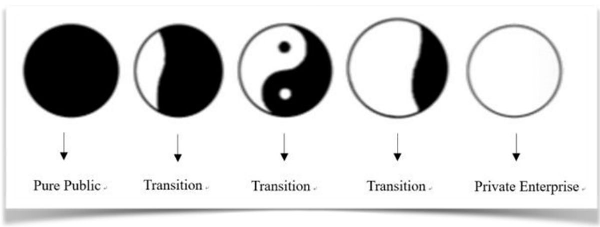

Figure 8.Change in payment subject

Therefore, we take the amount of charging piles P as one circle. We consider personal fee P_1 as the white part in the circle. Besides, we take government subsidies and social donations as the black part P_2 in the circle. The changes in white part and the changes in black part can interconvert. We can conclude that:$P = P_1 + P_2$

6.4.3. To Solve the Model

To deal with our model, we need to ensure that charging devices are quasipublic goods because quasi-public products are non-competitive. Once these products are supplied, the extra cost that consumed by others is zero. In addition, the consumption of quasi-public goods are non-exclusive. It means it is impossible to prevent others who are willing to purchase these products from buying them.

Therefore, charging services are not quasi-product goods because they are competitive. Also, the cost of exclusive charging services are low. Based on these reasons we provide above, we state that although charging devices are always provided by public, they are private products.

In this case, we illustrate that the expenses which are created by using public charging devices public should be took by both government and consumers. Besides, how much the government pay depends on the how many social benefits created in different public places.

In essence, the analyzation of social benefits are social evaluation. We use profit public places to quantify the social benefits, which are brought by charging devices. Big charging devices are profitable, such as the charging piles of electric vehicles. However, small charging devices have two types. One is profitable, and the other is non-profitable. What is more, based on the average Engel's Coefficient of cities where have charging piles, we can judge the average economic situation of consumers. We use experts' advice to reasonably allocate the cost which should be took by governments and consumers. (See figure 9)

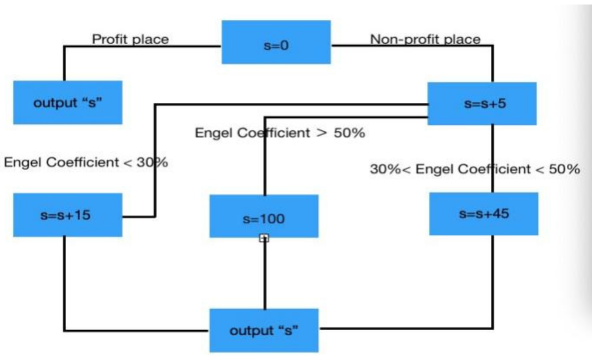

Figure 9.Judgment of social benefits

Based on the different output (computer program is in appendix) and experts' advice, we get the relationship between government borne costs and personal expenses: (See figure 10)

$$\begin{cases} P = p_1 & (s=0) \\ P = 2p_1 = 2p_2 & (s=20) \\ P = \dfrac{10}{3}p_1 = \dfrac{10}{7}p_2 & (s=50) \\ P = p_2 & (s=100) \end{cases}$$

Figure 10.Relationship between government borne costs and personal expenses

7. Application of Cost Model in Different Public Places

7.1. The Improvement of Charging Devices Model

For small charging devices, the applications of moveable charging devices and fixed charging devices have great difference in every public places.

We find that, there are many existing factors, which will affect the selection of charging devices in different public places. We use T_W to present the attendant time of staff every day on average. In different public places, people have different requirements of charging devices. We use r_p to present the ratio of using charging

devices in public places and use f_v to indicate the flow of people.

$$C = d_3 \frac{r_p f_v}{T_W} \tag{5}$$

It can be easily concluded that the economic cost of charging piles *c* and the maintenances cost of charging devices P_2 are positively correlated to these factors. C_e and T_W are in direct ratio. Equipment cost P_1 and f_v can be concluded as:

$$\begin{cases} P_1 = d_1 f_v & (6) \\ P_2 = r_p f_v \dfrac{k_2 Q_s T}{300} & (7) \\ P = P_1 + P_2 + P_3 + r_p f_v \dfrac{k_2 Q_s T}{300} + \dfrac{k_1 T}{30} & (8) \end{cases}$$

7.1.2. To Solve the Model

Do the simulation of this model to get the results under different situations

7.1.2.1. As to electric cars

1. In airports and train stations, people do not take cars as main transportation tools normally. The flow of people is big and the time people stay in is short on average in these places. Therefore, we estimate the value of r_p is 0.1, *T* as

1.5 hour, f_v is about five million people, and *C* is 250000. We put this data into the model, and get $d \approx 833$.

2. In non-transportation places, such as shopping malls and schools, the flow of people is relatively big. And the time people stay in is relatively long. Besides, people will mainly choose cars as traffic tools. Taking shopping market as an ideal instance, we estimate the value of r_p is 0.5, *T* is eight hours, f_v is about two million, and *C* is 500000. We can conclude that: $d \approx 4000$.

7.1.2.2. As to sharing power banks

According to our market survey, we can get the hourly rent $Q_p = 2$, monthly rent k_1 =1500 . And the maintenances cost of each power bank k_2 is 1.5 dollars per

1. In places, such as airports, train stations and shopping centres where have high frequency of using mobile phones, the flow of people f_v Is big. So people have great demands of sharing power banks r_p and T_W is small. Take shopping markets as typical examples. We estimate the value of r_p is 0.7 , T_W is 6 hours, f_v is about two million, and P is 25000. We get: $d_1 = 123.08$

2. In places, such as café and schools where have low frequency of using mobile phones. People have small demand*s* r_p of using sharing chargers. Besides, the flow of people f_v and T_W is relatively small. Take big café as an ideal instance, we estimate the value of f_v is 0.2, T_W is 2 hours, the flow of people f_v is one million, and *P* is 1000. We can get: $d_1 = 899.976$

8. MODEL OPTIMIZATION

8.1. Symbol Description

See figure 11:

Symbols	Definition	Symbols	Definition
I_{ad}	Advertising revenue	T_w	User waiting time for charging
F_{cp}	Cash pledge	T_i	User's actual charging time
M_{ah}	Deduct the deposit amount every hour for more than two hours	T_{ic}	Time required for electric vehicle charging
P_m	AC slow charging power	T_j	User waiting time for charging
P_k	DC fast charging power	T_{icm}	Charging time of electric vehicle with slow charging
T_s	Users spend more than two hours in a single use	T_{ick}	Charging time of electric vehicle using fast charging
n_{sy}	User timeout		

Figure 11.Symbol Description

8.2. Measures to Decrease the Cost of Charging Devices

1. Establishing space for advertisements in charging piles. It can attract companies to buy space and advert their products. By doing this, public places can earn a certain amount of money. It helps to reduce cost.

2. Building deposit system: users must pay a certain amount of money before using charging devices. Once users want to have more time to charge, systems will reduce a certain amount of money from rent automatically.

3. Improving charging devices can develop users' satisfaction. More time consumers charge, less social cost will be.

8.3. The Adjustment of Economic Cost

Through all the analyzation, we can deduct advertising revenue and the repaired compensation of users for long time use of charging devices from original economic cost. From this, we get:

$$C = Cic + Cmc + Ce + Cemp - Iad - Ts \times nsy \quad (9)$$

8.4. The Adjustment of Social Cost

8.4.1. The Lack of the Model

Likert scale has possibility to be interfered and distorted by some factors. Tested person will avoid choosing extreme options because they have the tendency to middle. Meanwhile, Consumers who have inertia deviation and social approval deviation will lead them to choose other options, which are different from their actual feelings. Therefore, to understand users' satisfaction accurately, we extract factors, which affect satisfaction, in various places.

8.4.2. The Construction of Model T_i

Social benefits can reflect the satisfactions of consumers. Fees took by individuals should be considered in each situation. For the satisfaction of electric vehicle charging piles i_1 in various places. r_{sc} represents as the cover ratio of charging piles and T_i represents time of waiting. For the satisfaction of small charging devices i_2 in profit public places, r_{sp} represents cover ratio and $p_y$represents rent. For the satisfaction of small charging devices i_3 in non-profit places, r_{sj} represents cover ratio.

Towards these three situations, the evaluation of measuring satisfaction will change, but we can adjust it by adding i .

According to the market investigation and empirical law, we find that consumers' satisfaction is positively correlated to the cover ratio. Besides, it is negatively correlated to waiting time and rent. We use An to represent weight. With the suggestions of experts, we can conclude the relationship as:

$$\begin{cases} i_1 = i + a_1 p_1^2 + a_2 p_1 + a_3 \dfrac{1}{r_{sc}} + a_4 T_i & (10) \\ i_2 = i + a_5 p_1 + a_6 \dfrac{1}{r_{sp}} + a_7 \sqrt{P_y} & (11) \\ i_3 = i + a_8 p_1 + a_9 \dfrac{1}{r_{sp}} & (12) \end{cases}$$

8.5. Further Improvement of Satisfaction as Big Charging Devices

The requirements of charging time for electric cars users is divided into two situations to discuss:

1. When users arrive at the charging station and the charging devices are not occupied, at this time, users' waiting time T_j can be neglected. We can consider actual charging time T_i as charging time T_{ic}. The formula is: $T_i = T_{ic}$

2. When users arrive at the charging station and the charging devices are occupied, at this time, actual charging time T_{ic} is equal to the sum of charging time T_{ic} and waiting timeT_j . The formula is: $T_i = T_{ic} + T_j$

We can reduce consumers' waiting time by changing the power of charging piles. In this case, we can develop the satisfaction of consumers.

By doing market investigation, we find that there are two kinds of charging stations in the market. The one is slow AC, and the other is quick DC. The power of slow AC is P_m, and the power of quick DC is P_k

We get the time using slow AC by calculating consumers: $T_{icm} = \frac{c_{bc}}{P_k}$

The time using quick DC: $T_{ick} = \frac{c_{bc}}{P_m}$

By using this model, we can describe the level of satisfaction accurately and its reflected social benefits.

9. EVALUATION AND EXTENSION OF THE MODEL

9.1. Model Evaluation

The strength of the cost model are mainly three parts: 1. This model use data from the United States, which makes it widely used in there. 2. It inhibits the phenomenon of arbitrary charges. 3. This model uses accurate data and makes it has great value in application. The Weakness of the cost model are: 1. This model only considers the most common public places. It cannot be applied in cities, which have complex residential structure and security. 2. The model applies a part of accurate data. Other data is not accurate enough.

The strength of the market-based complementary model under cost constraint are: 1. This model ensures the method about how to distribute ratio in market-based society. 2. This model is simple and makes readers easily understand. And the weakness of this model is that the benefits of society are complex. Hence, non-quantitative feature makes government difficult to calculate money accurately.

9.2. The Promotion of Model

In this paper, the single-objective mathematical model can be used to predict the energy cost of charging devices in public places. Also, it can be applied in the prediction of energy cost in other subjects by revising.

10. Conclusion

We are living in an electrical world. Every day we are using electrical devices, such as mobile phones and computers, etc. To be convenient, many public places provide residents charge points, including sockets, charging piles, and sharing power banks. Those public places have two types. One is non-profit business and the other is profit business. With the development of technology, mobile phones are becoming widespread. In this case, the requirement of charging points is increasing. It means the supply of electricity will augment in the future. According to it, my group take the cost of installing equipment into consideration. Therefore, we analyze this question and give some suggestions.

Scientists are inventing new techniques to improve the quality of wireless systems. Recently, the 5th generation mobile networks is invented. The aim of 5th- Generation is to reduce energy and delay, which can make users more satisfied. Also, it is able to simultaneously deal with more tasks than ever before, which leads to the requirement of quicker operation systems. Therefore, electricity consumption will hugely increase to achieve this goal.

Additionally, most people need to charge many times one day to satisfy their daily demands. Hence, many places provide sharing power banks to people. Power banks have two types. One is desktop power supply, the other is charging device cabinet. Normally, consumers can use desktop power freely. Charging device cabinets always appear in shopping markets. Consumers need to pay rent

to use these chargers. We find that the rent is not enough for running this program because these devices need to be repaired in a regular time. To address this question, we find that there are three methods to pay for the extra electricity fees. Firstly, advertisements can be displayed in touch screens in cabinets. Secondly, advertisements can be posted in each chargers. Thirdly, some enterprises can design their advertisements themselves. Besides, we suggest setting up award and penalty. If someone return the power bank in time, his or her credit points will be added. However, if someone does not return the power bank on time, the rent will not be returned. In non-profit places, people can get free charge in the first hour. After the first hour, power banks can be rent by the hour.

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