Scholar Publishing Group
Academic Journal of Energy
https://doi.org/10.38007/RE.2022.030207
ISSN 2790-2714 Vol. 3, Issue 2: 57-65

The Current Situation and Development of Electric Vehicle Energy Supply Facilities Construction Based on Structural Changes

Rasan Sadia *

Dhurakij Pundit University, Thailand

**corresponding author*

Keywords: Structural Changes, Electric Vehicles, Energy Supply Facilities, Ac Charging Piles

Abstract: With the development of the economy, the number of automobiles in our country has grown steadily. The development of the automobile industry has increased people's consumption of fuel, and at the same time, the energy crisis and environmental pollution have also increased. Electricity is a clean energy, and new energy vehicles, especially clean electric vehicles, are an environmentally friendly future option. This paper aims to study the current situation and development of electric vehicle energy supply facilities construction based on structural changes . This paper analyzes the current situation of China's energy supply structure. On the basis of defining the concepts of energy supply structure and low carbonization, the present situation of China's energy resource endowment and supply structure is analyzed, and the problems existing in China's energy supply structure are discussed in depth . This paper summarizes the development status of electric vehicle power supply mode at home and abroad, and combines the practical application of domestic electric vehicle power supply mode, using SWOT analysis, demand analysis, consumer behavior theory and business gap analysis and demonstration. Through the analysis of the advantages and disadvantages, advantages and threats of the development of electric vehicles, people pay attention to the economy and practicability of using electric vehicles, and the three power supply methods have adopted the whole-vehicle electrification method. Research and compare the charging operation mode, conventional charging mode and mechanical charging mode, and finally propose a business model that conforms to the development of the industry according to the actual situation in my country. Experiments have proved that the effective utilization rate of the distribution of energy supply facilities simulated in this paper can reach more than 95%, and after the structural changes in this paper, the carbon emissions will change from the original estimated 35 billion tons to the current one in the next 20 years. 18 billion tons or so.

1. Introduction

With the concept and development of a low-carbon economy, it has become a global consensus to transform the development mode and realize energy conservation and emission reduction. The rapid development of my country's economy has led to a continuous increase in energy consumption. At the same time, the increase in energy consumption has also led to many problems such as resource scarcity, environmental pollution, and ecological degradation. my country's energy system, especially the power supply system, is dominated by coal, and the large-scale use of coal is one of the main factors that cause a large amount of carbon dioxide emissions. With my country's economic development entering a new normal and the requirements of "energy cycle" and "supply-side adjustment", the electricity-based energy supply system will inevitably face adjustments, creating a new energy system and creating a clean, safe and efficient modern energy system closely linked [1-2].

In the research on the construction status and development of electric vehicle energy supply facilities based on structural changes , many scholars have studied them and achieved good results. For example : Kulbyakina AV uses extraction analysis to study the relationship between energy consumption structure and economic growth. The research results show that economic growth affects the energy consumption structure to a certain extent [3]. Salarifard A plans to promote a business model for leasing batteries, which differentiates electric vehicles from batteries, where batteries are only rented and not sold [4].

This paper analyzes the current situation of China's energy supply structure. On the basis of defining the concepts of energy supply structure and low carbonization, the present situation of China's energy resource endowment and supply structure is analyzed, and the problems existing in China's energy supply structure are discussed in depth. This paper summarizes the development status of electric vehicle power supply mode at home and abroad, and combines the practical application of domestic electric vehicle power supply mode, using SWOT analysis, demand analysis, consumer behavior theory and business gap analysis and demonstration. Through the analysis of the advantages and disadvantages, advantages and threats of the development of electric vehicles, people pay attention to the economy and practicability of using electric vehicles, and the three power supply methods have adopted the whole-vehicle electrification method. Research and compare the charging operation mode, conventional charging mode and mechanical charging mode, and finally propose a business model that conforms to the development of the industry according to the actual situation in my country.

2. Research on the Current Situation and Development of Electric Vehicle Energy Supply Facilities Construction Based on Structural Changes

2.1 Analysis of Development Stages of China's Pure Electric Vehicle Energy Supply

The development of pure electric vehicles in China can be divided into two stages: demonstration application period and promotion maturity period.

The development of electric vehicles is inseparable from the use of electricity, and the energy supply mode of this electric energy is closely related to the development of electric vehicles. Broadly speaking, the energy supply mode includes the charging infrastructure, power supply network, and service enterprises that operate charging. It consists of multiple parts such as suppliers of batteries. The energy supply model not only refers to the conversion of the alternating current power obtained from the national grid into the chemical energy of electric vehicles through the substation charging system, but also how to deliver the power to the users with high efficiency and low cost. The research on this business model is more than technical. How to realize charging has more practical significance for the promotion of electric vehicles [5-6].

In the two development stages of electric vehicles, the energy supply mode will have different characteristics.

In the demonstration application stage, the service targets are mainly grouped public service vehicles, such as centralized vehicles for large venues, public events, and tourist attractions, cleaning vehicles for sanitation departments, and taxis in demonstration cities. The energy supply modes of normal charging, fast charging, and battery replacement can be used intensively. Electricity comes from a wired supply from the grid, or flexible means such as night-time charging are available. The public charging infrastructure is gradually improved, and the needs of personal charging are gradually solved in a point-to-point manner. The public facilities are not for profit, but are aimed at cultivating customers' usage habits and willingness.

In the mature stage of promotion, electric passenger vehicles for personal use have become the focus of electric vehicle development. Providing high-quality, convenient and cheap power supply services has become the focus of this stage, and the self-management of charging facilities is also an important aspect to be considered. The advanced charging network will take advantage of its scale effect, adopt advanced Internet technology and information technology, use valley electricity, centralized procurement, and technical cooperation will effectively reduce the price of batteries and electricity, improve services, and ultimately make electric vehicles no matter from In terms of practicality or economy, it surpasses traditional cars in an all-round way, making electric cars enter thousands of households.

At present, my country is still in the stage of demonstration and application to the mature stage of promotion, and no mature energy supply model has surfaced and entered into actual commercial operation. Therefore, it is practical to study the energy supply model and transform it into a feasible business model at this time. The guiding significance [7-8].

2.2 Supply Mode of New Energy Electric Vehicles

(1) Plug-in hybrid

Compared with pure electric vehicles, plug-in hybrids use a small battery pack to ensure smooth urban traffic, because the internal combustion engine can also be used for long distances, reducing users' anxiety about low battery power during use. It has better performance because it can continuously output electricity and has both an electric motor and an internal combustion engine. A plug-in hybrid has a small battery capacity and limited charging time, so users can charge the car with a home battery.

(2) Hydrogen fuel cell

There is no problem of battery life and recharging of energy. No endurance anxiety. There is no need for consumers to change their car habits. Because the hydrogen fuel cell is closer to the traditional battery, the performance is basically the same as that of the pure electric vehicle, and there is no problem in the life cost of the pure electric vehicle due to the cumbersome battery pack. And the emissions are close to zero and can be ignored. Hydrogen can be extracted through a variety of fossil energy sources, so there are many sources of hydrogen. The main problem at present is that the extraction technology of hydrogen is not mature enough. The infrastructure construction is slow, and the promotion resistance is great.

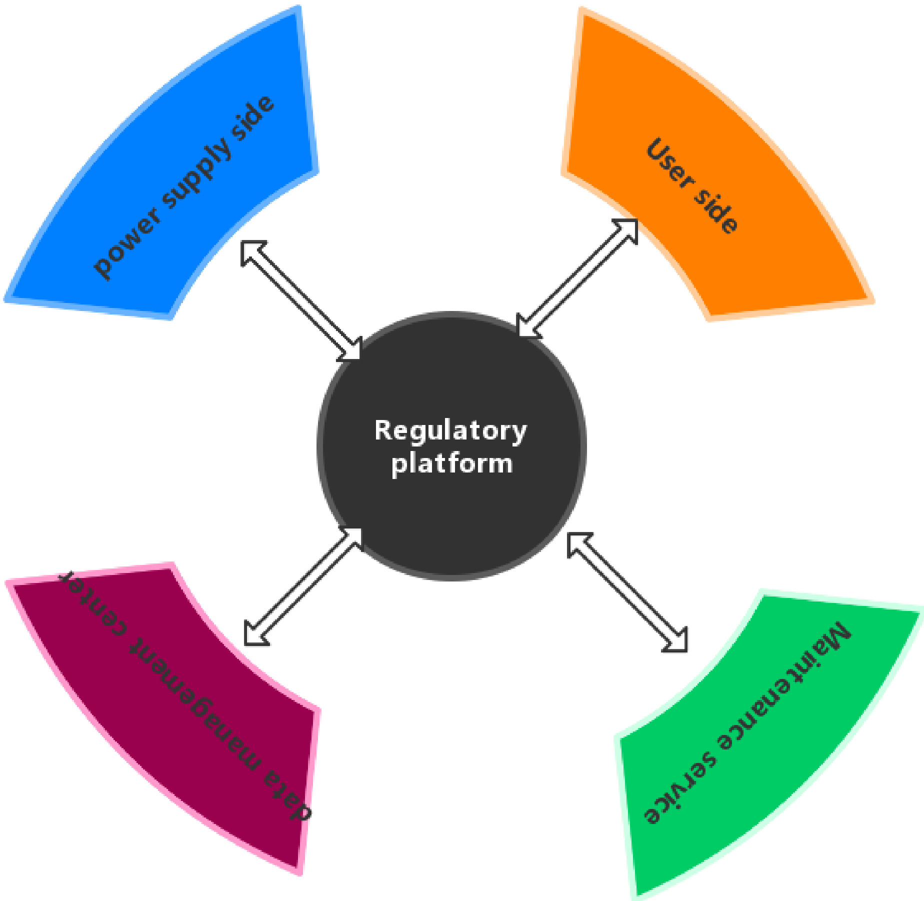

Figure 1. New energy supply mode of electric vehicles

2.3 Construction of an Evaluation Model For the Role of Energy Supply Structural Factors

The subjective evaluation method is a method in which experts assign subjective scores to each attribute based on experience. This method realizes the transformation from qualitative to quantitative, but the evaluation results rely too much on the subjective judgment of people, which are significantly affected by subjective factors and are more random. big. The objective evaluation method is to analyze the objective information of the evaluation object data itself. It is a method of assigning weights by establishing a mathematical model. The evaluation results are more objective, but the importance of expert experience in determining the weight coefficient is ignored, and the evaluation results are subject to indicators. The effect of sample random error. There are often inconsistencies in the evaluation scores and rankings obtained by calculating the same evaluation object using a single weighting method, and the differences between the evaluation objects are not large, which cannot well reflect the differences between the evaluation objects. Therefore, this chapter applies the optimal combination weighting method, combines the subjective evaluation method and the objective evaluation method, fully highlights the differences between the evaluation objects, and adjusts the weights of the evaluation objects reasonably, making the evaluation results more scientific and reasonable. The specific construction ideas are as follows [9-10] :

(1) Standardize the data on the factors affecting the low carbonization of the energy supply structure;

(2) Four single weighting methods, Gl method, G2 method, entropy method and dispersion maximization method, are used respectively to give the corresponding weights to each index;

(3) Calculate the weight coefficients of the four single weighting methods of G1 method, G2 method, entropy method and dispersion maximization method, and obtain the combined weight of the evaluation object;

(4) Evaluate and analyze the influencing factors of low-carbon energy supply structure.

Normalization of positive indicators

Let x ij represent the normalized value of the j-th index of the ith object; v ij represent the value of the j-th index of the ith object; n represent the number of evaluated objects. According to the positive scoring formula:

$$x_{ij} = \frac{v_{ij} - \min\limits_{1 \le i \le n}(v_{ij})}{\max\limits_{1 \le i \le n}(v_{ij}) - \min\limits_{1 \le i \le n}(v_{ij})} \quad (1)$$

The meaning of formula (1) is the relative distance between the difference between the jth index value and the minimum value relative to the difference between the maximum value and the minimum value. The larger the difference is, the higher the normalized value is [11-12] .

Normalization of Inverse Indicators

According to the scoring formula of the inverse indicator:

$$x_{ij} = \frac{\max\limits_{1 \le i \le n}(v_{ij}) - v_{ij}}{\max\limits_{1 \le i \le n}(v_{ij}) - \min\limits_{1 \le i \le n}(v_{ij})} \quad (2)$$

3. Discussion and Design Experiment of the Current Situation and Development of Electric Vehicle Energy Supply Facilities Construction Based on Structural Changes

3.1 ARIMA Model Construction

ARIMA models treat data patterns created by forecasting over time as discrete patterns and use a specific mathematical model to approximate the series. Once a model is defined, it is possible to predict future chronological order based on past and present values. The ARIMA(p,d,q) model consists of three processes: the autoregressive process AR(p), the moving average process MA(q), and the process I(d).

3.2 Experimental Design

This paper conducts experimental analysis on the construction and development model of new energy supply facilities constructed in this paper, first of all, it discusses the effective utilization rate of supply facilities, and the effective utilization rate of simulated facilities in the simulation scenario constructed in this paper and the effective utilization of realistic traditional The effectiveness of the model constructed in this paper is analyzed. Secondly, it analyzes the process of supply-side reform and changes, and discusses the future development of energy supply facilities .

4. Experimental Analysis on the Construction Status and Development of Electric Vehicle Energy Supply Facilities Based on Structural Changes

4.1 Effectiveness of Energy Supply Facilities

This paper relies on the construction scheme of energy supply facilities constructed in this paper to simulate the use of energy supply facilities, simulate the use of energy supply facilities according to the daily flow of people, and compare the effectiveness changes in time with the distribution of traditional energy supply facilities. The experimental data are shown in Table 1. Show.

Table 1. Comparison of the distribution and effective utilization rate of energy supply facilities and traditional supply facilities

	1	2	3	4	5
Distribution of traditional facilities	22	27	31	40	40
This paper distributes facilities	25	47	82	89	96

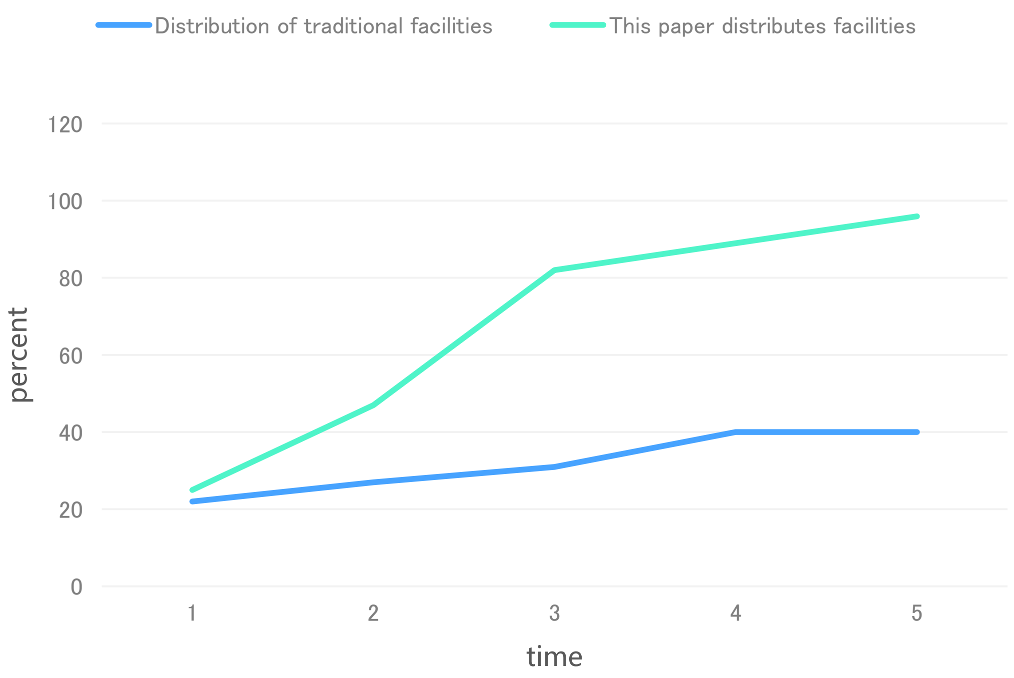

Figure 2. Comparison of efficient changes in the two distribution modes

It can be seen from Figure 2 that at the beginning, the difference between the effective utilization rates of the two is small, but with the increase of time, the difference between the utilization rates of the two is getting bigger and bigger, and the effective utilization of the traditional distributed energy supply facilities The rate of energy supply is only about 40%, and the distribution method of this paper can make the effective utilization rate of energy supply facilities reach more than 95%.

4.2 Carbon Emission Optimization Results

This paper simulates and analyzes the impact of structural reform on carbon emissions in this paper, and compares the carbon emissions and emissions predictions based on inertial carbon emissions changes and the optimization of the energy structure through structural reforms. The experimental data are shown in Table 2. .

Table 2. Optimization results of carbon dioxide emissions

	2000	2010	2020	2030	2040
Inertial results	52	130	200	300	350
Optimize the results	52	130	150	170	180

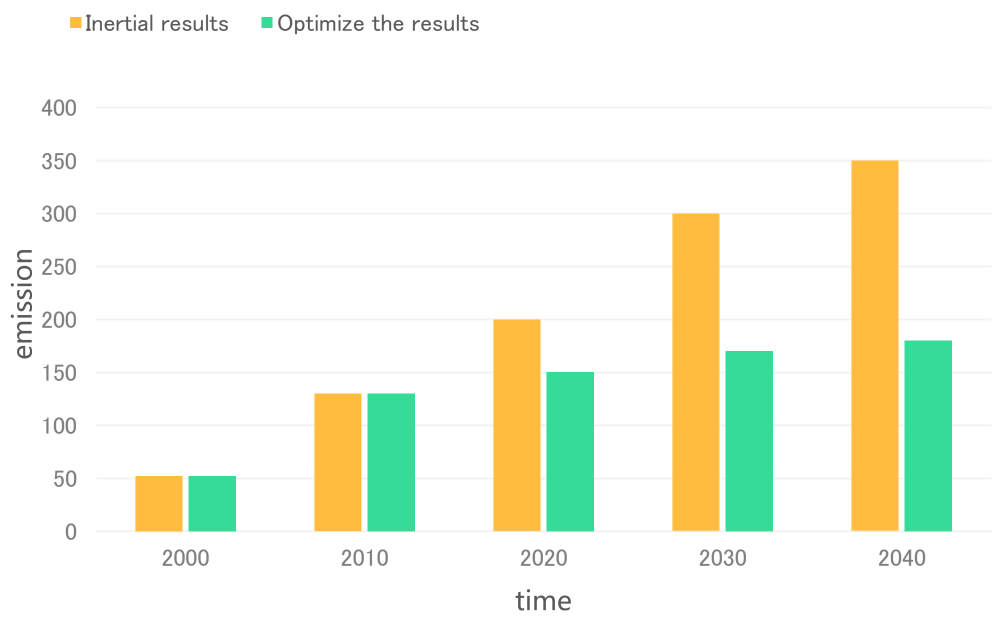

Figure 3. Optimization results of carbon emission emission through structural reform

As can be seen from Figure 3, through the reform of the energy structure in this paper, in the next 20 years, carbon emissions will be greatly reduced, from the originally estimated 35.1 billion tons to about 18 billion tons. Greatly delaying the development of the greenhouse effect and optimizing the energy structure.

5. Conclusions

Through systematic theoretical analysis and reasoning demonstration, this paper concludes that the business model of mechanical charging, that is, battery swapping, has the most potential for development. It provides the possibility for people to use the means of transportation economically, is the best choice for the energy supply mode of pure electric vehicles, and is the fundamental guarantee for the rapid and healthy development of pure electric vehicles. In this system, the industrial layout will undergo earth-shaking changes. The electric vehicle industry will consist of three pillars of auto companies, battery swap networks, and battery suppliers, just like the relationship between telecom operators, telecom equipment vendors, and mobile phone manufacturers. Among them, the battery swap network plays an important role. The battery swap network not only provides energy supply for the user's electric vehicle by quickly replacing the battery, but also undertakes the charging and maintenance work after the battery is replaced. Good maintenance will greatly extend the battery life and further reduce the depreciation cost of the battery. While reducing the battery consumption of the battery swap network, the advantages of centralized management will eventually be reflected in the customer's vehicle cost. The battery swap network can use its dominant position in large-scale centralized procurement of batteries to establish greater bargaining power, reduce battery purchase prices, and work closely with battery suppliers to recycle retired batteries and further reduce battery usage costs .

References

[1] Balzamov D S , Akhmetova I G , Balzamova E Y , et al. Options for organizing own sources of energy supply at the facilities of generating companies based on steam screw machines. Journal of Physics: Conference Series, 2019, 1399(5):055018 (6pp).

[2] Konusarov V A , Shutov E A , Turukina T E . Grounding Systems for Power Supply Facilities. Energy and Power Engineering, 2019. https://doi.org/10.4236/epe.2019.111001

[3] Kulbyakina A V , Ozerov N A , Batrakov P A , et al. Efficiency improvement of oil and gas facilities power supply systems. Journal of Physics Conference Series, 2021, 1791(1):012016. https://doi.org/10.1088/1742-6596/1791/1/012016

[4] Salarifard A . Everything You Need To Know About Data Centers Or Mission Critical Facilities. Engineered systems, 2019, 36(5):32-32,34,36.

[5] Biryukov A , Dobryshkin E , Yu B , et al. Complex method for restoring the energy facilities technical condition in the Arctic. IOP Conference Series: Earth and Environmental Science, 2020, 539(1):012149 (7pp).

[6] Popov N N , Khvostov A A , Kalach A V , et al. Improving the efficiency of heat supply systems for infrastructure facilities by optimizing the pipeline subsystem according to technical and economic indicators. Journal of Physics: Conference Series, 2021, 1902(1):012082-.

[7] Kesidou S , Sovacool B K . Supply chain integration for low-carbon buildings: A critical interdisciplinary review. Renewable & Sustainable Energy Reviews, 2019, 113(Oct.):109274.1-109274.15. https://doi.org/10.1016/j.rser.2019.109274

[8] Ivanova I Y , Khalgaeva N A . Validation of the efficiency of using solar energy resources

for autonomous power supply of the trans-border area between Russia and Mongolia. IOP Conference Series: Earth and Environmental Science, 2021, 629(1):012020 (8pp).
[9] Buerger A , Bohlayer M , Hoffmann S , et al. A whole-year simulation study on nonlinear mixed-integer model predictive control for a thermal energy supply system with multi-use components. Applied Energy, 2020, 258(Jan.15):114064.1-114064.14. https://doi.org/10.1016/j.apenergy.2019.114064
[10] Yu S P , Khadikov M K , Zorina I Y , et al. Increasing the efficiency of using renewable energy sources for energy supply of autonomous highland objects. IOP Conference Series: Materials Science and Engineering, 2019, 663(1):012045 (4pp).
[11] Gibadullin A A , Yu V E , Polyakov A E , et al. Monitoring the technical and technological state of electric power complex facilities. IOP Conference Series: Materials Science and Engineering, 2020, 862(2):022050 (6pp). https://doi.org/10.1088/1757-899X/862/2/022050
[12] Osintsev K V . Using the organic Rankine cycle for heat supply of greenhouses at agricultural enterprises. IOP Conference Series: Materials Science and Engineering, 2020, 941(1):012056 (4pp).
[13] Mahzouni A . The institutional challenges of scaling-up housing retrofit: the Swiss cities of Basel and Sion. Facilities, 2019, 37(11-12):780-798. https://doi.org/10.1108/F-02-2017-0025
[14] Vazifeh Z , Mafakheri F , An C . Biomass supply chain coordination for remote communities: A game-theoretic modeling and analysis approach. Sustainable Cities and Society, 2021, 69(2):102819. https://doi.org/10.1016/j.scs.2021.102819
[15] Dmitriev A A , Gerasimov V E . To the issue of complex increasing energy efficiency of electric receivers of oil and gas fields. IOP Conference Series: Earth and Environmental Science, 2020, 421(7):072009 (5pp).
[16] P Juan-García, Rieger L , Darch G , et al. A framework for model-based assessment of resilience in Water Resource Recovery Facilities against power outage. Water Research, 2021, 202(23):117459. https://doi.org/10.1016/j.watres.2021.117459
[17] Ahamad N , Su C L , Xiao Z , et al. Energy Harvesting From Harbor Cranes With Flywheel Energy Storage Systems. IEEE Transactions on Industry Applications, 2019, PP(4):1-1. https://doi.org/10.1109/TIA.2019.2910495
[18] Khismatullin A S , Bashirov M G . Methods of improving the power supply reliability of industrial site. IOP Conference Series: Materials Science and Engineering, 2021, 1155(1):012067 (5pp). https://doi.org/10.1088/1757-899X/1155/1/012067