Digital Green Certificate Generation And Trading System Based on Internet of Vehicles Platform

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Abstract. In February 2017, various new energy power generation enterprises and power users have attracted wide attention, after the issuance of the green power certificate and the issuance of the trial notice of voluntary subscription system. This paper makes a detailed investigation and analysis of the research status of green energy certificate trading at home and abroad. Then, based on the status quo of the company's Internet of Vehicles platform, green certificate generation and transaction architecture, transaction subject and transaction process are designed. Finally, based on the above basis, five green certificate trading business models, namely, trading platform mode, energy storage system mode, demand side management service mode, new business mode of electric vehicles and energy big data information service mode, are designed and analyzed.

1. Introduction
The green certificate system was created in the 1990s when Texas and other states in the United States implemented the renewable energy quota system. Then Denmark, the Netherlands, the United Kingdom, Australia and other countries also implemented the green certificate system. Up to now, about 20 countries around the world have implemented the green certificate system.

After the issuance of green power certificate and voluntary subscription system trial notice in February 2017, China has attracted extensive attention from new energy power generation enterprises and power users. At present, China's green certificates are still in the stage of voluntary subscription, and the mandatory renewable energy quota system has not been implemented yet. In addition, domestic scholars have conducted a systematic study on green certificates.

One is the research on price mechanism of green power certificate. Second is the implementation effect evaluation of policy. The third is the establishment of green certificate trading recommendations.
Domestic scholars mainly studied the price mechanism, performance evaluation and trading mechanism of green power certificate. However, in the context of the issuance of green power certificates for renewable energy and the formal implementation of the voluntary subscription trading system in China, there are few studies on the generation and trading system of green certificates. The research on the generation and trading system of digital green certificates based on the Internet of vehicles platform has important theoretical and practical significance.

2. Green certificate generation and trading system based on Internet of vehicles platform

2.1 Green certificate generation design based on block chain technology

Blockchain technology based on the Internet of vehicles platform can provide a completely decentralized energy system and is the basis of providing measurement, billing and settlement processes. Through the application of block chain technology, data collection, green certificate generation, green certificate encryption and transmission, charging and discharging control of charging piles are realized by energy router. Its structure is shown in figure 1.

Green certificate area nodes are built based on the regional distribution of charging piles. One or more nodes can be built according to the actual project needs. Each node directly manages a batch of charging piles, and each regional center node writes data synchronously into the block chain and application system.

2.2 Green certificate generation design based on block chain technology

Based on the Internet of vehicles platform, we analyze access to distributed new energy, energy storage facilities, charging piles and other economic entities; Analyze the generation and supervision mode of green certificates; Create the appropriate green certificate generation method in different operating scenarios. We study the circulation value and transaction mode of green certificate transactions on the platform, and establish a green certificate transaction system of green certificate generation, certification, transfer, deduction, transaction, discount and other transaction modes.

Therefore, it is necessary to establish incentive compatible transaction objectives. For power generators, a real-time subsidy mechanism for green energy should be established to raise the electricity price (more than or equal to the fixed subsidy level) and/or the electricity fee income; As for the buyer, we should construct a profit mechanism with spiritual incentive for the buyer.
2.2.1 Transaction subject and process of green certificate. The subjectivity characteristics of green certificates, the participants of green certificates include the generating subjects, clearing subjects, general trading subjects and clearing centers, etc. Its transaction process is shown in the figure 2.

![Green certificate transaction flow](image)

Figure 2. Green certificate transaction flow

2.2.2 Green certificate trading mode. The trading mode of Green certificate may include negotiation trading mode and market trading mode. Negotiation transaction mode refers to the negotiation between two (or more) parties to determine the quantity and price of green certificate transactions. In this mode, the number of green certificate transactions in a certain period is basically fixed. Market transaction mode refers to the formation of green certificate transaction through the free participation of green certificate subjects of both parties (or multiple parties) in the transaction market of Internet of vehicles platform. Due to the high randomness of market trading results, green certificate trading has great uncertainty.

Negotiation trading mode mainly includes two trading mechanisms: fixed green certificate quantity trading and temporary adjustment trading. Among them, the fixed number of green certificates agreed by both parties through negotiation in advance is the main component of the actual trading volume of the platform, while temporary regulatory green certificate trading only accounts for a small part. Market transaction mode refers to the formation of green certificate transaction through the free participation of green certificate subjects of both parties (or multiple parties) in the transaction market of Internet of vehicles platform. Due to the high randomness of market trading results, green certificate trading has great uncertainty.

3. Business model design of green certificate
The premise of the green certificate market model is to transfer part of the use value of renewable energy power commodities to the green certificate. We will establish a green certificate generation and certification mechanism related to green energy production; We will promote the establishment of a mandatory quota system for green energy production, develop a green certificate trading and settlement model based on Internet platforms, and realize securitization and financialization of green certificates. We will explore ways to integrate the establishment of a green certificate trading system with existing carbon trading and emissions trading. Specifically, green certificate trading has three characteristics: first, the outstanding financial attribute of green certificate transaction; Second, the green certificate trading price volatility and difference; Third, green certificate trading is closely related to electricity and other energy trading.
### 3.1 Transaction platform mode

As an energy network platform providing information interaction for buyers and sellers, it does not participate in the transactions between buyers and sellers, but gives the option to both buyers and sellers. It adheres to the platform strategy and attracts many partners, including power generation enterprises, distributed energy service providers, auxiliary service providers and other partners.

1) In the early stage of business, it adopts the strategy of free to attract customers, quickly establish brands and gather customers, and adopts the strategy of "free" market penetration to meet the consumers' desire for low cost, so that the platform can quickly occupy the market.

2) Build a third-party payment platform to provide security for transactions. Through the implementation of real-name registration system for both buyers and sellers and the construction of third-party payment platform to reduce the perceived risk of payment for both buyers and sellers, the transaction security problems and user trust problems are solved. By replacing personal credit with third-party credit, the transaction is guaranteed to be completed.

3) Relying on its resource advantages, it enters the field of B2C (business-to-customer) and achieves transformation and development. Based on the massive users and traffic of the platform, the integration and sharing of various resources such as power generation providers, enterprises, data, logistics and payment have been fully realized.

There are three main profit models: profit from third-party payment platform, profit from advertising revenue and profit from value-added service charge.

### 3.2 Energy storage system mode

The current business model of energy storage system mainly includes "peak-valley spread", "paid auxiliary service for thermal power generation" and "independent auxiliary service".

- **Mode 1: combine with the user side**
- **Mode 2: combined with the power generation side**
- **Mode 3: independent mode**

**Figure 3. Energy storage system mode**

Under the influence of the current peak-valley time-sharing electricity price, the energy cost can be controlled by arranging the electricity consumption period. The energy storage power station stores energy in the low period of energy use and makes efforts in the peak period to obtain the yield of peak-valley spread. Considering the current market openness and mainstream applications, this paper focuses on the analysis of peak-valley spread model.

For the benefits of the user side, the tax revenue included in the spread income of the energy storage system is adopted to share the benefits with the user in the form of sharing. At the same time, through the investment in energy storage system, the user side can reduce the investment in new capacity, UPS investment, and reduce the monthly electricity cost of basic capacity.

### 3.3 Demand-side management service mode

Under the competitive market environment, power supply and demand show the characteristics of bilateral random fluctuations. In order to adapt to this new situation, it is necessary to implement the countermeasures of bilateral interaction between supply and demand, which is reflected in the demand side, namely, the service mode of implementing demand side management. To this end, on one hand, energy services are optimized, and on the other hand, energy diagnosis is provided.

By optimizing energy consumption service with the majorization of users' electricity consumption scheme, the quality service level can be effectively improved. Firstly, the load rate of power grid can be
effectively increased by reasonable adjustment of power consumption structure during peak and valley periods. Secondly, the active off-peak power consumption behavior of large power users can effectively reduce the line loss rate and ultimately reduce the power supply loss and cost. Finally, from the perspective of users, the implementation of measures such as the comprehensive optimization of electricity consumption time and the application of electricity price categories as required is carried out.

Power diagnosis service refers to the phenomenon of high power consumption but low efficiency or unreasonable distribution of peak power and valley power, etc., and provides users with comprehensive power consumption analysis and corresponding professional suggestions.

In the demand-side management service mode, it can slow down the investment and construction process of distribution network, cut down the operating costs of energy companies, cut down the users' electricity expenses, and promote the consumption of new energy in the region.

3.4 New service mode of electric vehicles

The service mode associated with electric vehicles needs to be combined to establish the following mechanisms:

(1) Establish charging service mechanism

The electric car operation management system based on Internet platform and the client APP, push in the range for electric vehicle charging stations at the provincial level/charging pile construction access standards, requirements of electric vehicle charging station/charging pile data uploaded to the platform, operation management system combined with real-time traffic information and status information of grid operation, to provide users with considering Shared co-ordinated charging guide service, through the APP for users to provide information, guide the wrong peak (rush hour/grid peak) charge.

(2) Establish P2P charging facility leasing mechanism

By publishing and searching information on the platform, the owner of charging facilities and ev users can realize the interaction and response between the supplier and the user, complete the short-term rental service of charging facilities, complete the transaction between the supplier and the user online, and the platform plays the role of rent commission supervision.

(3) Establish O2O mechanism for installation, operation and maintenance

Charging facilities operators have expanded their services to provide charging pile site selection, installation and maintenance services for ev users, and charged service fees.

(4) Establish extended service mechanism

On the one hand, APP is used as the advertising carrier of automobile related products to provide supporting services such as car washing and maintenance. Meanwhile, APP is also used as charging service settlement terminal to open up the purchase channel of funds, set up the bonus point mechanism and promote the emergence of online mall services. On the other hand, it can be considered to build an ecosystem integrating convenience stores, maintenance centers, restaurants, automobile experience stores, brand stores, multimedia movie halls and so on, with charging stations as the core.

3.5 Energy big data information service mode

The process framework of energy big data information service mainly includes four parts: multi-source heterogeneous data wide area information acquisition channel, information service content sorting and index system design, information service pattern design, and information product pricing mechanism.

(1) Multi-source heterogeneous data wide area information acquisition channels

The platform relies on big data and cloud computing technology to collect state information of equipment, including temperature, humidity, pressure, real-time monitoring and scheduling. Fully perceive the user's power load to ensure the accuracy and timeliness of power quality and demand response; And through the information physical system nodes to accept, process, fusion, forward data to other nodes, to achieve the overall process control system. (2) Information service architecture design and content sorting

According to the demand information of energy information service objects, different versions of information service content can be designed to better match the utility of users. Consider each version
of the information service content, search to get data from different subjects, will reflect the information content of several data summary information, comprehensive type for evaluation index data, then analyze the various indicators, the processing, the processing, to fully reflect the explanation content of the overall situation, to guide the user decision scientifically, improve the comprehensive benefit of users.

(3) Pattern design of information services
The design of energy big data information service mode can be divided into application service mode and consultation service mode. Application service mode reflects the flow of information between users and information service providers, which mainly includes three modes: user free search service mode, platform information publishing service mode, flexible interactive package customization and intelligent push service mode. The consulting service pattern defines how the information content is presented and it mainly includes three modes: intelligent consulting service mode, semi-intelligent consulting service mode and manual training service mode.

(4) Pricing mechanism of information products
The pricing of energy information products can refer to the market demand and competition of products, and the cost-plus method is adopted to cut into the product cost. Major costs of energy big data information service include: acquisition of energy big data and integration of energy big data information. By analyzing the main cost, the lower limit of the price of information service product can be determined. Then, considering the perceived value of customers, it designs personalized service mode of energy information service products, establishes differentiated information service mode according to different information communication modes, and finally determines the market price of information service products.

4. Summarizes
The key step to promote the development of green certificate trading is to effectively manage a series of issues such as the grade of certificate trading subject, certificate issuing, certificate ownership transfer, information disclosure, diversified development of renewable energy and dispute coordination. This will play a key role in the development of China's renewable energy in the future.

This paper mainly makes a detailed investigation and analysis of the research status of green energy certificate trading at home and abroad. Then, on the basis of the design in view of status quo of electric cars in China green credentials generated and transaction system architecture, main body, transaction process, according to the different business characteristics and demand information trading platform is designed, energy storage system, demand side management and service mode, service mode of electric cars, new forms and energy five big data information service model of business model. Finally, the generation, circulation and trading of green energy certificates are realized, which provides a reference model for the development of green certificate trading and has certain reference significance.

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