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To cite this article: Jiangtao Li *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **702** 012031

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Research on the market-oriented trading of renewable energy power based on BlockChain technology under the new quota system

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Abstract. With the steady progress of the energy transition, the proportion of renewable energy in my country has continued to increase, and the market-oriented trading of renewable energy power has become an important link in promoting the construction of Chinese low-carbon clean energy system. Under the background of the new quota system policy, through the analysis of Chinese renewable energy distribution and market-oriented transaction needs and characteristics, research the application method of BlockChain technology in renewable energy power transactions, from the three aspects of transaction system architecture, BlockChain support technology selection, and transaction process management, an intelligent transaction model suitable for Chinese renewable energy power consumption is proposed, building an automatic matching and automatic settlement method for renewable energy power transactions based on BlockChain technology, optimizing the transaction process, and reduce transaction management costs, providing a certain reference for the development of Chinese renewable energy power market trading.

1. Introduction

Compared with conventional energy, renewable energy has the advantages of large amount of resources, extremely low pollution rate, high energy conversion rate, and being recyclable. With the rapid development of our country's economy, and the demand for energy continues to grow. In order to promote the development and utilization of renewable energy, the Comprehensive Department of the National Energy Administration and the General Office of the National Development and Reform Commission solicited opinions on the "Renewable Energy Power Quotas and Assessment Methods" twice in March 2018 and September 2018, and the third edition of the draft for comments was released in November 2018, and it is clear that the quota assessment will be officially carried out from January 1, 2019. In May 2019, the National Development and Reform Commission and the National Energy Administration jointly issued the "Notice on Establishing and Improving Renewable Energy Power Consumption Guarantee Mechanism", clarifying the specific implementation mechanism of the renewable energy quota system. The promulgation of "Renewable Energy Power Quotas and Assessment Measures (Draft for Comment)" and "Notice on Establishing and Improving Renewable Energy Power Consumption Guarantee Mechanism" play an important role in promoting the development and utilization of renewable energy and improving the power market trading mechanism, and marking that our country's renewable energy development has entered a new stage.



Our country is rich in renewable energy and has great development potential. However, due to the uneven distribution of energy resources in our country and obvious regional economic differences, our country's renewable energy is in urgent need of optimization and adjustment in terms of transaction mode and trading mechanism. In the process of market-oriented trading of renewable energy power, the traditional centralized transaction model and single transaction mechanism can no longer adapt to the development of renewable energy power. Facing the market-oriented trading development bottleneck of renewable energy power with variable trading needs and diverse trading model needs, the use of advanced scientific and technological means of blockchain to optimize the renewable energy trading system has a strong role in promoting the development and utilization of renewable energy.

BlockChain is essentially a distributed accounting system with features such as immutability, uniqueness, smart contracts, and decentralization. Utilizing the characteristics of low trust cost and non-tamperable information of BlockChain technology can be effectively applied to distributed power transactions, which is of great significance for promoting the consumption of renewable energy power and promoting the development of distributed power transaction models. Based on the characteristics of distributed storage and point-to-point transmission of BlockChain technology, this article provides a broadcast, intelligent and transparent transaction mode for renewable energy consumers, and publishes transaction supply and demand information to the platform (Renewable energy power trading platform based on BlockChain technology), using smart contracts and consensus mechanisms to provide automatic matching and automatic settlement services for renewable energy consumers. At the same time, combined with BlockChain data security and tamper-proof features, transaction data is stored on the chain, improving transaction efficiency and ensuring the security of both parties' transactions. At the same time, BlockChain technology is used to mark consumption transaction data to provide reliable data support for consumption weight distribution. Finally, this article gives suggestions on the future application of BlockChain to distributed power trading, in order to provide a beneficial way for the market-oriented trading of renewable energy power.

2. Renewable energy power market-oriented trading system based on BlockChain technology

2.1. Overall architecture

Renewable energy power market-oriented trading system based on blockchain technology adopts B/S architecture, which is generally divided into a three-tier architecture of a basic layer, a service layer, and an application layer (Figure 1). The basic layer mainly provides BlockChain technology support for the service functions of the system to ensure that the power transaction data cannot be tampered with on the chain, distributed power automation transactions, multi-node consensus, etc; the service layer mainly provides functional services for distributed power market transactions, mainly including functional modules such as BlockChain identity authentication, electronic contracts, distributed power transactions, data storage, consumption certificate support management, and BlockChain operation management; the application layer is mainly designed for users of power transactions, providing a system accessible to the PC, helping users complete distributed power transactions, simplifying the transaction process, and improving the overall efficiency of power transactions.

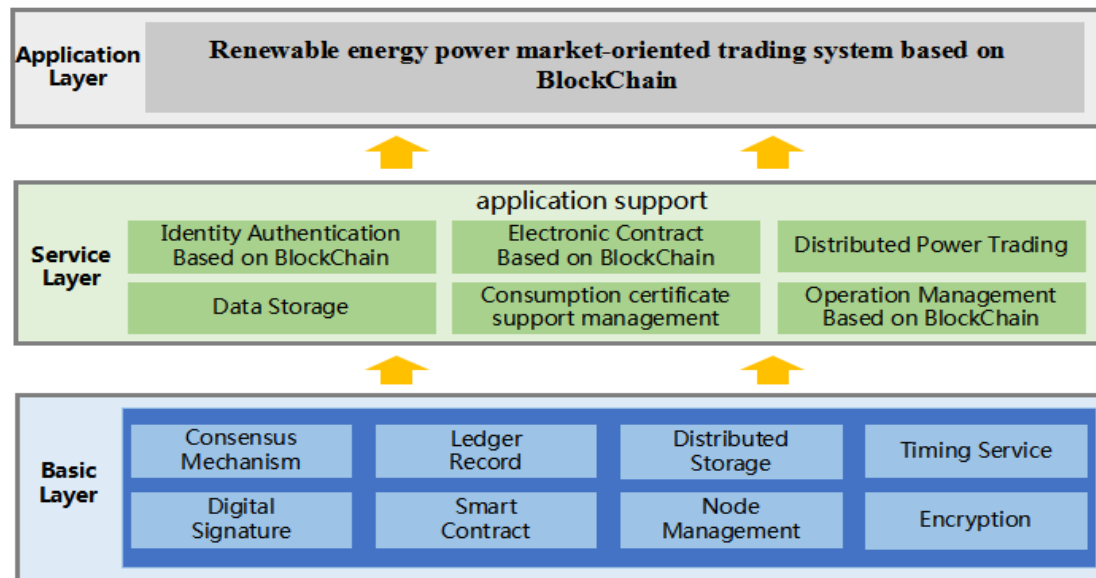


Figure 1. Overall architecture

2.2. Main function

2.2.1. Identity authentication based on blockchain. Mainly taking advantage of the multi-point consensus, irreversibility, immutability and transparency of the BlockChain to generate a credible BlockChain identity certificate, and the authorities on the chain jointly endorse the binding relationship between the user identity and the public key to ensure the credibility of user identity and enhance the security of identity authentication. The identity of users participating in distributed power transactions needs to be authenticated and verified in this module to ensure that the identities of the participants are authentic and reliable before performing business operations on the platform.

2.2.2. Electronic contract. Using technologies such as P2P agreements, consensus mechanisms, and digital certificates, the signing of electronic contracts can be realized through smart contracts without the need to introduce third-party agency trust endorsement, which meets the "Specification of the process of online contract signing". The main body of the electronic contract concludes the user information on the electronic contract module, adds a contract template, publishes the contract, and invites the other party to download, read, and sign the contract. If a distributed power transaction party has a difference in understanding of the electronic contract during the transaction or after the transaction is completed, it can also inquire about the change of the electronic contract to ensure the traceability of the data.

2.2.3. Distributed power trading. After the participants in the distributed power generation market pass the identity verification, they will publish the power supply capacity, electricity demand, transaction price, transaction mode, etc. in the system transaction module, and submit it to the BlockChain through smart contracts. The supply and demand parties initiate transactions automatic matching through smart contracts, and use automatic execution scripts to complete the automated execution of distributed power generation market transactions when the trigger conditions are reached, ensuring the transparency, non-tampering and permanent operation of data.

2.2.4. Data storage. Mainly including data storage, data collection, data proof and data cross-examination. In the storage process, for the completed power transaction content and process, the system provides a standardized data storage format based on the BlockChain for safe storage to ensure that the evidence cannot be tampered with; In the forensics link, the judicial institution participates in

the data consensus as one of the BlockChain nodes, to assist in determining the authenticity of the electronic evidence of power transactions; in the demonstration link, using smart contract automatic control, and the BlockChain browser to show the evidence, improving the legality and authenticity of the transaction data; in the cross-examination link, Blockchain can solidify the two links of obtaining evidence and showing evidence, and the whole process can be traced to enhance the legality of electronic evidence.

2.2.5. Consumption certificate support management. Registering the renewable energy power consumption certificate on the chain, recording the issuance and transfer process of the certificate, and completing the whole process management of the issuance, transaction, accounting and traceability of the certificate, and strengthening the attractiveness of the renewable energy power consumption certificate to buyers, increasing the authority of the certificate, realizing the full traceability, solving the cumbersome process of issuing renewable energy electricity consumption certificates. At the same time, preventing false transactions and repeated transactions, promoting the consumption of new energy and electricity, and ensuring the transparency and safety of certificate transactions.

2.2.6. BlockChain operation management. This module mainly supports the business operation of the system, and effectively prevents harmful information from being written on the chain through cross-validation of the consensus mechanism, and implements a permanent record on the chain through operations such as uploading, querying and updating business data of platform authenticated users to achieve the security audit of the information on the chain. At the same time, it effectively integrates the national secret algorithms SM2, SM3 and SM4, and complies with the SSL VPN technical specifications, realizes complete national secret support, completes chain security, chain consensus, chain authorization, chain information management, and chain data retrieval, etc.

3. Renewable energy power market-oriented transaction process based on BlockChain technology

The use of a renewable energy trading platform based on blockchain technology provides an effective solution to the technical problems in power trading. The platform transaction process can be divided into four stages: information release, transaction matching, transaction settlement, and data storage. The transaction process is shown in Figure 2.

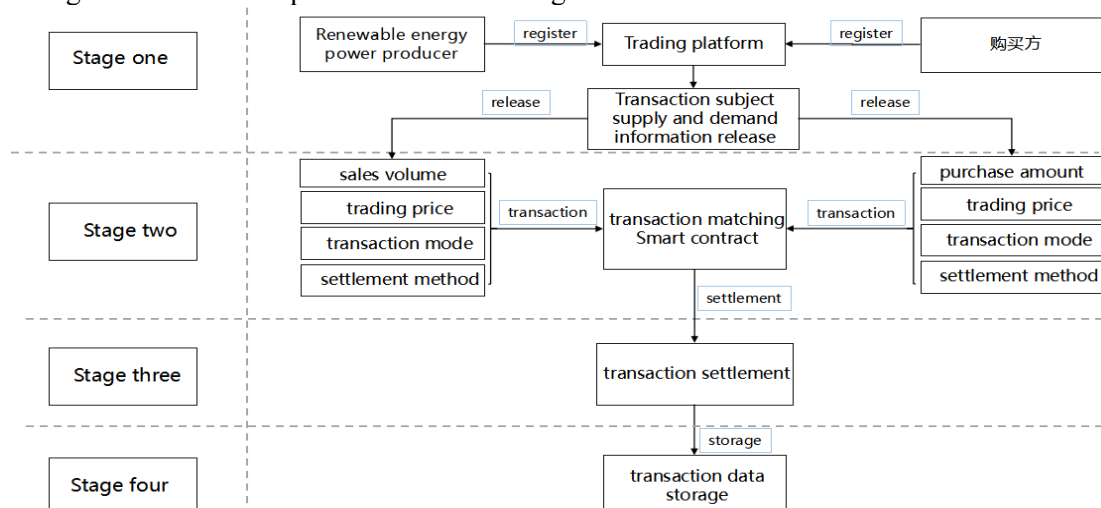


Figure 2 transaction process

3.1. Information release

Enterprises or individuals participating in renewable energy power consumption transactions publish transaction demand information on the platform. The platform uses BlockChain technology to mark and classify renewable energy, including geographic information, energy type information, corporate information, transaction volume, Transaction price, and transaction mode.

3.2. Transaction matching

Using smart contract technology and consensus mechanism, according to the needs of the transaction subject and custom transaction rules, the eligible transaction information is automatically screened to realize smart contract transactions without human interference, and improve transaction efficiency and transaction accuracy and transparency.

3.3. Transaction settlement

The settlement model of both parties to the transaction is embedded in the trading platform (renewable energy power trading platform based on BlockChain technology) with the smart contract formula. When the two parties meet the transaction conditions and trigger the transaction, the smart contract automatically executes the corresponding settlement rules to complete Transaction task.

3.4. Data storage

After the transaction is completed, the transaction information (identity information of the transaction subject, transaction content) is automatically stored in the BlockChain network, which is used for renewable energy consumption statistics and consumption purposes, while providing data support for consumption distribution.

4. Conclusion

Distributed energy will play an increasingly role in the development of the energy Internet, so how to trade distributed energy to maximize its distributed characteristics is a research focus at this stage. This article focuses on the application of BlockChain technology to distributed energy transactions, and looks forward to the development direction of BlockChain in improving the level of energy consumption. At present, distributed power generation is being vigorously promoted in China, The application of BlockChain technology to distributed energy can promote resource consumption and clean power generation. I hope that the research in this article will have certain reference significance for the development of related application.

Acknowledgments

This work is supported by Science and Technology Program of State Grid Corporation of China (Research on the mechanism design and key technology of electric power market under the new quota system policy, No. 1200-202017227A-0-0-00).

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