# Application Research Based on Blockchain Technology in the Field of Energy Saving

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**Abstract:** Blockchain has the characteristics of decentralization, openness and transparency, reorganization, and uncorrectable data modification. It can establish trust between participating entities that do not trust each other in a distributed scenario. Application scenarios, such as distributed energy transactions, regional microgrids, energy rights trading, renewable energy certificates, etc. The application of blockchain technology in the field of distributed energy has landed multiple projects. Related parties can use information and communication technology to interconnect to achieve authorization and interaction. All operations and contracts in the transaction will be recorded and converted, and the data cannot be tampered with. Mutual trust between the parties involved in the transaction. In view of the difficulties in sharing energy-saving benefits, difficulty in promoting energy-saving technologies, difficulty in financing, and difficulty in supervision of energy consumption and energy-saving effects in contracted energy management projects in the energy-saving field, how does blockchain energy-saving application technology solve the information asymmetry between two parties and multiple parties, and the data is untrustworthy The crux of the problem is to promote disruptive innovation in traditional energy-saving mechanisms and methods. Technology and energy and energy-saving industries have a very high degree of fit in many aspects and fields, “chain + energy-saving” has a very broad application space.

## 1. Introduction

The concept of blockchain originally originated in 2008, first proposed by Satoshi Nakamoto in his paper “Bitcoin: A Peer-to-Peer Electronic Cash System” (Bitcoin: Peer-to-Peer Electronic Cash System). In 2015, “Blockchain Technology Reshaping the World” was published in The Economist magazine, which promoted the application of blockchain in the financial field. In early 2014, Canadian programmer Vitalik Buterin launched the Ethereum project, one using blockchain technology. The release of Ethereum's blockchain technology has broken through a single payment scenario, enabling all industries and industries to use blockchain technology for transformation and innovation. Blockchain technology has more imagination and application space, which has set off a new wave of blockchain technology development and application research in the world.

## 2. Blockchain Concept and Hierarchical Architecture

The blockchain technology originates from Bitcoin, and can establish trust between participating entities that do not trust each other in a distributed scenario. It has the characteristics of decentralization, openness and transparency, reorganization, and non-tampering of data. A new decentralized infrastructure and distributed computing paradigm of encrypted chain-type blockchain structure to verify and store data, use distributed binary consensus algorithms to generate and update data, and use automated script code to write and manipulate data. The blockchain architecture mainly includes the data layer, network layer, consensus layer, and application layer. Among them, the data layer processing method is realized by means such as encryption algorithms

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and digital signatures, and the data information can be stored in the blockchain. Each node in the network layer blockchain makes an agreement through the network communication protocol, and verifies the authenticity and legality of data transmission [1]. The consensus layer uses a consensus mechanism to ensure data consistency. The consensus mechanism is represented by the POW (ProofofWork) architecture to ensure data consistency and system availability. The overall upper limit of the blockchain system and the speed of transaction confirmation are guaranteed by the algorithm of the consensus mechanism. At the application layer, based on the continuity of smart contracts, blockchain technology has a wide range of application scenarios in many industries

## 3. Blockchain Application Practice in the Field of Distributed Energy

Blockchain has good application prospects in distributed energy, regional microgrid and other fields. Its decentralized features, smart contracts and other technologies can fit the characteristics of decentralized energy, which can greatly reduce the transaction cost of distributed power and promote transactions. effectiveness. In the consensus mechanism, distributed energy participants use information and communication technology to interconnect, realize authorization and interaction through blockchain technology, and all operations in transactions, contracts will be recorded and converted, and the data will not be able to be said, can be said , Blockchain provides innovative solutions for the development of multiple energy sources, especially the application of the P2P peer-to-peer model. In 2016, Professor Davor proposed to ensure the accuracy and security of energy transaction data through multi-signature, blockchain, and anonymous information flow. The final solution is that without relying on a third party, participating parties can safely and trust each other conduct energy transactions in a decentralized smart grid [2]. As a result, there have been multiple blockchains. In 2017, PowerLedger launched a interconnected P2P power trading system using blockchain technology in the Perth city of Australia. The system contains 80 families, each Households can trade surplus solar power on the system platform. American startup LO3Energy has developed a blockchain micronet and combined it with a peer-to-peer trading platform (Trans-ActiveGrid) to form a blockchain-based local power trading platform that covers Brooklyn ’s BoerumHill, ParkSlope and Gowanus communities. Residents can transfer the surplus power generated by the rooftop solar photovoltaic system. Through this blockchain-based EU Scanergy project, it is possible to achieve direct trading of green power generated by decentralized users. Users with surplus power input to the distribution network and sell it on the local power trading platform. It is sold to the local power grid or neighbors and payment settlement can be made through the platform. After the green power is confirmed by the distribution network operator, the user of the electricity supplier can obtain the virtual currency generated by the smart contract as a reward. The entire transaction is simple and efficient, without the supervision of other third-party institutions. The use of blockchain technology to establish an electricity trading system can fully realize the effective application of electricity transactions through blockchain technology, can realize the real-time settlement of electricity bills, determine whether the traded electricity attribute is green and environmentally friendly electricity, and combine with government alternative policies to promote The market-oriented development of electric energy, such as the registration of renewable energy certificates on the blockchain. The traceability of the blockchain is recorded on the blockchain by the historical ownership of each green certificate, which avoids the repeated sale of the certificate, thereby safeguarding the interests of the various parties in the process of issuing and subscribing the green certificate.

## 4. Blockchain Helps Solve the Problems in the Field of Energy Saving

### 4.1 Difficulties in Sharing Energy-Saving Benefits of Contract Energy Management Projects

Contract Energy Management (EPC) is a market-based promotion mechanism for energy-saving technologies. It has formed a perfect business model and is commonly used to share energy-saving benefits. The advantage of this mechanism is that by implementing energy-saving technological

transformations to reduce energy costs, energy-saving units do not need to invest from saving, and only need to provide energy-saving technologies, equipment application scenarios, technology, equipment, financing, etc. are all undertaken by energy-saving service companies [3]. This mechanism has been obtained in the promotion of energy-saving technologies. In practice, after the energy-saving benefit-sharing contract energy management project is completed, energy-using units and energy-saving service companies may have different opinions on the energy-saving data generated by the project, and they cannot convince each other. Once the two sides have different opinions, the sharing of energy-saving benefits can not be fulfilled in time, and frequent breaches of contract have hindered the wider promotion of this market-based energy-saving mechanism. At the same time, after the implementation of the EPC project, the energy-using unit has a large amount of comprehensive equipment operation, energy consumption and energy-saving effect information, but the service company can not grasp it in time, the two parties have information asymmetry, and malicious defaults are sometimes occur. As a result, the role of the final contract energy management mechanism cannot be brought into full play. In order to solve this problem, the data after the chain is uncorrectable and rewritten. The traceable blockchain technology is combined with sensors and Internet of Things technology to record energy consumption and energy saving data of EPC projects in real time. Without manual meter reading and manual recording, there is solid evidence for the energy saving data for sharing. In addition, there are still disputes between each other and judicial intervention is required. The data recorded on the blockchain can also help to make judgments quickly and effectively, greatly improving the cost of malicious breach of contract has promoted the practical feasibility and commercial attractiveness of the contract energy management mechanism [4].

### 4.2 Difficulty in Promoting Energy-Saving Technologies

From the perspective of energy-saving technology companies, it is difficult for the general promotion of energy-saving technology because energy-saving technology belongs to the professional field, and the information asymmetry between the supply and demand of energy-saving technology is a problem. Blockchain technology can solve the problems of intellectual property protection of energy-saving technologies, transparent and verifiable investment and financing data, thereby reducing the risk of technology promotion and investment and financing, and promoting the promotion and implementation of energy-saving technologies. The deepening of the transformation of energy-saving work continues. Energy-saving work is no longer a simple equipment replacement, instead of investing in comprehensive green energy technology innovation, research and development and integration, and developing a one-stop comprehensive energy service. Through the development of big data, energy internet and cloud computing, the Energy Internet of Things, energy management and energy market can be connected in series through the network, connecting the control center with energy-saving projects such as industry, commerce, and public institutions to carry out comprehensive energy services. From the perspective of energy-using units, there are many types of energy-saving scenarios, and different technical scenarios require customized energy-saving solutions. To carry out energy-saving diagnosis for energy-consuming units, a comprehensive energy service plan is issued and implemented. The comprehensive energy service plan requires the integration of multiple energy-saving technologies and equipment. These individual energy-saving technologies and equipment are often created by different energy-saving technology companies. Provided, the intellectual property rights of each energy-saving technology enterprise, if the comprehensive energy index of the energy-consuming unit is constructed by using blockchain technology, the energy-saving amount and income of each technology enterprise's energy-saving technology will be clear. Providers can use blockchain technology to fix the basis for evaluation and settlement with energy-saving technology providers. In other words, if the technology is advanced and the energy saving effect is significant, you can negotiate with a large energy-saving comprehensive service provider to obtain the application scenario of the technology, instead of directly facing a large energy-consuming unit to seek a smaller amount of energy-saving service contract. . With the support of blockchain technology, the integration of technology savings

is possible, and the development of integrated energy services has great potential and prospects.

### 4.3 Difficulty in Financing Energy-Saving Projects

One of the important reasons for energy-saving project financing to “have a good reputation” is that the data of energy-saving projects are unclear and unreliable. No matter how good the energy-saving technology is, a specific project cannot produce the amount of energy savings and economic benefits recognized by both parties, and it cannot provide financial institutions with funds for debt service. In the three-party game of energy-saving technology companies, technology application units and financial institutions, financial institutions often have the least information and often have reduced losses. If blockchain technology is applied, financial institutions also have a guarantee of blockchain technology. Financial institutions can provide more reliable green data by providing reliable data. There are many pairs of data links, and the more real, the more financing amount can be obtained for the promotion and landing of energy-saving projects, and the lower the interest rate. The improvement of the credibility of the data of energy-saving projects by blockchain technology will contribute to the difficulty of financing energy-saving technological transformation.

### 4.4 Difficulty in Monitoring Energy Consumption and Energy Efficiency

Blockchain technology is an important regulatory technology. In general, the government is promoting the construction of a gradual online monitoring system, real-time monitoring of energy use by energy-using companies, and providing technical support for government supervision, intelligent management and control of energy-using companies, and social services. From the government's point of view, it is necessary to supervise and serve energy consumption, energy conservation and emission reduction, industry development, etc. based on the data provided by the current online monitoring system. It is difficult to guarantee the accuracy of the data if relying on the data submitted by the energy user unit. If the dating blockchain technology records energy use, and in addition to the regulatory departments and key energy-using units, there are third-party intermediaries, energy-saving technical service companies to upload and synchronize data together, and maintain the blockchain stack, which can be further clarified The authenticity and comparability of the recorded data greatly improve the reliability and credibility of energy consumption and energy efficiency monitoring, and also provide an important basis for the implementation of energy and energy conservation policy tools.

## 5. Conclusion

Blockchain technology and the energy and energy saving industry have a very high degree of fit in many aspects and fields. “Blockchain + energy saving” has a very broad application space. The specific application scenarios that can be expected at present include energy-saving technology promotion and investment and financing services, contract energy management (EPC), paid use and trading of energy rights, real-time online monitoring, decentralized energy, and price (compensation) settlement of residential electricity and gas. At present, some of the pain points and difficult problems in energy saving work can be solved or alleviated by using blockchain technology, and the traditional energy saving mechanism and means are promoted to carry out subversive innovation.

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