Energy efficiency of microgrid and the application of blockchain in microgrid

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Abstract. Blockchain has the characteristics of reliability, encryption, non-tampering and traceability, which can effectively solve many problems such as data isolation and uneven distribution and energy waste in China's microgrid. Both have the characteristics of decentralization, security, transparency and intelligence, which provide a basis for the combination of the two. The exploration of the integration of the blockchain's own characteristics with the technology of the microgrid illustrates the advantages and feasibility of the blockchain in current transactions.

Keyword: Blockchain; microgrid; power transaction.

1. Introduction
Traditional power market transactions mainly refer to several aspects such as electrical energy transactions, power generation rights transactions, and auxiliary service transactions. At present, these aspects exist in isolation. Due to the relatively lag of intelligent integration, the development of new energy and the use of microgrids still lack technical support. The application of microgrid can make the overall power grid disconnect and connect to new power in time when disasters or faults occur, and ensure that the overall power supply system tends to be stable to achieve flexible distribution of electrical energy. There are still many problems in the internal trading system of the microgrid. For example, the transaction method is relatively simple, the electricity price is opaque, and the checkout time is not timely. This sets a lot of obstacles for the implementation of the microgrid. Blockchain is essentially a database of virtual currency[1]. At present, the technology and applications of blockchain are relatively mature, and applying its advantages to the microgrid will definitely bring disruptive changes to it, and it will be very good. Solves many concerns in current transactions, its advantage is to ensure the normal implementation of the microgrid through the decentralization, transparency, non-traceability, reliability and other characteristics of power purchase, thereby achieving the appropriate matching of the "Internet of Energy", Meet the real-time requirements of energy trading and demand.

2. Research status at home and abroad
Below we discuss the transaction mode brought by the next bit and the blockchain:
1. Every transaction must be broadcast on the entire network, and all blockchain nodes act as "notaries" to witness the completion of each transaction.
2. After the miner node receives the published transaction information, the miner with the accounting right will record the transaction in the ledger and receive the corresponding bitcoin reward.

3. Miners with accounting rights will time stamp the transaction and record it in the ledger, broadcast it to the entire network, and after confirming that the transaction is successfully recorded in the blockchain, once the blockchain is recorded, it cannot be changed at will[2]. Although two miners simultaneously solve the puzzle answer and simultaneously account for the possibility of forming blocks, if this small probability event occurs, the system will consider the longer one to be valid, and the shorter one to be invalid. This is the reason why 6 blocks can be considered as the completion of the real transaction after the transaction is entered into the account. Reaching such a consensus is based on the existence of a consensus mechanism (PoW in PoW).

Blockchain is a distributed ledger, a technical solution for collectively maintaining a reliable data in a decentralized manner. From a data perspective, it is distributed storage, and from a technical perspective, it is the integration of multiple technologies.

Blockchain currency, mainly for digital currency, can be applied to cash, including basic transfer, payment and exchange services, which can solve the decentralization of currency and payment methods (as expressed in the comic above).

The smart contract of the blockchain decentralizes the entire market more macroscopically, and can use the blockchain technology to register, confirm and convert different types of assets and contracts, such as can be applied to the financial market, including stocks, bonds, futures, etc. In the contract; public records can also be transferred to the blockchain, such as land and property rights certificates, business licenses, marriage certificates, etc[3].

Blockchain's efficiency and collaboration applications beyond currency, economy and market use blockchain technology for organizational activities, allowing organizational activities to reduce friction and improve efficiency. For example, blockchain technology can be used in medical and health care to treat patients' medical data Store, share the patient's previous medical history between medical institutions, and only disclose their own information with the patient's permission.

The classification of blockchain is shown in Table 1.

| Participants | Private chain | Alliance chain | Public chain |
|--------------|---------------|----------------|--------------|
| Trust mechanism | Custom | Collective endorsement | Proof of work |
| Bookkeeper | Suspension insulator | Participant's decision | All participants |
| Incentives | No need | Optional need | |
| Degree of centralization | Centralized | Multicentralization | Decentralized |
| Outstanding advantages | Transparent and traceable | Efficiency and cost optimization | Self-creation of credit |
| Typical application scenarios | audit | Liquidation | Bitcoin |

The private chain is completely closed, and only the blockchain technology is used for bookkeeping. The bookkeeping power is not disclosed and is exclusively enjoyed by the company or individuals; the alliance chain: semi-open, is a block chain used internally by a group or organization, and requires advance The designation of a node as the bookkeeper. The generation of each block is determined by all designated people. Other nodes can trade, but they have no right to book.

The public chain is fully open, and anyone can compete for the right to keep accounts. Bit is the typical representative.

The formation process of the block is shown in Figure 1.
3. Microgrid blockchain relationship
Due to the different development and use time of the microgrid system and the relative independence of its operation process, there are differences in management systems such as collection, monitoring, production, and scheduling. Therefore, the use of blockchain technology is essentially an "Internet +" grid method. One kind of expansion is particularly advantageous in electric energy trading. First of all, the fairness emphasized in the power transaction process includes price, the situation of both the supply and demand sides, and power quality. The immutability of the blockchain itself can ensure that the program is strictly in accordance with the calculation of data during the execution process, and does not involve artificial factor. Secondly, it is private, because the encrypted storage method is implemented during the transaction process, each user can seek a transaction object in the microgrid through their own block, and choose the price and model that suits them [4]. The whole process is point and point. There are no intermediate links between transactions, and they are all conducted under an anonymous situation, ensuring the secrecy of the entire process of the transaction. The last is the decentralized
feature. The transaction of microgrid can be completed by multiple distributed entities, without being limited to a single central institution. All entities conduct transactions in an equal form, such as for new energy[5]. In terms of utilization, users of new energy can be given certain encouragement and rewards, and the application of blockchain can achieve this purpose, as shown in Table 2.

### Table 2. Analysis of the integration of blockchain and microgrid management

| feature     | Microgrid characteristics | Features of blockchain                                                                 |
|-------------|---------------------------|----------------------------------------------------------------------------------------|
| Shared      | The power grid departments need to use the network to realize resource sharing and smooth communication. | The distributed network structure in the blockchain and the P2P transmission method ensure the interconnection between block nodes. |
| Not tamperable | The microgrid department discovers the existing problems and the future development direction by analyzing the resource information it masters, which requires absolute security of the network information. | The nodes between the blockchains are non-tamperable and can only be modified with the intervention of more than 51% of the blockchain nodes, so the security of the blockchain is very high. |
| safety      | Data related to power dispatching and transmission in the microgrid is not leakable, so it is necessary to ensure safety in data processing and operation. | The encryption technology of the blockchain can add public and private keys to the data in the power grid. The encrypted content cannot be modified and used without the key. |
| Privacy     | Not all employees in the microgrid can access the data at will, and only some employees or specific personnel have rights. | The blockchain is a distributed storage. The block itself has data processing functions and can be set with access rights, which fulfills the requirements of partial openness. |

### 4. Technology application

The application of blockchain in the electricity market has the following points: blockchain-based electricity market transaction settlement, blockchain-based blocking management, and blockchain-based microgrid point-to-point transactions. The blockchain originates from Bit, so it is also possible to virtualize current transactions as an asset and publish it on the blockchain. Users can conduct electrical energy transactions on the blockchain of electrical energy by themselves. At this time, the virtual encrypted currency can be used as the behavior of electrical energy transactions to perform equivalent value transaction conversion. The transaction behavior mainly includes information such as buyer behavior, seller behavior, transaction volume and unit price. The block link is formed by a random hash algorithm and a time stamp is added. During the transaction process, each user has a signature algorithm to give The function of the private key of this can ensure the integrity of the transaction, and the party that has breached the contract must have a record and reduce its credit rating in its account. At the same time, the distributed ledger technology of the blockchain is used to distribute the data of all transactions to all participants in the process of electrical energy transactions, so as to avoid the possibility of tampering with the transaction. The distributed transaction method is to ensure that it is feasible. Only after entering the smart contract stage to complete the payment and clearing process, the client of the blockchain can use the private key to view it at any time. Of course, the query permissions also vary due to the different permissions granted by the client, which is satisfied The privacy requirements of the microgrid.

Blockchain can provide reliable and accurate data information for power dispatching due to its own traceability and non-tampering features in the power dispatching of smart grids. The distribution of microgrids mainly uses distributed photovoltaic, wind and other power sources, There are certain
problems with its stability, and it is relatively interfered by the outside world. In the process of dispatching electrical energy, it is necessary to fully consider the previous data information, and deliver relatively stable electrical energy to those users with high demand, of course, we must also consider the principle of fairness. At the same time, blockchain technology can also provide incentives for users who use clean energy, such as providing a reward mechanism for cryptocurrencies, providing a platform for transactions between users, or providing priority for users when purchasing electricity. Figure 2 shows.

![Blockchain-based number according to the collection](image)

**Figure 2.** Providing priority for users when purchasing electricity

5. **Conclusion**

The microgrid is the most important part of the power enterprise reform, which solves the development of each power grid from decentralization to centralized networking, thereby improving the stability of power supply. The transaction method of microgrid is still in the exploration stage, and the development of blockchain technology in finance has achieved great results. At the same time, the characteristics of the blockchain itself are also very in line with the needs of microgrid development. There are many things in common. This paper proposes the application of the architecture and technology of the blockchain in the microgrid, and the application of the characteristics of the distributed ledger in the power market through the blockchain. The Chinese language indicates that the area is realized through the design of power purchase, transmission and payment settlement. The intelligent management of the blockchain in the microgrid makes the grid more rational in both the trading market and the deployment.
market. Adding blockchain technology in the process of micro-grid transactions can enable it to truly play the role of financial services in the grid trading market. The application of blockchain technology in the future will also play a greater role in the entire energy Internet. effect.

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