Discussion on the application of energy microgrid integrated with blockchain technology

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Abstract. Based on the technical characteristics of the blockchain, the credibility, fit, architecture, and main business models of the data processing of the energy microgrid integrated with the blockchain technology are analyzed and discussed. It shows the feasibility and necessity of implementation, and puts forward a targeted solution to the current situation. Blockchain is very promising to promote the development of energy microgrid.

1. Introduction
The implementation of the energy microgrid cannot handle the trust issues of distributed nodes, and it cannot guarantee the interests and efficiency of all parties. The energy microgrid based on blockchain technology can take advantage of blockchain technology to solve the current The issue of trust and trusted data processing in distributed nodes of energy microgrids has the greatest role in building a trust ecological architecture system to ensure the more effective implementation of the main business model of energy microgrids and promote the sustainable development of energy microgrids.

2. Relevant overview of blockchain technology
Blockchain technology can complete the underlying technical architecture of Bitcoin. Blockchain is similar to the account book maintained by participants. It can handle many real-world problems such as double payment and general Byzantine through cryptography principles, distribution architecture and computing paradigms. The Byzantine Generals problem is first based on the assumption that there is no problem with the channel, and then does research on consistency and fault tolerance. It manifests itself as a problem of trust among multiple parties. Blockchain technology builds mutual trust and decentralized systems through advanced computer technologies such as distributed consensus algorithms, digital encryption and authentication mechanisms. It can mainly carry out information transmission, value transfer, etc. to form a distributed node of mutual trust mechanism [1].

Blockchain can be divided into three categories: (1) Public blockchain. This type of blockchain is widely used, and all institutions/individuals can participate in transactions and get valid confirmations. This type of blockchain is completely decentralized without the influence of any organization/individual. It uses cryptography to ensure that the transaction cannot be tampered with, verified, and encouraged. (2) Alliance blockchain. The alliance blockchain is limited to all or part of the functions of the alliance members. Its read and write permissions and accounting rules are customized according to the alliance rules. The alliance blockchain is characterized by fast transaction speed and good scalability. (3) Private
blockchain. The private blockchain emphasizes privacy and is limited to access and transactions within a unit, organization, or institution. The node layout is limited and controllable, so this type of blockchain has a high security factor. Compared with the database, it is more likely that single node tampering/hiding data will be discovered. However, in practical applications, when a single blockchain is difficult to meet the demand, a blockchain can be formed. Such as private chain + alliance chain, alliance chain + public chain and other forms, and finally produced side chains and interconnected chains.

Generally speaking, the longest chain of the blockchain can build a distributed consensus mechanism. The blockchain system meets the requirements of transaction execution and query in the application of Bitcoin. At present, there is a blockchain platform that can provide a user code execution mechanism called "smart contract". This execution mechanism can be effectively executed by a smart contract from the perspective of credibility, and all execution results will be effectively recorded. This ensures that special issues such as data traceability are effectively resolved.

3. Credibility of energy microgrid data processing integrated with blockchain technology

The authenticity and validity of the data of the existing energy microgrid system are difficult to guarantee, and are vulnerable to man-made attacks and tampering, and it is difficult to maximize the effectiveness of the problems. Blockchain is a distributed system of consensus, maintenance and storage of all historical transaction records throughout the network, which can achieve multi-node indistinguishable records, thereby ensuring data security, reliability and traceability.

From the perspective of the credibility of the data processing of the Bitcoin blockchain, its transfer function is only suitable for digital currencies, but there are major limitations. In traditional database management system applications, the transaction processing data content is mainly submitted to ensure the process type. The combination of language and SQL statements can be effectively formed. At this time, the logical structure of the blockchain itself has many similarities with the log.

In the entire Bitcoin blockchain, the school-based language it provides is simpler, it can provide smart contract content for the data processing process, and provides two smart contract writing mechanisms for Go and Java. Smart contracts can effectively enhance the ability of the blockchain to process data, and at the same time put forward higher requirements for the security of users and systems, combined with the blockchain to optimize the system of smart contracts caused by concurrent control factors [2].

4. Analysis of the agreement between blockchain technology and energy microgrid

Blockchain technology uses P2P network technology, cryptography, and mathematical algorithms to build a distributed network environment, which enhances the trust between all parties involved in the energy microgrid. The newcomer model is transformed from a human-to-human trust model to a human-to-machine trust model. The value transfer channel is transformed from a centralized high cost to a blockchain low-cost secure channel. Blockchain technology can improve the current energy microgrid trust and its causes Long decision-making period and poor synergy effect [3,4]. The blockchain energy microgrid dynamically participates in nodes in conjunction with specific needs, and has the structure of energy dispersion characteristics, which is beneficial to the addition of new nodes in the energy microgrid to join the existing network without changing the network structure. The blockchain-wide consensus mechanism can be used to make transaction decisions. The system stores and records the historical data generated in the transaction by all participating nodes in order to achieve data information sharing. In addition, the distributed characteristics of the blockchain will make the energy micro-grid network environment more secure and reliable, and issues such as power generation measurement, data operation and responsibility attribution among nodes are guaranteed. Blockchain technology can lay the foundation for the governance, supervision mechanism and business model of new nodes of the Energy Internet. Role nodes can be built on the blockchain to form a green energy system that supervises and cooperates with each other. It can also set up a democratic decision-making mechanism. Combine the on-chain and off-chain co-governance models to build a good energy microgrid industry environment,
and coordinate power resource production and storage, processing conversion, transmission and distribution, supply and demand balance, and terminal sales.

5. Research on regional micro-grid architecture and system based on blockchain technology

5.1. Overall architecture approach
Because distributed energy microgrids have large losses in long-distance transmission, a regional energy microgrid should be constructed nearby, and transmission and distribution within a small range should be implemented. The energy microgrid has restrictions on the cross-regional scope. A large number of microgrids are formed nationwide. Each energy microgrid forms a complete ecosystem. Adjacent microgrids can be connected to each other and connected to the State Grid Electricity Trading Platform. State Grid can be used as a supervision node in the blockchain to supervise the nodes of the entire network. Form a top-down, combined supervision model.

5.2. Regional Microgrid Credit Ecosystem
The bottom of the regional micro-grid adopts P2P networking technology. Power companies and users such as generation, transmission and distribution constitute the regional microgrid ecological environment system. Microgrid users spend less on purchasing local electricity. According to the characteristics of the microgrid, the block alliance chain can be selected to build an accounting service system for the underlying platform, and a power trading platform can be reasonably set up so that the business can be smoothly implemented [5]. General user nodes can directly participate in system transactions without deploying a server. This blockchain can generally limit the query of application program interfaces to about 150.

6. The main business model of energy microgrid integrated with blockchain technology

6.1. Physical business model under energy points
After ensuring the normal operation of local business, the energy microgrid integrated with blockchain technology can also conduct transactions with microgrids in other different regions. Related business can be integrated into online transactions to achieve the effect of information and intelligence. Transform the original offline business into an online automated business transaction mode. All users in the power industry have their own private keys and will use smart contracts when dealing with upstream and downstream enterprises. After the private key signature authorization permission, the energy points can be transferred to complete the settlement. After the relevant transaction business is completed, the traceability function of the blockchain system can prevent the transaction from being indispensable, and can effectively reduce the workload of the relevant personnel.

6.2. Business operation business model
The energy points microgrid can be used for business transactions, etc., and users purchase energy through the energy points in the application account. The energy point transaction is controlled by the energy microgrid system, so it is beneficial to obtain the effect of business digitalization and intelligence. Under this condition, users can complete power transactions on their own. The blockchain is mainly responsible for energy points transaction records and transaction management, and timely input of relevant data into smart contracts [6].

6.3. Points system model
In order to improve the efficiency and quality of energy microgrid settlement work integrated with blockchain technology, grid companies have reasonably constructed a point system for issuance, supervision and recovery. Supervise and manage the flow of points within the regional energy microgrid. Regional microgrids are divided according to regions and the number of nodes. Normally, energy points flow in a microgrid. When it needs to flow between regions, the output side builds transaction lock
points for the main chain, and the input side is side chains that can build cryptographically proven transactions, which can protect the entire network. The range of energy points flows reasonably [7]. Different transfer companies or users can use points for business transactions. Not only that, but also strengthen the connection with enterprises in the power generation business, transmission business, distribution business, etc., based on smart contracts to settle the electricity flow through smart meters, effectively prevent the monopoly phenomenon of transmission and distribution enterprises, and energy points circulation as Support from grid monitoring companies.

7. Energy microgrid data query and processing integrated with blockchain technology
Combining the blockchain can realize effective query and optimization processing of the microgrid trusted data management system, ensuring that all data in each block can be effectively displayed. It can provide authenticated query and processing data for outsourcing database, combined with cloud computing platform to achieve synchronous operation of hardware and software, and provide favorable conditions for blockchain trusted data processing. In addition, it is also necessary to build a trusted computing platform for hardware and software operating systems based on cloud computing platforms. It can also combine Haven system prototypes and Inter SGX chips to process threads, virtual memory, file system abstractions, system scheduling content, etc. in the system. The operation is to ensure effective coordination with the Windows operating system [8].

8. Conclusion
Based on the technical characteristics of the blockchain, this paper analyzes and discusses the credibility, fit, architecture, and main business models of the data processing of the energy microgrid integrated with the blockchain technology. Targeted solutions are proposed according to the current situation, and the research results can be used as a reference for decision makers.

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