Research on Carbon Account Construction Based on Blockchain Technology

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Abstract. Climate change is one of the greatest crises to the Earth in the 21st century, and man-made greenhouse gas emissions are the main cause of climate change. On Earth Day, April 22, 2016, 171 countries signed the Paris Climate Agreement at United Nations Headquarters, committing to carbon reduction targets. The Kyoto Protocol stipulates that due to different countries' different emission reduction responsibilities, there are differences in the allocation and actual use of carbon allowances, which makes carbon emission trading emerge among countries. However, due to the carbon emission quota (CEA) trading can be adopted by agreement transfer, one-way bidding or other ways in accordance with the regulations, the current carbon emission trading and low-carbon economy system still has problems such as opacity, manipulation, lack of unified data calculation standards, double counting, data security and privacy. Possessing the largest carbon resources in the world, China undoubtedly is the main subject in the international carbon market. However, China finds itself in an awkward and passive position when entering this market due to the lack of a multi-level carbon-trading market with price discovery and resource allocation functions. In the context of a global commitment to low-carbon activities, Companies are committed to building a smart carbon account management system based on blockchain technology to achieve the goal of carbon neutrality. The consensus mechanism, smart contract and encryption algorithm technology of blockchain technology provide strong technical support for carbon account credit conversion, information application and data security.

Keywords: carbon account, blockchain technology, Cross-chain Integration

1 Introduction

In 2022, after China put forward the two-carbon goal, in the past year, "carbon accounts" to quantify individual green and low-carbon behavior have been emerging and heating up. China's exploration and practice in the field of carbon accounts have entered a period of activity. Many local governments, financial institutions and enterprise platforms have laid out trial carbon accounts. Many carbon account platforms already in operation have also carried out further system improvement and diversified innovation.

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Among them, most carbon accounts are still based on traditional accounting methods and do not use blockchain technology. There are relatively mature markets and products in the European Union, Japan and the United States, but they have not been used on a large scale. As part of the global endeavor toward “carbon neutrality,” an analysis of China’s current carbon emissions shows that although China’s per capita carbon emissions have exceeded the global average, the per capita cumulative carbon emissions are far below that of developed countries, which suggests that achieving the "carbon neutrality" goal is more difficult than expected. [1] Take the creation of the earlier ant Forest, which went online in August 2016, Analyze the current situation of the development of China's traditional carbon account.

The first is the lack of unified calculation standards for carbon emission data. China is still in the exploratory stage in the field of individual carbon accounts and carbon accounts for other enterprises (non-key emission control enterprises and voluntary emission reduction owners), and has not established unified methods and standards in terms of carbon emission reduction accounting rules, data acquisition and measurement. Some platforms do not have the ability of data measurement and accounting themselves, so they need to rely on third-party cooperative institutions to build professional measurement models. For example, the Personal carbon account of Shanghai Development Bank, which was released this year, relies on Shanghai Environment and Energy Exchange to provide support for carbon emission reduction calculation. The Taobao 88 carbon account is calculated by professional institutions in the field of carbon emissions, such as Zhonghuan United Certification Center, Beijing Green Exchange, China Institute of Standardization and Tianjin Emission Rights Exchange. The data collection methods, measurement models and calculation rules adopted by various institutions are not authoritative and universal, which is not conducive to further enriching and expanding the application scenarios of carbon accounts. [2] (IIGxF view | Analysis of the development status and future prospects of China's carbon account system) Ant Forest online shopping of movie tickets is limited to the purchase of online movie tickets on Tao Ticketing software, and the energy of buying movie tickets is more than that generated by walking, which is suspected to induce consumers to consume. Secondly, Ant Forest is not ready to connect with the carbon market. If there are not enough standards, tradable markets and a complete circulation environment, it is not enough to constitute an asset with circulation attributes. Personal carbon account will produce double calculation, if the credits have been exchanged by steps in one software, it can be calculated again in another software, which is not conducive to the management and trading of personal carbon account.

This is followed by a lack of readiness to connect with the carbon market. Carbon credits and carbon currency can only play a real role if they can participate in market transactions. At present, the incentive method of "point exchange" is commonly used. Usually, the value of goods or services exchanged by points is still relatively small and the type is limited. Assets have financial attributes. Since they have financial attributes, their quantitative methods, market recognition and policy background should be relatively perfect and widely recognized. If there is not enough standard, tradable market and complete circulation environment, it is not enough to constitute an asset with circulation attributes [3] (Interview with Wang Xiaoying, head of Ant Forest low-carbon

advocacy project: The establishment of personal carbon account is to advocate low-carbon life). Low interoperability among traditional carbon accounts, carbon market participants may have to operate many carbon account systems for carbon trading activities, low sharing efficiency, lack of traditional carbon account credit conversion paths, can only rely on manual access to carbon account information and carry out low-carbon enterprise identification work, resulting in low efficiency of carbon account credit conversion. Unable to obtain timely financial support and carbon trading market information. It is difficult for third-party institutions to verify and authenticate the data, and the existing management costs and operational complexity pose obstacles to the market connection of carbon accounts. Moreover, the problem of double calculation among various carbon accounts also makes it impossible to conduct reasonable market docking of carbon accounts.

Data security and risk control lack mechanism guarantee. Data is the core of the digital economy, and its value lies in its full flow and utilization [4], while data security is the basis to ensure the flow of data. Many social production data such as personal life and enterprise operation involved in the process of collecting carbon data are the direct manifestation of our country's social economy. Therefore, the security and risk management of carbon data are not only the privacy protection of citizens, but also the risk management and control of the state, government, financial institutions and platform companies in the data flow. With the deepening of practice, data security will certainly become a major constraint on the future development of carbon accounts, and directly affect the enthusiasm of enterprises and individuals to participate in the construction of carbon account system.

This paper will start from the application of blockchain, explore the suitability of blockchain technology and carbon account construction, creatively propose a carbon account construction framework based on blockchain technology, and analyze the coupling degree of blockchain technology and carbon account construction.

2 Analysis

Blockchain technology (BCT) was first popularized by the spread and application of Bitcoin, a peer-to-peer cash system that allows two parties to transact directly without the supervision of a third party. Initially, Bitcoin was unable to conduct secure transactions for a long time, which led to a shift in attention to Bitcoin's underlying technology, the blockchain technology. American scholar Melanie Swann gave the definition of blockchain in her book "Blockchain: Blueprint and Introduction to the New Economy", pointing out that blockchain technology is an open, transparent and decentralized database [5]. The bulk and block structure of the blockchain ensure the security, immutability, continuity and integrity of the blockchain. The core technology of its application, such as distributed ledger, works by storing the transaction history of each node on the block and linking all transactions from the beginning to the end of the chain. Each node is a complete account, and there are enough nodes to ensure data security and integrity. In addition, blockchain encryption technology mainly uses asymmetric encryption algorithms, digital signatures, and smart contract technology to automatically complete

the workflow and trigger the next operation when conditions are met. All participants can immediately determine the result without the involvement of any middleman, reducing the waste of human resources and avoiding operational errors.

By analyzing the compatibility of blockchain technology and carbon account construction, it is found that the technical advantages of blockchain in all aspects can be well adapted to various management needs of carbon accounts. In the following aspects, blockchain technology and carbon account management needs show high compatibility: First of all, data transparency, carbon account management needs transparent carbon emission data, so as to facilitate supervision and audit. However, blockchain ensures that once the data is recorded on the chain, all participants can access it, ensuring transparency. For data immutability, it is necessary to ensure the accuracy of carbon emission data and prevent data tampering. Blockchain can also make the data recorded on the blockchain immutable, ensuring the authenticity and credibility of the data. The carbon emission data needs to be shared among multiple departments and organizations to avoid data silos. This can be done by using the digital identity authentication technology, key technology and traceability technology of blockchain to conditionally access and open the carbon data of a single subject to the alliance chain through the private chain, forming data sharing between the subject end and breaking the phenomenon of data silos [6]. Carbon account management also needs to trace the source and changes of carbon emission data to ensure the integrity and coherence of data. The technical structure of blockchain ensures that every carbon transaction and operation are recorded in detail and can be traced back to the source. At the same time, in terms of data privacy protection and data interoperability, blockchain technology has shown high compatibility, but because it needs to combine privacy protection mechanisms to fully meet the privacy needs of carbon accounts, and it needs standardized protocols and interfaces to achieve interoperability with other systems, the complexity of blockchain technology has increased. In terms of technical complexity and cost, due to the deployment and maintenance of blockchain technology requires higher technical capabilities and costs, resulting in reduced compatibility, and the advantages and disadvantages need to be weighed.

Technology enabling management, blockchain decentralization, immutable, open and transparent, traceability, security and privacy, the whole process of the technical characteristics, so that it has great application potential in the field of carbon management.

The combination of blockchain technology and carbon account -- life cycle tracking technology

Focuses on the different time dimensions of a single object tracking, focusing on the data changes of a single object over its life cycle.

The key to blockchain technology in combination with carbon accounts is its lifecycle tracking capability, allowing for an exhaustive data recording of a single object at each stage of its life cycle. The entire process from the object's starting point to its end point, such as from production to abandonment, is tracked. For data traceability, blockchain technology ensures the immutability and security of carbon emission-related data (such as emission factors, accounting results, etc.). Once the data is recorded on the blockchain, it cannot be tampered with, thus ensuring the authenticity and reliability of

the data in the carbon account. The carbon footprint accounting model and the basis can be linked to the blockchain technology to ensure that the accounting process is normative and verifiable. In the accounting process, blockchain technology is applied to reduce human resource waste and human error. Accounting results are stored on the chain to ensure the traceability of accounting results, but also improve interoperability, easy to interoperate with other platforms, and realize the integration of data and functions.

With increasingly stringent environmental policies, blockchain will play a greater role in the carbon trading market. A "blockchain sustainability platform", such as IBM's, is already being tested in some industries to help companies optimise carbon emissions by recording product lifecycle data. In addition, more cross-industry cooperation platforms may emerge in the future to achieve seamless integration of data through blockchain, further promoting standardization and interoperability of carbon emission management. This will help build a more transparent and trusted carbon account system and promote the achievement of the Sustainable Development Goals.

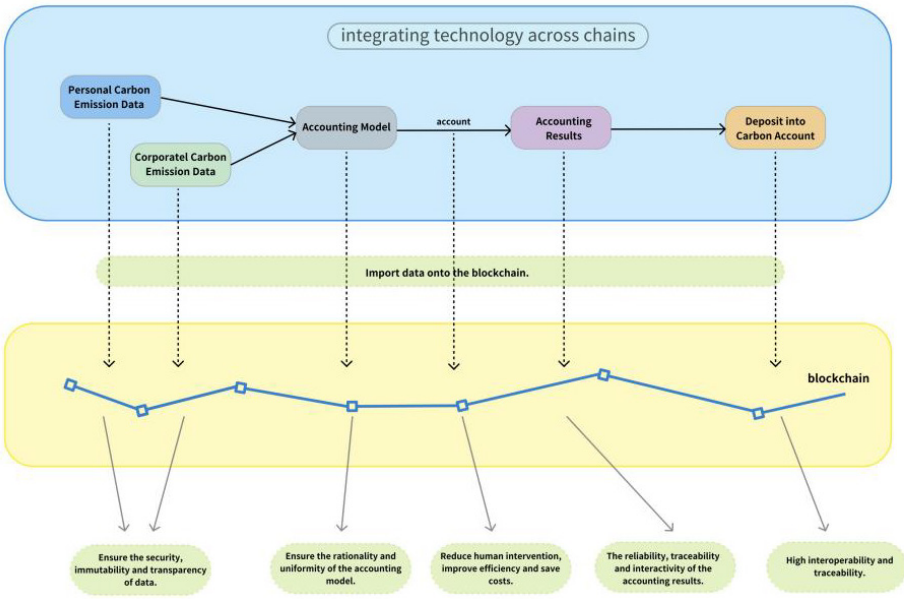

Fig. 1. The combination of blockchain technology and carbon accounts - Life cycle tracking technology.

The cross-chain integration technology combined with blockchain technology and carbon accounts aims to achieve data tracking and verification of multi-participant and multi-dimensional carbon emission data (such as different supply chain links, organizations or regions), as shown in Fig.1. It covers multiple parts of the supply chain, from the supply of raw materials to production, transportation and sales. And involve multiple players and organizations to ensure data transparency across the ecosystem. The application of blockchain technology can achieve the safe storage, use, invocation and

disclosure of carbon emission data for the whole life cycle from raw materials, processing, manufacturing, transportation to the sale of brand enterprises.

In terms of technology implementation, cross-chain integration uses smart contracts to achieve automated data sharing and verification, and enterprises can set different data access rights according to their own needs to ensure the privacy and security of information. In addition, encryption algorithms are used to ensure that the data exchange between participants is transparent while not revealing sensitive information. This mechanism effectively reduces the phenomenon of information silos and improves the integration and interoperability of carbon footprint data.

The "VeChain" platform demonstrates how blockchain technology can be used to track carbon emissions in different parts of the supply chain, as shown in Fig.2. VeChain uses its blockchain ecosystem to connect manufacturers, transport companies and retailers, enabling transparency of carbon footprints from production to consumers. Through cross-chain integration, data is not only updated in real time, but can also be easily verified by regulators, enhancing compliance and corporate accountability.

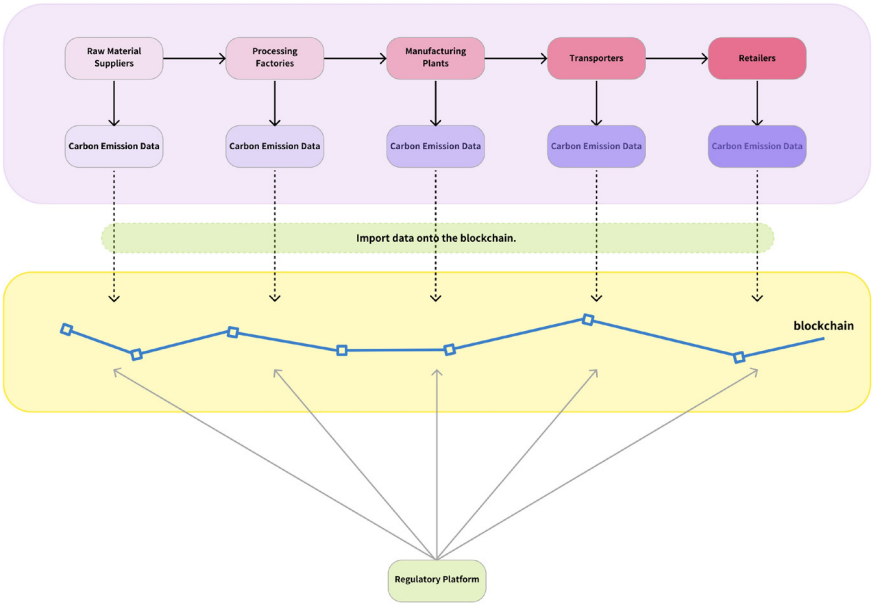

Fig. 2. The combination of blockchain technology and carbon accounts - Cross-chain integration technology.

3 Conclusion

The enabling potential of blockchain technology in the construction of carbon accounts is huge, but there are still many bottlenecks to be overcome. In terms of scalability, as the amount of data increases, the load on the blockchain network rises, often leading to network delays and congestion, which in turn affects the transaction speed. For example, public chains such as Ethereum, during peak periods, transaction fees soar and

processing speeds drop significantly, which is particularly critical in real-time carbon emission data tracking.

The lack of market penetration is also a major challenge. At present, the awareness of blockchain technology is still low among enterprises, and there is a lack of adequate education and training resources to help them understand the potential value of this emerging technology. The inertia of traditional industries makes these enterprises face resistance during the transformation process, which affects the promotion of the technology. In addition, regulatory policies in different regions are inconsistent, leading to complications in compliance. For example, there are significant differences in regulatory standards and data reporting requirements for carbon emissions in certain countries, which makes it necessary for multinational companies to devote additional resources to deal with regional laws and regulations when implementing blockchain.

Vulnerabilities in smart contracts are equally a potential threat at the technical and security

level. While smart contracts automate transactions and reduce human intervention, errors in their code can lead to the loss of funds and data breaches. Therefore, how to strengthen the security audit and development specifications of smart contracts to ensure their reliability is the key in the application of technology. In addition, the high adaptability and flexibility of blockchain is also a challenge, as different regions have different needs for carbon emission management, requiring blockchain platforms to be able to quickly adapt to diverse business environments.

Finally, the high cost and resource consumption of initial deployment are also important considerations for enterprises. The development and maintenance of blockchain technology requires continuous investment of skilled personnel, infrastructure and capital, which puts financial pressure on many smes to innovate. Therefore, finding a viable financing model or government support will be an important way to promote the construction of carbon account blockchain. In conclusion, although blockchain has significant application prospects in the field of carbon accounts, the above-mentioned technical, regulatory and cost challenges need to be addressed in order to realize its full potential.

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