

# ***Development of the Carbon Trading Market Empowered by Blockchain Characteristics***

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**Abstract:** The 'double carbon' goal refers to China's commitment to reach peak carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060. However, achieving a low-carbon transformation requires more innovative technologies to support it. The concept of blockchain is one of them. Blockchain technology has characteristics such as characteristics and advantages are also applied to achieving carbon emission goals. In order to integrate blockchain technology into the governance of the double carbon goal, it is necessary to understand the blockchain technology and the double carbon field, which poses significant regional barriers to research. At present, most research is based on the practice of the double carbon goal, including the impact of the carbon market on the double carbon goal. In this article, the authors analyzed the impact of blockchain characteristics on the carbon market (including carbon emissions and carbon offset systems). Through its numerous strengths, blockchain technology has the potential to offer robust technical backing for the carbon trading market, thereby fostering its swift growth and innovation.

**Keywords:** blockchain, carbon trading market, double carbon

## **1. Introduction**

In September 2020, Xi Jinping, Chinese Chairman, firstly proposed the target of 'dual carbon' at the 75th UNGA (General Assembly of the United Nations). The 'dual carbon' goal means that China committed that carbon dioxide (CO<sub>2</sub>) emission would reach its peak before 2030, and before 2060, carbon neutrality is projected to be achieved as well. Since then, China's low-carbon transformation has been steadily going forward. The 'dual carbon' goal has appeared in several important central meetings, indicating that achieving the 'dual carbon' goal has become a milestone of historical significance for China. Not only that, but its significance also lies in the development of modern economic society as well [1]. The low-carbon economy transition will certainly bring changes in energy structure, industrial structure, and technological innovation. However, the realization of low-carbon transformation requires more innovative technologies to support it. The blockchain concept is one of them. As the technology with great development potential in China at present, in October 2019, Xi Jinping, the General Secretary and Chairman of China, pointed out that blockchain technology applications have been extended to digital finance. During the study in 18th Collective, Chairman Xi focused on the developing status and trend of blockchain technology by the Political Bureau of the

Central Committee of the Chinese Communist Party [2]. Blockchain technology has characteristics such as decentralization, traceability, immutability, and openness and transparency. These characteristics and advantages have also been applied to the realization of carbon emission targets.

For the purpose of integrating the technology of blockchain into the governance of 'dual carbon' goal, it is necessary to understand not only blockchain technology but also the 'dual carbon' field, which poses significant regional barriers for research. Currently, most studies are based on the practice of the 'dual carbon' goal, and the influence of carbon market on the 'dual carbon' goal, etc., which include a case analyzing the position of carbon trading activities in China which promote the green and low-carbon social developing transformation [3]. Another case oriented by the carbon emission rights trading piloting in China, which is derived and analyzed the repercussions of carbon trading policies of China on regional industries [4]. An authoritative study inferred that 'dual carbon' goal in China is schemed to be finished on time under the existence of the carbon market [5]. Or some scholars will study digital economy technologies such as blockchain. There are few academic achievements in studying blockchain investment in 'dual carbon' governance. However, in recent years, some scholars have also conducted research on this topic. Most of the existing studies in this direction are discussing the pros and cons and impacts of applying technology to the carbon market [6-8]. Their research in this field has great significance, but there has not been any research that starts from the characteristics or advantages of blockchain itself, summarizing its advantages in achieving 'dual carbon' impact [9].

Nowadays, the amount of research paying close attention to the characteristics of blockchain for the carbon trading market is hardly any. Therefore, this article will invest in the research of the carbon trading market in line accordance with the various advantages and distinction of blockchain, taking that of still existing problems of blockchain as a case study.

This research mainly focuses on the existing advantages of blockchain and elaborates and analyzes their actual and potential impacts on the carbon trading market one by one. We begin from the 5 main specific of blockchain, that is high security, immutability, high autonomy, openness and transparency to elaborate and analyze. Through this research, we have also concluded that the characteristics of blockchain are indeed suitable for application in promoting the increasing of the carbon trading market. In addition, its advantages have brought positive impacts to the market too. Our research will demonstrate the advantages of a carbon trading market empowered by blockchain technology, thereby helping the government make new decisions to improve the carbon trading market, and finally propose some research suggestions based on this literature review.

## **2. Problems Faced by the Carbon Trading Market**

### **2.1. The Current Price Situation in the International Carbon Market**

Against the backdrop of intensifying global energy market shocks, a series of phenomena such as surging energy prices and expanding inflationary pressures have occurred. 2022 At the beginning of the year, the decline in the expected production of nuclear power in France as well as the reduction in the EU's natural gas reserves have boosted the market's demand for high-carbon energy sources. 2023 The two-energy supply and demand changes have caused an increase in the market's long-term demand for carbon allowances, and the price of carbon has once surged to exceed the 95 euro/tonne. The price of carbon once surged past the €95/tonne mark. On the other hand, the tightening trend of climate policy under the influence of the geopolitical crisis has strongly supported the carbon price. The future of the carbon market looks promising.

## **2.2. Feasibility of Introducing Blockchain Technology**

“The problem of global warming is becoming increasingly serious. From the year 1880 to 2012, there was an increase of 0.85°C in the mean temperature of the Earth’s surface [10]. The issue of carbon emissions has become a global challenge. To address this challenge, the international community has proposed the concept of a carbon trading market, which encourages companies to reduce carbon emissions through policy and market means to achieve sustainable development. In addition, blockchain technology, as an innovative technology with broad application prospects and innovative potential, has received unanimous praise from all walks of life in recent years, including archival management [11], vaccine companies [12], and international business conferences [13]. Compared to traditional databases, blockchain technology has many advantages such as high security, immutability, high autonomy, and openness and transparency [11], which has made it widely used in various industries and achieved significant development. In China, according to the “14th Five-Year National Informatization Plan”, it has now achieved the world’s first patent application volume in the field of blockchain [11]. Blockchain technology can also provide corresponding solutions for the carbon trading market.

## **2.3. Problems Currently Facing China's Carbon Market**

The process of improving the construction of China's carbon market is still facing many problems, firstly, a more perfect mechanism system has not yet been established, and secondly, the carbon trading market currently adopts a centralized management system, which can easily lead to fraudulent behaviour, and in a carbon trading environment, the carbon credit system can be manipulated by a few powerful entities that own most of the carbon credits, thus creating problems and causing carbon false data, low efficiency, and lack of liquidity and other outstanding problems. The primary elements that influence the growth of the carbon market in China are numerous. For the carbon trading market to function effectively, it is essential to have data that is both precise and dependable.

## **2.4. Ideas for Solving Current Problems**

The carbon market is a virtual market built on carbon emission data, and each link relies on carbon emission data information, environment but the current market has such disadvantages as data falsification, false trading, high regulatory costs and high centralized trading, which requires the introduction of the application of relevant technological means to this requires the introduction of technology to ensure the authenticity of the data. The authenticity, security, and trustworthiness of the data become an important basis to support the accurate, reasonable and orderly allocation, trading and clearance of carbon emission rights. The absence or manipulation of data can have a severe impact on the fundamental fairness and structure of the carbon market. The current shortage of innovation in China’s carbon market presents a challenge, and addressing the lack of digital technology to enhance the business model is a pressing issue.

## **3. Evidence of the Impact of Blockchain Advantages on the Market of Carbon Trading**

The carbon trading market is an emerging market for trading environmental rights and interests. It introduces market logic into the carbon emission management system by establishing property rights for environmental resources, a unified trading platform, and trading rules. This promotes independent trading and orderly flow of carbon emission rights, with the goal of optimizing the allocation of environmental resources and reducing the cost of energy conservation and emission reduction through market mechanisms [14]. This unified trading platform setup and peer-to-peer trading mechanism design is logically compatible with the operation idea of blockchain, and thus also provides a

theoretical possibility to apply blockchain to the market of carbon trading and optimise and improve the functions of the carbon market [14]. Markets can accelerate the process of mitigating climate change by investing in efficient decarbonisation activities, but issues of trust, transparency and uptake are what they are facing, and blockchain can provide a foundational technology to create new carbon markets that can address these current issues [15]. As a technology that is at the cutting edge of technology today, blockchain has the advantage of solving the problems of system operational efficiency, management costs, data asset security and fraudulent trading that our carbon market faces in the future big data environment. Currently, the market is using blockchain technology as a secure yet distributed way of making transactions [16]. Today, it is increasingly being used in the carbon trading market, where the application of blockchain can enable the integration of green finance with emerging technologies under the "dual carbon" objective, and this integration will drive further maturity and popularity of blockchain applications. Blockchain provider BlockCDN (BCDN), founded in 2014, it is used as a content distribution network (CDN) and trading platform that is powered by blockchain, which links demand-side and node-sharing parties to protect the rights of all parties. It is possible because it is a smart contract supported through the transparency, fairness, openness and immutability of blockchain technology [17]. CDN (Content Delivery Network) is a distributed network where node servers in different parts of the world come together to form it, and it is responsible for delivering the Internet's content such as websites, videos, and online games to end node servers near the end user, while maintaining its high availability [17]. Blockchain is reconfiguring the current energy market and transforming it from a null-break scenario to one that is more competitive and distributed [18].

### **3.1. The Impact of Blockchain'S High Governance on the Carbon Market**

Blockchain is an emerging technology that is a combination of several technologies - distributed ledgers, consensus mechanisms, and cryptography [19,20]. It is highly autonomous, blockchain cannot be used without norms and protocols, which is based on the consensus of all the people of a normative protocol, which ensures that all the nodes in the whole system can freely and securely exchange its data, record the data, update the data, and this is based on a de-trusted environment free from human intervention. The autonomy of the blockchain allows the participants and the central system to form an automatic consensus mechanism according to open algorithms and rules, and every transaction recorded on the blockchain is more accurate and authentic. Therefore, the high autonomy of blockchain can be used to create a blockchain carbon data management platform, i.e. the "double carbon" data management platform. The platform uses blockchain technology as the underlying application foundation, opens up the data collection and data analysis data process, collaborates with IoT devices, existing information systems and other software and hardware systems, supports credible carbon emission data and credible carbon emission certification management, and provides a credible basis for carbon asset management, in order to establish a safe and reliable carbon trading market. Blockchain, as an information technology innovation with the strongest development trend in today's society, is able to provide high precision modulation for human beings in terms of the quality and authenticity of the information concerned. It connects big data, cloud computing, the Internet of Things, artificial intelligence, robots, etc. to a network that can communicate with each other, through which different programs, in order to be able to achieve their goals, digital intelligence will require their transfers and transactions, many tasks can be managed automatically through the blockchain, providing a convenient way to manage carbon trading platforms.

### **3.2. The Impact of Openness and Transparency and Immutability for the Market of Carbon Trading**

The generation and existence of carbon emission rights are based on data. As an abstract and fictitious property right, the authenticity, security and credibility of relevant data have become an important basis for the accurate, reasonable and orderly allocation, trading and payment of carbon emission rights. Once the data is missing or distorted, the basic fairness and order of the carbon market will be seriously affected [14]. Therefore, the use of blockchain can be of great use. Its open and transparent and immutable characteristics can significantly improve the authenticity, accuracy and security of carbon trading-related data, which will be able to maintain the order of the carbon market operation. For example, through blockchain technology, all participants' data can be recorded on a distributed ledger and ensure that the data is tamper-proof. This can prevent fraud from occurring and ensure the authenticity and credibility of carbon emission data [21].

### **3.3. The Impact of Blockchain Security for the Carbon Market**

When establishing a carbon trading market, the security aspect should be emphasized. Issues of trust, transparency and uptake are problems that markets are facing in accelerating climate change mitigation using investments that promote efficient decarbonisation activities. As mentioned above, once data is missing or distorted, the basic fairness and order of the carbon market will be severely affected. Whereas blockchain technology can provide a strong technological means to aid this goal, Blockchain has unique decentralized and tamper-proof characteristics and plays a crucial role in the carbon trading market [22]. Especially its tamper-proof feature, because blockchain uses cryptographic technology to store data in a distributed ledger in an unchangeable way [23]. When someone tries to tamper with the data of a block, it will cause the values of that block and subsequent blocks to change and be rejected by other nodes. This ensures the integrity and consistency of the data [14, 23]. This is a new way of trading which has blockchain provision which allows energy scenarios to be exchanged between market participants without any centralised authority and in addition to this it allows for a distributed solution for secure trade settlement and record keeping. Blockchain has been used to allow users to track such transactions in energy trading wells without the risk of such transactions being altered, which significantly increases the security of the carbon trading process.

### **3.4. The Impact of Blockchain'S High Autonomy on the Carbon Trading Market**

Blockchain's high autonomy is one of its decentralized characteristics. It is not controlled and managed by a central authority, but rather through consensus and decision-making by many nodes in the network. This autonomy can also be used in the market of carbon trading. This feature has many advantages, including enhancing the credibility of the market of carbon trading and promoting the rapid development and innovation of the carbon trading market. The biggest advantage is that it can reduce the number of intermediaries in the market of carbon trading. Traditional carbon trading markets often require a large number of intermediaries to coordinate and manage transactions. By using blockchain technology, direct peer-to-peer transactions can be achieved. Participants can trade through smart contracts and share and verify transaction records through the blockchain's distributed ledger, thereby reducing the participation of intermediaries, improving the efficiency of carbon trading and reducing costs. As blockchain technology is gradually applied more deeply in the market of carbon trading, the pricing standards of the market of carbon trading will gradually become more reasonable, and participants will know that green can help them achieve resource allocation more efficiently. In the future, more and more companies are expected to abandon their previous extensive emission methods and take a more economical and low-carbon development path [6,24].

## 4. Conclusion

The study discusses the role of blockchain technology in promoting the development of dual carbon goals. The construction of China's carbon market is still facing many problems and needs more innovation-driven, using digital technology to improve business operations. Blockchain technology can provide a powerful technical tool for the carbon trading market, solving problems such as system operation efficiency, management costs, data asset security, and fraudulent trading.

In the second part, the article discusses in detail the various advantages of blockchain technology in the carbon trading market and its impact. Firstly, the high autonomy of blockchain can establish a blockchain carbon data management platform for the carbon trading market, support credible carbon emission data and credible carbon emission certification management, and provide a reliable basis for carbon asset management. Secondly, The blockchain technology, with its open, transparent, and unchangeable nature, can greatly enhance the authenticity, precision, and safety of data related to carbon trading, thus ensuring the smooth operation of the carbon market. Furthermore, the security provided by blockchain is vital to the carbon market. Its distinct decentralized and tamper-resistant features can guarantee the completeness and consistency of data. Lastly, the high level of autonomy offered by blockchain can also be beneficial in the carbon trading market. It can minimize the involvement of intermediaries, increase the efficiency of carbon trading, and lower costs. In conclusion, research suggests that blockchain technology can offer robust technical support for the carbon trading market and foster its rapid growth and innovation through its various strengths.

In line with practical needs, the future research direction in this field is to further explore the application and optimization of the blockchain carbon market, which may include the integration of emerging technologies with blockchain to empower the carbon trading market, thereby promoting a more mature carbon trading market system and providing forward-looking suggestions. In addition, this article did not complete an evaluation of the shortcomings of blockchain characteristics, so future research should explore how blockchain technology can be applied to the broader carbon trading market rather than within a small scope. This will require us to respond to and explain the problems that exist with blockchain, as well as find solutions to these problems and evaluate them.

## Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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