



Blockchain + Internet of Things in the Field of Environmental Protection

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Abstract. As the concept of blockchain technology continues to mature, its application is gradually extended from the financial field to various links, and in the future blockchain will promote the combination of green finance and energy conservation and environmental protection. This paper analyzes the current pain points of the environmental protection industry from the characteristics of blockchain, takes the application of energy conservation and environmental protection + blockchain as an example to circumvent the existing problems, and aims to optimize the energy conservation and environmental protection industry and energy structure, promote the transformation and upgrading of traditional industries, and realize the coordinated development of environmental protection and economy.

Keywords: Blockchain · Internet of Things · Environmental protection · Innovative application

1 Introduction

With the rapid development of the Internet of Things, the Internet of Everything will reshape the existing network and service platform. With the gradual maturity of blockchain technology concept, the role of new generation information technology in a variety of industries has become more and more important, and gradually become the direction of deepening information technology applications in various industries. From the perspective of the development trend at home and abroad and the evolution path of blockchain technology development, the development of blockchain technology and application needs cloud computing, big data, Internet of Things and other new generation information technology as infrastructure support, while the development of blockchain technology and application has an important role in promoting the development of new generation information technology industry [12]. Figure 1 illustrates the relationship between blockchain and new generation information technology.

Including blockchain and cloud computing, 5G communication, artificial intelligence and other technologies in the category of new infrastructure, accelerating the implementation of blockchain development plans and platforms, and promoting the mutual integration of blockchain and other frontier technologies is one of the action plans for domestic blockchain from 2020 to 2023 (see Fig. 2).

The concept of blockchain technology is applied to the environmental protection field to solve some of the current problems and challenges in order to bring new value to the society [5].

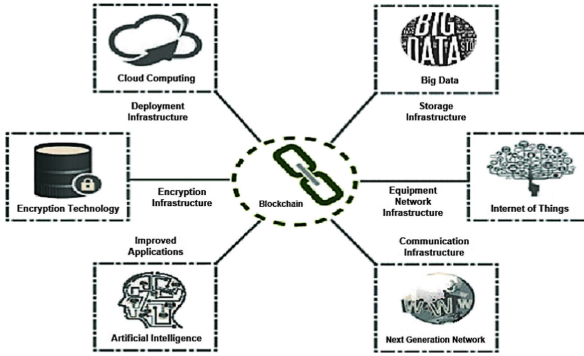


Fig. 1. Blockchain and New Generation Information Technology. Data source: China Blockchain Technology and Application Development White Paper.

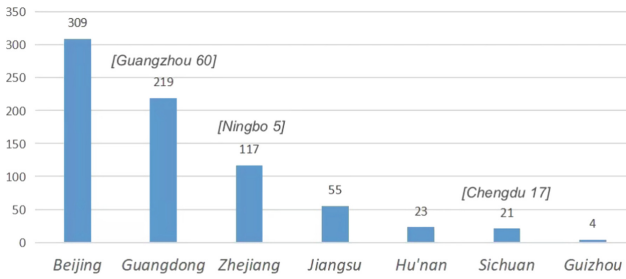


Fig. 2. Statistics on the number of filings of blockchain information services in relevant provinces (four batches in total). Data source: Digital Qin Research Institute.

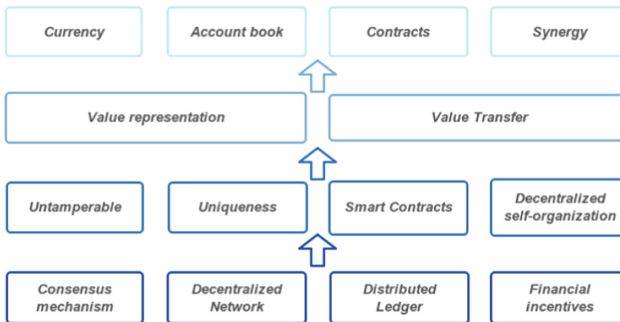


Fig. 3. A diagram to understand blockchain: from foundation to application.

2 Blockchain Definition and Characteristics

Baidu: It is a new application model of computer technology such as distributed data storage, peer-to-peer transmission, consensus mechanisms and encryption algorithms. Wikipedia: an intelligent peer-to-peer network that uses distributed databases to identify,

disseminate and record information, also known as the Internet of Values. Babbitt: a distributed database system with node participation [15]. The four main features of blockchain are immutability, uniqueness needed to represent value, smart contracts, and decentralized self-organization (as in Fig. 3) [13].

3 The Current Pain Points of the Environmental Industry

At present, the following problems still exist in environmental protection: tampering and falsification of environmental monitoring data occur. Data quality is the lifeline of environmental monitoring, and the authenticity, comprehensiveness and long-term nature of environmental data are the most basic requirements of environmental monitoring; corruption in environmental charity exists, and the flow of funds received by environmental charities is difficult to track. Bureaucracy, corruption and inefficiency still exist in the field of charity, and trust is the lifeline in the field of public charity; waste recycling lacks incentives, and to fundamentally solve China’s ecological and environmental problems, it is still necessary to give full play to the advantages of China’s population resources, and in a series of environmental initiatives, the public often does not receive reasonable and appropriate incentives and rewards, and the motivation to participate is generally low and difficult to promote [3].

4 Blockchain for Smart Environmental Protection

Everything is connected, data intelligence for the environmental protection field ushered in new opportunities, the Internet of Things and blockchain technology to integrate with each other, and actively layout the blockchain application ecosystem to solve the existing pain points in the environmental protection industry, is the current environmental protection urgent need to be resolved (Fig. 4).

In terms of the application of blockchain technology, the scalability of the technology to meet the risk of storing massive environmental data and the security risks affect the

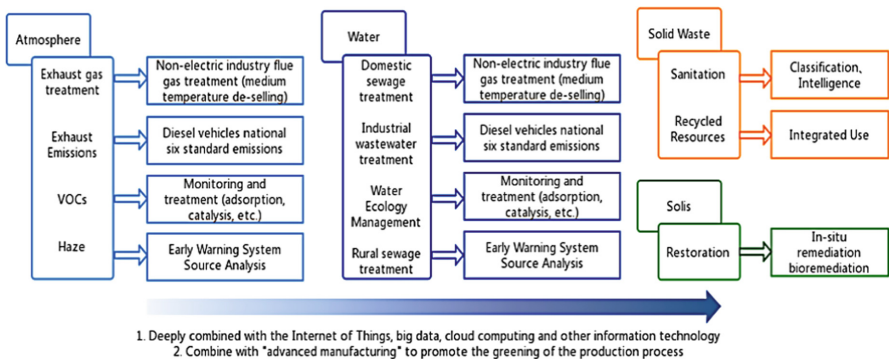


Fig. 4. Examples of urgent technical problems in the environmental protection industry. Source Everbright Securities Research Institute.

application of the technology [4]. By organically connecting multiple links such as production and manufacturing as well as transportation, with the help of blockchain technology, we can realize the monitoring of relevant factors as well as data to achieve accurate records without tampering, and then find the root cause of the problem and propose measures for environmental governance and protection [6] Blockchain, as a new technology concept, has very important applications in digital copyright, identity authentication and network security.

4.1 The Most Basic of Environmental Protection is Data

There is a possibility of tampering of pollution data during transmission from environmental monitoring devices to the network. Blockchain can provide a permanent record for each monitoring, prevent tampering by applying encryption technology, improve the reliability of data, and strengthen the supervision of sewage enterprises [14]. The application of blockchain technology concept can achieve digital tracking of the whole process of sewage discharge and avoid the influence of human factors on the accuracy of sewage data. The combination of blockchain + Internet of Things can effectively control pollution. This is illustrated by the first “Internet of Things + Blockchain” recycling system in Taizhou City, Zhejiang Province. For example, a sewage transporter pours collected oily wastewater into a giant “black box” on the shore. Immediately afterwards, detailed data appears on the digital display of the “black box” - the “Ocean Cloud Warehouse” - and all collected hazardous waste is conveniently processed by it using this device. “Ocean Cloud Warehouse” can automatically record the time, quantity and type of pollutants put in, and reduce the amount of pollutants put in such as concentration and filtration, and is one of the recycling devices of the hazardous waste system in Taizhou, Zhejiang Province, as well as the Internet of Things terminal of the system. The system solves the pain points of untimely collection and treatment and high cost of classification and treatment in the traditional hazardous waste treatment mode. Another role of “Ocean Cloud Warehouse” is to analyze and calculate the type and total amount of pollutants after reduction, and plan the transportation path in a targeted manner to transport these pollutants to the disposal enterprises with corresponding qualifications. Using the system support, disposal enterprises can understand the amount of waste generated in advance, reasonably arrange storage and production plans, significantly reduce costs and improve disposal efficiency, compared with the traditional process, can save 94% of the manpower and reduce costs by 84%. In the whole process of data supervision, the whole process of visualization of hazardous waste information is achieved. In particular, the system is online, linking hazardous waste with related parties such as transportation, disposal, supervision and market, realizing the decarbonization and standardization of hazardous waste. The environmental protection department uses blockchain technology to establish the basic information database of emission enterprises, centralize the information and pollution equipment of all recorded emission enterprises, establish corresponding files for each source, and put the files on the blockchain to prevent forgery and tampering, while using the blockchain public and private key system to establish an account verification mechanism to prevent theft of account data [10].

4.2 Towards a Circular Economy

Circular economy is the elimination of waste, where everything is recycled and reused to the maximum extent possible, thus minimizing environmental hazards, some call it a regenerative economy, and in the global consumer goods industry alone, it is expected to avoid more than \$700 billion in waste annually [2]. With the rapid development of China's economy and society, the production and continuous increase of important industrial materials such as steel materials, non-ferrous metal materials, plastic products, paper products and household products, as well as the increasing consumption rate of these products, the production of waste resources such as steel scrap, metal scrap, paper scrap, plastic scrap, etc. is increasing, causing great pressure on the environment. Therefore, the recycling of waste resources is an inevitable development trend in Chinese society. From 2016 to 2018, the three head representatives of China's renewable resources (i.e. Qidian Environment, Greenmei, and Yuguang Gold Lead) all showed stable growth in operating revenue (see Fig. 5).

The circular economy is seen as a top priority by many sectors and leaders, which brings a boon to the sustainable management of human society and the future environment, where companies can grant tokens to incentivize consumers to recycle their waste products and track whether they are disposed of responsibly [11]. In particular, with the advent of blockchain, its tracking capabilities combined with tokens for rewarding individual behavior have significantly increased the viability of the circular economy (see Fig. 6).

For example, BESC Enterprises plans to use crowdfunding to invest in renewable energy projects, allowing participating companies or individuals to receive a digital currency corresponding to the carbon emission reductions generated by the project [8]. Alipay's Sesame Credit also uses blockchain technology to score each company and product based on the carbon footprint of the products sold, increasing transparency in the production and sale of products and reducing resource waste while preventing environmentally unfriendly situations. The incentive mechanism creates a momentum for

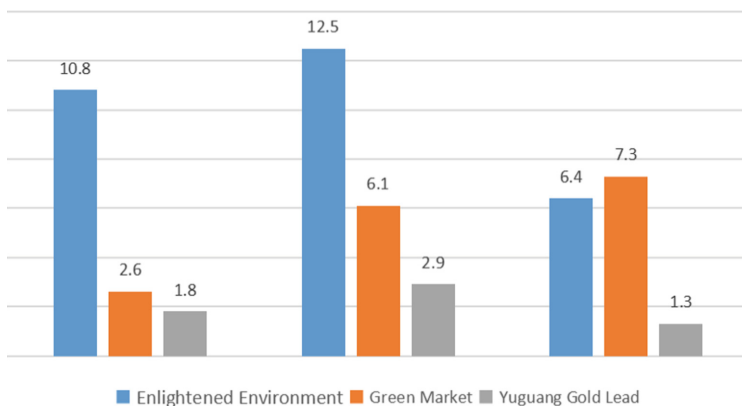


Fig. 5. List of net profits of representative companies in China's renewable resources, 2016–2018 (in billions). Source: Financial Reports by Companies, Aimedia Data Center.



Fig. 6. The circular economy of tokenization. Source: IBM Business Value Institute analysis.

rapid economic and social development and contributes to the development of a circular and low-carbon economy [9] Plastic Bank encourages recycling-minded companies to collect discarded plastic bottles from beaches and bring them to Plastic Bank recycling sites. Waste pickers are encouraged to recycle their waste. After recycling, these waste products are turned into “social plastic” (social plastic is resold to environmental partners such as Henkel Germany and Norton Point Sunglasses, which turn these waste products into recyclable consumer goods, 3D printed bricks for building houses, or reusable consumer goods). Whatever the material of the packaging, it will be labeled with a “social plastic label” [1]. Most importantly, it will prevent plastic from entering the ocean. Moreover, to reward waste collection, fraud and fraudulent claims can be prevented. With the help of blockchain, waste pickers can receive blockchain-based digital tokens instead of cash through their smartphones. This gives waste pickers the convenience of not needing a bank account. Scavengers can use tokens to buy groceries, pay for school fees, purchase health insurance, and pay utility bills through microtransactions. Tokens also ensure that manufacturing partners’ funds are not misappropriated and support them in clearly verifying where donations are going. Through plastic banks, scavengers can gain access to savings accounts and even credit ratings for their long-term persistence, enabling them to access better financial terms for loans and mortgages. It is blockchain-based tokens that make this new business opportunity possible (Fig. 7).

4.3 Environmental Tax Implementation

The integrated application of blockchain and IoT can provide a feasible technical solution for the implementation of environmental protection tax. Blockchain technology can achieve network-wide consensus and common maintenance of data, and the combination with IoT can collect emission data of emission enterprises more accurately. At the same time, by applying blockchain for differentiated authorization, regulators can mark the enterprises that are exempt from the tax and prevent them from abusing the tax exemption provisions [7].

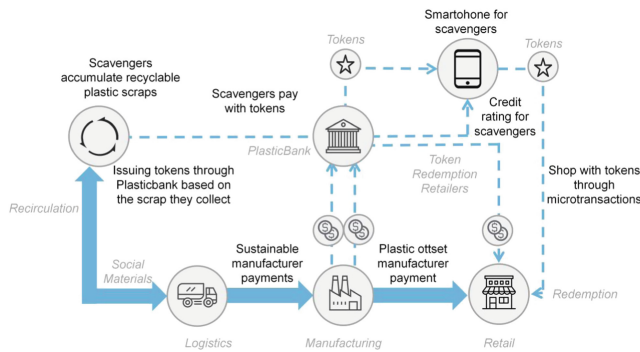


Fig. 7. Turning plastic scrap into money. Source: IBM Business Value Institute analysis.

5 Conclusions

With the gradual formation of the national digital sharing economy, blockchain technology will become an important source of kinetic energy for the future development of IoT innovation. At present, global environmental issues, especially in developing countries, are receiving increasing attention from the international community, and the emergence of a new “green blockchain” ecosystem is inevitable. This paper makes some discussion on the application of blockchain + Internet of Things in environmental protection. Energy conservation and environmental protection + blockchain means that the combination of blockchain and distributed energy will reshape the whole energy conservation and environmental protection industry in the future, and for the environmental protection industry, blockchain is an opportunity to leap again. Blockchain, as a trust-building machine, will likely revolutionize the way value is delivered throughout human society. “The integrated application of “Internet of Things + Blockchain” in the environmental protection field will greatly accelerate the construction of the industrial ecology.

References

1. Allington A (2018) Can Blockchain Fix the Ocean Plastic Problem? Bloomberg BNA 18, 56–58
2. Cui YL (2019) Towards the circular economy. Opportunities for the consumer goods sector Part 2. Ellen MacArthur Foundation 2013 78, 99–101
3. Gao J, Ye Q (2018) Environmental monitoring data falsification is another kind of “pollution”. Guangming Daily 326, 77–83
4. Furukawa K, Zhao JY (2019) Experimenting with blockchain technology-based auto payment for cars in the United States. Sino-Foreign Manag 46:21–22
5. Li F (2020) Blockchain White Paper. China Academy of Information and Communication Research 89, 22–45
6. Liu CX (2019) China’s blockchain enters innovation and development to welcome favorable policies. China Electronics News 52, 74–76
7. Liu QQ (2019) Exploratory Applications of Blockchain in the Field of Smart Cities 72, 63–65
8. Luo SM (2019) Using blockchain technology to enhance the modernization of government governance system and governance capacity. People’s Political Consultative Conference Daily 4, 3

9. Mei LH, Li X (2010) Policy regulation and incentive mechanism of circular economy. *Chongqing Soc Sci* 58:101
10. Tan HB, Zhou T (2019) A blockchain-based approach to archival data protection and sharing. *J Softw* 74:43–44
11. Wang LJ, Zhang QM, He P (2019) A brief discussion on environmental protection and sustainable development. *Green Environ Prot Build Mater* 55:67–68
12. Wu WD (2016) China Blockchain Technology and Application Development White Paper. Ministry of Industry and Information Technology 64, 23–26
13. Xu F (2019) Application long and short boards from blockchain features. *Beijing Daily* 92, 117–119
14. Zhang Q (2020) China Security Blockchain helps solve IoT pain points Enabling more functions 41, 92–93
15. Zhang X (2018) Blockchain (Blockchain). *360 Encyclopedia* 38, 49–52

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