Research on the Application Prospect of Energy Blockchain in Power Grid Enterprises

Yixin Sun¹,*, Cheng Wang¹, and Xiaobao Yu²
¹State Grid Energy Research Institute Co, LTD
²Shanghai University of Electric Power

Abstract. Blockchain technology used widely in the financial field. As a representative of payment tools, Bitcoin impacted the monopoly of traditional finance and currency. As the key technology of Bitcoin operation, blockchain technology also has broad prospects in the energy field. Based on the analysis of the application prospects and related influences of blockchain technology in the field of energy and power, this paper puts forward an application model suitable for power grid enterprises and gives corresponding countermeasures and suggestions.

1 Blockchain technology features and application prospect judgment

Blockchain technology is an open distributed database technology, which can manage data in time sequence and ensure that the data cannot be tampered. Blockchain technology establishes a spontaneous trust mechanism among multiple nodes, which can solve the demands of transaction information recording and sharing, trusted data exchange and business transmission among multiple entities in the business world, and is a new engine driving the development of digital economy and sharing economy.

1.1 Basic features of blockchain Technology

The technical features of blockchain are mainly reflected in the following aspects:

First, it forms a real and reliable data base. Blockchain is a kind of distributed database for background technicians. The traditional database has four classic operations: adding, deleting, modifying and querying. For the whole network ledger, the blockchain technology is equivalent to giving up the two options of deletion and modification, leaving only two operations of addition and query. Through the "block chain" structure such as block and list, and the corresponding time stamp to solidify the voucher, a set of linked and hard to tamper trusted data is formed.

The second is to establish a cooperative foundation for multi-user participation. Blockchain technology realizes the openness and transparency of system operation rules through mathematical principles and program algorithms, and the data is stored on the chain, which cannot be tampered with, so that both sides of the transaction can reach trust through consensus without the endorsement of the third-party authority, and build a multi-party cooperation foundation.
Third, it has laid a fair and transparent foundation for business implementation and value transfer. The blockchain realizes the programmable and automatic contract. The smart contract automatically executes the pre-defined rules and terms based on the non-tamperable data, reduces the legal disputes caused by the ambiguity of human language, and realizes the consensus between machines without human intervention.

Fourthly, the foundation of sustainable development is established. Blockchain is mainly to reduce transaction cost (trust cost) and expand market transaction scale. The public blockchain adopts the way of issuing tokens as the reward and incentive mechanism of participants. The private chain does not need to rely on currency as a reward.

Generally speaking, the blockchain technology is applicable to the application scenarios based on database, which need multi-party cooperation and establish the trust mechanism together, which is helpful for multi-party to reach data consensus, trust consensus and cooperation consensus. As a disruptive technology, blockchain is leading a new round of technological and industrial changes in the world. It is expected to become the "source" of global technological innovation and model innovation, and promote the transition from "information internet" to "value Internet".

1.2 Application and development trend of blockchain technology

From the perspective of technology application maturity, the application conditions of blockchain are relatively mature. In the financial field, such as cross-border payment and settlement, bill business, loan settlement and other businesses with high trust cost and many audit procedures, there have been a large number of blockchain application cases, such as China Merchants Bank's blockchain direct cross-border payment, China Construction Bank's insurance service system with IBM, etc. From the perspective of business influence, the products that can fundamentally solve the pain points and difficulties of the application industry and have enough promotion potential have not appeared. With the destruction of the tokens issued, the application of block chain has gone from virtual to real. More traditional enterprises are exploring the use of blockchain technology to reduce costs and improve collaboration efficiency.

2 Strategic value and basic thinking of power grid enterprises applying blockchain technology

2.1 Attach great importance to the strategic value of blockchain technology to power grid enterprises

Blockchain technology has become the key technology to support the construction of "three types and two networks" of power grid enterprises, and has a key strategic value for the medium and long-term development of power grid enterprises in the future.

2.1.1 Support platform ecological construction and promote shared governance

Blockchain technology enables the power grid to have the ability of industrial entrance and interaction. In terms of energy flow, business flow, data flow convergence, new technology integration and development, it attracts external enterprises to join the power grid ecosystem, and helps to build a high-quality energy platform ecosystem with the power grid as the core.
2.1.2 Support the incubation of new business forms and promote coordination

Blockchain technology has stimulated the innovation of energy production, consumption and upstream and downstream industries. It has provided new models such as demand discovery, product incubation, channel expansion and value transfer for comprehensive energy services, electric vehicles, e-mall, smart home and other businesses, and promoted industrial integration in terms of gathering common development and accelerating win-win cooperation.

2.1.3 Support internal operation and promote quality and efficiency improvement

Blockchain technology helps power grid enterprises to break the institutional dilemma. In terms of electronic contract, audit, document circulation, etc., the development of automatic implementation of blockchain application approval procedures will greatly improve the efficiency of internal department cooperation, accelerate management reform, and enhance the vitality of enterprises.

2.1.4 Support data governance and promote value creation

Focus on four aspects of strategic value, and do a good job in the strategic layout and implementation of blockchain technology. As shown in Figure 1.

Figure 1. Block chain technology promotes value creation of power grid enterprises.

Principle 1: adhere to the advance of strategic layout. At present, the construction of energy Internet is subject to the game of multiple interests, and the external environment is complex. Power grid enterprises must be ahead of time to promote the application of blockchain technology. In the fields of distributed energy transaction and electric vehicle charging and changing, it is necessary to seize the commanding point of blockchain technology application because the initial rule maker will affect the fair and stable operation of the whole application system.

Principle 2: adhere to the application orientation of incremental value contribution, and grid enterprises should focus on the main line of energy Internet development of grid enterprises. The key is to give full play to the potential of incremental value creation, break through the limitations of traditional systems and mechanisms, force business change and
management change, accelerate industrial integration and data integration, enable grassroots businesses, and enable production front-line employees and customers.

Principle 3: focus on areas with high online level and high value density. In the aspect of data chain management, power grid enterprises should focus on the chain management of key data with high information value density and high online degree to create an open, transparent, traceable and tamper proof data environment.

Principle 4: adhere to new technology integration and iterative application. In terms of platform deployment, power grid enterprises should fully integrate 5g communication, artificial intelligence, Internet of things and other new technologies, carry out multi scenario application in combination with practical pain points and difficulties, and continue to iterate in practice.

2.2 Key application directions of blockchain technology

For power grid enterprises, blockchain technology is mainly used in power grid operation and power trading, enterprise operation management, value-added services (see Table 1), which can effectively support the construction of hub type, platform type and sharing type modern enterprises of power grid enterprises, and adapt to the new situation of power grid enterprise reform and development.

Table 1. Relevant application scenarios of blockchain technology in power grid enterprises.

| Implementation function | Application scenario |
|------------------------|----------------------|
| Enterprise operation management | On line monitoring and detection of power grid equipment | Equipment fault diagnosis |
| Value added services | Realize the data cannot be tampered, traced and distinguished | Standardized management of data assets, power financial audit, benchmarking of power enterprises, power supply chain management, supply chain finance |
| | Reduce the risk of intrusion through external systems | Internet of things device security |
| Power grid operation and power trading | Realization of credit guarantee and data realization | Power asset securitization, cross-border payment, digital bill, data open sharing service |
| | To develop the token economy in the field of energy | Virtual currency of energy (e.g. monetization of photovoltaic and green card assets) |
| | Power grid operation and power trading | Distributed equipment cooperation, integrated management of substation + charging station + Data Center Station |
| | Point to point transactions between multiple entities | Distributed energy power trading, charging and trading services of charging piles, carbon emission trading and traceability, virtual power plant |
| | Credible management of energy measurement | New energy subsidy behavior identification and energy performance management |

3 Countermeasures and suggestions

First, give full play to the strategic breaking value of blockchain application. Avoid the application tendency of big data as a tool and fragment, focus on the new situation and
problems of power grid enterprises, take decision-making as the guide, give play to the key role of blockchain in the construction of platform and sharing enterprises, and strengthen the research and application of fundamental and overall problems in the innovation and development of power grid enterprises.

The second is to strengthen the building block innovation and front-end integration innovation. Focusing on the pain points and difficulties, selecting the application topics of blockchain for key common research and major business prospects can give full play to the advantages of all units in the system, and achieve complementary advantages in business model innovation, technology realization, data processing and other links.

Third, accelerate the pilot construction with the concept of openness, cooperation and win-win. Attract the capital of upstream and downstream energy enterprises, powerful Internet enterprises, private enterprises and other parties, jointly build the pilot of energy blockchain commercial application, explore the application of blockchain technology in smart city, comprehensive energy services and other businesses, and jointly carry out pilot construction, share risks and share profits.

Fourth, establish a supporting mechanism to adapt to the application of technological innovation. Establish an incentive mechanism for blockchain technology and data sharing within the power grid enterprise, encourage the majority of front-line teams to carry out blockchain technology innovation competition; promote the improvement of blockchain standards with the application practice of blockchain technology, gradually improve the application system of blockchain technology, and improve the voice of power grid enterprises.

This work was supported by the science and technology project of SGCC, called ‘Research on Key Technologies of Power Data Asset Operation and Value Mining’.

References

1. Swan M. Blockchain: Blueprint for a new economy. California: O’Reilly Media, 2015.
2. Nakamoto S. Bitcoin: a peer-to-peer electronic cash system [Online], available: https://bitcoin.org/bitcoin.pdf, 2009.
3. Wang Fei-Yue. Computational experiments for behavior analysis and decision evaluation of complex systems. Journal of System Simulation, 2004, 16(5): 893–897.
4. Sarkar P. Data Asset Management[M]//Data as a Service: A Framework for Providing Reusable Enterprise Data Services. John Wiley & Sons, Inc. 2015:43-60.
5. Simmhan Y L, Plale B, Gannon D. A survey of data provenance in e-science[J]. Acm Sigmod Record, 2005, 34(3):31-36.