

Research on block chain technology in energy Internet

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Keywords: Energy Internet, block chain technology, Problems faced, application prospect

Abstract. In order to speed up the application of the energy of the Internet, to promote the planning process of the national energy strategy, and build competitive and healthy market mechanism fully, Energy Internet and block chain technology is studied in this paper, in view of our country's development energy block chain problems, it put forward some suggestions to solve these problems. Finally, it introduced the application of block chain in the energy in the field of the Internet.

1. Introduction

Now, energy Internet has become the forefront of the science academic and technology industrial innovation, it is an important development direction in the field of energy after the smart grid. But, the solution still exist some problems such as Grid connection of renewable energy, long-distance transmission loss, demand side response, network security. Energy Internet has not change the Energy field fundamentally, particular business model and market mechanism inherent in the power industry. Until the emergence of block chain technology, energy block chain make us see the chance of Energy power's complete reconstruction from the underlying architecture to the business platform. Block chain has gradually become the underlying technology for the future value of the Internet, It play an important role to structure the new value system of centralization based on the "Internet+" and the Internet of things.

2. Development of the energy Internet

With the increasingly serious environmental problems, the energy crisis is coming, more and more organizations importance to environmental protection, and also began to actively explore a variety of new energy research. Although some progress has been made, but there are many problems, such as scattered distribution, low utilization rate and high cost of energy conversion the technology. It is greatly restricted the new energy in large-scale applications and marketing. In order to solve the problem of large-scale promotion and application of new energy, this paper puts forward the concept of energy Internet. The energy Internet has wide direction for the Scope and space-time, the energy of the Internet is the Internet technology as the core, take the distribution network based on large-scale renewable energy and distributed power access, realize information technology and energy infrastructure integration, through the energy management system of large-scale renewable energy and distributed energy infrastructure implementation wide area coordination control, realize optimization of cold, heat, gas, water, electricity and other energy optimization complementary, and intelligent control system to improve energy efficiency. "Internet+energy" has a wealth of imagination and developing prospect, showing a diversified development trend. The depth of fusion energy and the Internet will be more conducive to the development of technology.

The Energy Internet take the power system as the center, integration of smart grid, Internet, big data, cloud computing and other cutting edge technology, advanced technology, comprehensive management, implementation of energy exchange of complementary, fusion energy system into the next generation. Energy Internet has the characteristics of leveling, socialization and customer service hesitation. The power, oil and other transportation nodes are interconnected to form a personalized and customized energy applications to achieve full control of energy flow. Energy Internet is a new type of power grid structure, which is based on renewable energy generation, distributed energy

storage devices and the existing Internet.

3. Block chain technology

In November 2008, a self proclaimed Nakamoto scientist published an article entitled.<Bitcoin:A Peer-to-Peer Electronic CashSystem>of the paper, He propose a P2P based network technology, mathematics, cryptography, electronic cash system algorithm and economic model of the frame concept. Block chain refers to the center and go through the trust the way of collective, maintaining a reliable database technology.

Block chain technology integrates a series of technical systems:

1) Removal center

Because the network block chain system using P2P, there is no centralized server and router, the status of any node in the system is equal, the system generated data blocks by all the nodes in the system to safeguard, all nodes have transaction data recording and storage.

2) Openness

The system is open to everyone, except the private information of nodes, anyone can query the block data information through the block size hash value, so the information of the whole system is highly transparent.

3) Autonomy

The block chain adopts a fixed consensus consensus algorithm, so that all nodes in the system can exchange data in the environment without any trust endorsement, It make the trust of the people and institutions into a trust in the machine and mathematical algorithms, nobody will interfere the correct operation of the system.

4) Information cannot be tampered

Once the transaction information of the system is verified by each node, it will form the records which can not be changed, Unless it is possible to control more than 51% of the nodes to interfere with the verification of the transaction at the same time, Otherwise, tampering with the database on a single node will not play any role. At the same time it will also be aware of the whole network node, and to be excluded by the system. Therefore, the data stability and reliability of block chain is excellent.

5) Anonymity

The exchange of data between nodes follows a fixed algorithm, so that both parties need not disclose their identity, but through the procedures in the block chain to allow the other party to produce their own trust.

4. The concept of energy Internet in block chain technology

To some extent, the concept of block chain technology is similar to the concept of energy Internet (see Table 1):

Table 1 Blockchain technique and energy internet philosophy

Characteristic	Block chain technology	Energy Internet
Removal center	All node rights and obligations are equal	The main decentralized decision
Cooperative autonomy	All nodes are maintained together	Different forms of energy efficient coordination
Smart contract	No third party trust mechanism	Diversified energy market
Marketed	Ability to execute contracts automatically	Automated trading everywhere

1)Block chain and the energy of the Internet embodies the idea of removal center, In the block chain system, there is no centralized database, the status of each node in the system is equal, and all the information of the block chain is preserved; Distributed energy and micro grid will become an important part of the energy Internet, "the consumer is producer", emphasizing the equal energy

sharing among individuals.

2)The block chain and the energy of the Internet reflects the cooperative autonomy. The block chain system consists of all nodes in the network operation and maintenance, no one can interfere with the correct operation of the system,and emphasis on self-scheduling and ecological operation in the energy Internet.

3)Block chain and energy Internet is trend to Intelligent and contractual, In the block chain system, the automation and intelligence of the contract can be realized by the intelligent contract, There are a large number of intelligent energy in the Internet, transmission, distribution, use and storage equipment, they need a series of smart contracts to ensure the automated trading of energy systems.

4)Block chain and energy Internet can promote the establishment of market-oriented and financial platform.Block chain technology can be used to establish a fair and open market system, at the same time, it can provide services for other financial products; Energy Internet is focused on building a free and open energy market.

5. Block chain to solve the problem of energy development of the Internet

5.1 Analysis of the Characteristics of Energy Internet

Energy Internet as a solution in the field of energy, there are some flaws about thinking and conceptual,The following analysis is five characteristics of the energy Internet.

1) Accurate measurement.Now, metering is a variety of energy systems running a wide range of digital perception, is the basis of control and the source of energy information.However, it is unable to solve the problem of data trust although the existing energy Internet is accurately measured.

2) Ubiquitous interaction.In the energy Internet system, to achieve the smooth transmission of energy information, there must be sufficient interaction between the sensor equipment and different subjects.But the premise of the interaction in the pan is the trust, Face to weak trust environment, it is difficult to achieve different entities between the equipment and systems between the data call and interactive operation.

3) Autonomous control.In order to cope with the use of large number of distributed local energy in the energy Internet, the equipment and the system should realize the dynamic response based on the local instruction and improve the operation efficiency and reliability of the system.However, in existing automation systems, it is not possible to determine whether external data should be trusted.If you trust external data, the implementation of the instructions after the accident liability attribution is unknown, it will affect the efficiency and reliability of the system.

4) Optimization decision.In the center of the decision-making process, it is impossible to stop the main body from its own interests, the abuse of decision-making authority, damage the interests of other subjects,The distributed decision-making, because a large number of energy directly between the Internet device to point to point interaction, resulting in low efficiency of consensus, no consensus on the consequences of the dead cycle.

5) Wide area coordination.Wide-area coordination refers to the maximization of effective benefits between participants in the energy system through coordinated interaction.The premise of coordination is that there is a consensus among the relevant subjects, but it is difficult to achieve a consensus on how to coordinate the interests of different values in the absence of trust.

5.2 Block chain technology solutions

Block chains provide an effective solution to the technical problems facing the energy Internet:

1) Upgrade from Accurate Metering to Trusted Metering. Data is arranged on the block chain to ensure that non-tampering, public-private key combination of asymmetric encryption protects privacy.

2) From pervasive interaction to trusted interaction. Building a low cost trust transfer chain between energy Internet interaction entities through block chains.

3) Upgrade from automatic control to intelligent control. By implementing the logic function in the form of intelligent contracts, a trusted local command is generated, complete the control process to deal with the change of the external environment.

4) From optimizing decision to democratic decision. Local consensus and inter regional consensus between energy Internet devices avoid the Mass distributed device Complex iteration and

dead loop in order to produce direct consensus. So as to realize the distributed decision making.

5) Upgrade from wide area coordination to cluster intelligence. Block chain technology is used to integrate different subjects and different systems into an energy Internet super-agent to Cluster intelligence in wide area.

The characters of distributed, intelligent, market and convergence of block chain technology are similar to the energy internet, by using block chain technology, we could update the cecept of energy internet to the reality.

6. The applications of block chain in energy internet

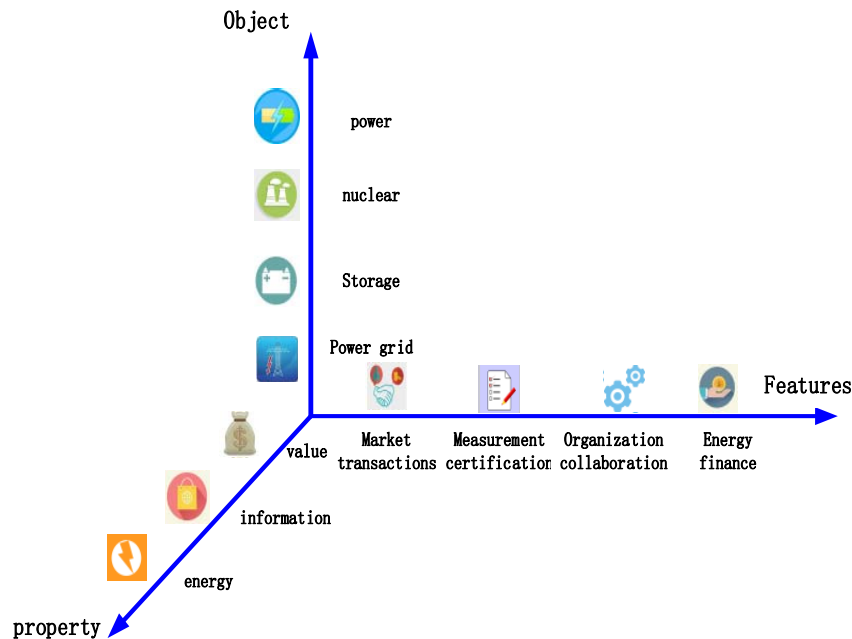


Fig. 1 The applications of block chain in energy internet

Now, although block chain used in the energy field still faces many challenges, but it has broad prospects in this field .And, it will lead the trend of “Internet smart energy”. Block chains play the following roles:

1) In order to lay a strong foundation for the future digital control of energy, “Internet + smart energy" need to promote the connection between the energy network and the Internet of things information facilities, to achieve efficient integration and intelligent control. And all of this cannot be separated from the digital perception and control of the operation of the energy system, Block chain could truly realize the digital management of energy, and ensure the data not be tampered with.

2) Intelligent interaction and mutual trust is a prerequisite for building an open sharing system of energy Internet,Low cost peer to peer value delivery can be achieved through block chaining,Reduce the cost of trusting building,From the point of view of future development, block chain may become a major way of establishing credit in the future,It uses large data to implement distributed accounting,The more subjects you have, the more reliable your credit will be,Finally,it could establish a trust based Energy Internet Ecosystem.

3) Promote the integration of the Internet and the financial sector in the field of energy.Block chain’s natural attributes in the financial field, will effectively promote the depth of integration of the Internet and the financial sector in the field of energy .The development of the future energy block chain needs to integrate finance, energy technology and information technology.

7. Conclusion

Block chain technology provides a good opportunity for the development and application of energy Internet, changing the status of national energy production, transmission, consumption fundamentally. As an important way to promote the transformation of the national energy, reform the

energy market mechanism, achieve energy saving and emission reduction and sustainable development, it will have a profound impact on the entire energy industry and society.

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