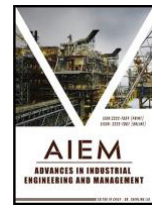


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## REVIEW ARTICLE

# EXPLORATION OF NEW EENERGY VEHICLE RECYCLING MODEL BASED ON BLOCKCHAIN

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## ABSTRACT

In order to study the application of blockchain technology in new-energy vehicle recycling, a five-layer architecture model of new-energy vehicle recycling blockchain is established, which is composed of the data layer, the network layer, the contract layer, the consensus layer and the application layer. The analysis shows that the model can provide a feasible solution and method for the recovery information tracing of new energy vehicles.

## KEYWORDS

New energy vehicles, blockchain, vehicle recycling, information traceability

## 1. INTRODUCTION

In recent years, the new energy automobile industry in China has developed rapidly, with the support of multiple factors such as policy support, technological progress and cost reduction, it has effectively promoted energy conservation and emission reduction, and greatly improved the environmental pollution caused by traditional vehicles. According to the "carbon peak Action Plan before 2030" issued by China State Council, it is proposed to promote low-carbon transformation of transportation equipment and actively expand the application of new energy and clean energy in the field of transportation, with the focus on vigorously promoting new energy vehicles. According to the statistics of China Association of Automobile Manufacturers, from 2011 to 2021, the production and sales of new energy vehicles in China increased by about 3.51 million units. It is estimated that by 2030, the proportion of new energy vehicles will reach 40%. However, a series of problems brought by new energy vehicles, such as endurance problems, safety problems, etc., have followed, and the rapid expansion of new energy vehicles has also brought pressure on scrap car recycling. The rapid expansion of new energy vehicles has also brought the pressure of recycling used vehicles. Seven departments, including the Ministry of Industry and Information Technology, the Ministry of Science and Technology, and the Ministry of Environmental Protection, have jointly issued policies on the recycling of power batteries for new energy vehicles, but there are no relevant policies for vehicle recycling. Reasonable recycling mode and stable income can accelerate the construction and improvement of recycling network and improve recycling efficiency (Yang et al., 2012), which is very important for the whole vehicle recycling mode of new energy vehicles. There is a large market space in the new energy vehicle

recycling industry, how to establish a more efficient recycling model, how to form a recycling network to meet market demand, these are urgent problems to be solved.

Scholars have gradually deepened the research on new energy vehicles, and the research related to the recycling of new energy vehicles has also made some progress. Based on the game theory research method, Wang Youfu et al. found that the greater the government's support for the recycling of waste new energy vehicles, the higher the economic benefits obtained by the production enterprises, and the higher the enthusiasm of consumers to participate in the construction of the recycling system of new energy vehicles (Wang et al., 2020). Yan and Di (2022) constructed an evolutionary game model between the two sides of the government automobile production enterprise, and analyzed and discussed the different evolutionary stability strategies of the two sides. Ding (2017) put forward three development strategies for China's new energy scrap vehicle recycling and dismantling industry to improve the recycling efficiency of scrap vehicles. Xu (2022) studied and analyzed the domestic patent literature on the disassembly and recycling technology of new energy vehicles by using patent econometric analysis method on the basis of three-level decomposition of the disassembly and recycling technology of new energy vehicles. The above research focuses on the recycling strategy of new energy vehicles, focusing on the recycling model from the policy level, but there is a lack of effective technical solutions.

In recent years, with the development of blockchain technology, more opportunities have been provided for the research of new-energy vehicle recycling. The government attaches great importance to the application

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and investment of blockchain technology, which has achieved application effects in digital finance, supply chain management, Internet of things and other aspects. It provides new ideas for the establishment of new energy vehicle recycling model, and also provides effective technical means for the realization of new energy vehicle recycling information traceability management. In 2019, Swedish automobile manufacturer Volvo (2019) reached an agreement with CATL and LG New Energy, two automotive power battery manufacturers, to use blockchain technology for the first time in the industry to trace cobalt materials used for battery product on globally. Li et al. (2012) proposed to use blockchain to improve the transparency and traceability of product eco-design, established an independent accountability process, and provided valuable insights for enterprises to improve the transparency of product eco-design. Xie and Fan (2021) studied and constructed a blockchain-based public opinion response mechanism, and built a blockchain-based material scheduling platform to deal with the scientific governance of major public health emergencies. Zeng et al. (2021) believed that the combination model architecture of the third generation blockchain using DAG blockchain IoT can solve the data security problem of the Internet of Things. The above research focuses on the traceability management of blockchain technology.

From the above analysis, domestic and foreign scholars have conducted meaningful exploration on the recycling of new energy vehicles and provided ideas for the research on recycling modes, but the research focuses on the recycling of new energy vehicle batteries and other aspects. In addition, the game theory research method used is restricted by the subjectivity of both sides, which will lead to the problem of information asymmetry, so as to affect the justice and fairness of new energy vehicle recovery.

The recycling of new energy vehicles involves car manufacturers, car sellers, car users, governments and various supervisory and administrative agencies, forming a recycling chain. Manufacturing information, sales information, user status information, and government supervision information of new energy vehicles are essential for vehicle recycling, and the information must be traceable to ensure the transparency of recycling transactions, but there is still a lack of research in this area.

Therefore, through the feasibility study of applying blockchain technology to the recycling of new energy vehicles, the research on the information traceability management of new energy vehicles based on blockchain technology is carried out in order to provide some references for enterprises to solve the problems in the recycling and traceability process of new energy vehicles.

## 2. THE PRINCIPLE OF BLOCKCHAIN TECHNOLOGY

Blockchain is a chain data structure that combines data blocks in a sequential manner in accordance with the chronological order, and is a distributed ledger technology, which has the characteristics of decentralization, immutable, traceability, low transaction costs, and smart contracts (Zuo et al., 2022).

First, decentralization increases the rate of information transmission. The biggest feature of blockchain technology is decentralization, which means that each node in the network jointly maintains data, eliminating the risk of single point of failure. This feature ensures that the blockchain technology is applied to the traceability management of the whole vehicle recycling of new energy vehicles. Each node stores the information that the seller and the distribution node of the car have entered into the system, ensuring that when the new energy vehicle has a problem, it can be timely notified to every consumer after the manufacturer releases the recall information. Consumers can also share recall information to solve the problem of information asymmetry (Wang, 2020).

Second, distributed storage makes transactions transparent. Blockchain technology distributes data in the form of blocks on each node in the network. Each node has a complete copy of the blockchain, which makes the security and reliability of the data greatly improved. New energy vehicle trading entities use smart contracts to conduct transactions, and each transaction generates a new block, which contains relevant information such as the transaction entity, transaction time, and new

energy vehicle sellers. It is conducive to the supervision of the sales and recycling data of new energy vehicles by the regulatory authorities. And facilitate new energy vehicle manufacturers to carry out vehicle recycling (Wang et al., 2023).

Third, consensus mechanisms ensure data security and reliability. The cryptography algorithm of the blockchain ensures the immutability of the data, a high degree of security, and a high degree of matching with the needs of the new energy vehicle recycling traceability system. The consensus mechanism of the blockchain requires that the new energy vehicle enterprises can be verified to transmit data between nodes, and can not hide and modify data and information at will, and the regulatory authorities can view the data of each node, which ensures the reliability of the data (Yang et al., 2019).

## 3. NEW ENERGY VEHICLE RECYCLING BLOCKCHAIN MODEL CONSTRUCTION

Based on the advantages of distributed ledger technology, decentralization, consensus mechanism and so on, combined with the current research pain points on new energy vehicle recycling, in order to solve the traceability management problems in the process of new energy vehicle recycling management, the establishment of a new energy vehicle recycling model based on blockchain technology has been proposed to solve the outstanding problems existing in the recovery of new energy vehicles. The model attempts to use blockchain as the underlying technology to build trust. Based on its transparent, credible and traceable advantages, it is used to establish the ID identification of new energy vehicles, completely record the data of manufacturers, sales manufacturers, consumers, and government supervision of each vehicle, and promote the standardized management of the whole chain of "production-supply-marketing-use-management-collection" of new energy vehicles.

The typical application of blockchain generally has a six-layer structure, and the nodes managed by the production, supply and marketing of new energy vehicles and supervision are all security nodes for organization certification without incentive layer. Therefore, this paper simplifies the blockchain management model into five hierarchical structures, namely, data layer, network layer, consensus layer, contract layer and application layer from the bottom up. The recycling model is shown in Figure 1.

### 3.1 Data Layer

The data layer is the basic level of the entire blockchain car recycling management, including data blocks, time stamps, HASH algorithms, asymmetric encryption and other technical means. Therefore, the layer stores some information that cannot be tamper with in the process of vehicle recovery with chain storage structure, such as raw material procurement cost, battery manufacturing performance, customer order quantity, product quality and other data in the "production-supply-marketing - use" stage of the vehicle, which can effectively ensure the authenticity of data information. In this way, in the process of vehicle recycling management, enterprises, government departments and consumers can clearly understand the current state of the vehicle through the accurate information recorded by blockchain technology, which can achieve efficient positioning and recycling and improve social benefits.

### 3.2 Network Layer

The network layer mainly realizes the decentralization and automatic combined networking ability of the automobile recycling information storage chain through the P2P network mechanism, and the distributed networking mechanism of its blockchain can make the information exchange of nodes in the automobile recycling related information storage network convenient, convenient and decentralized processing (Wang, 2021). Each node can receive automobile recycling related information, send automobile usage information, discover new nodes and other work, which promotes the establishment and update of new energy vehicle data storage network. At the same time, if you want to store new information, it can only be stored after passing the inspection of most nodes in the original storage network. The distributed network

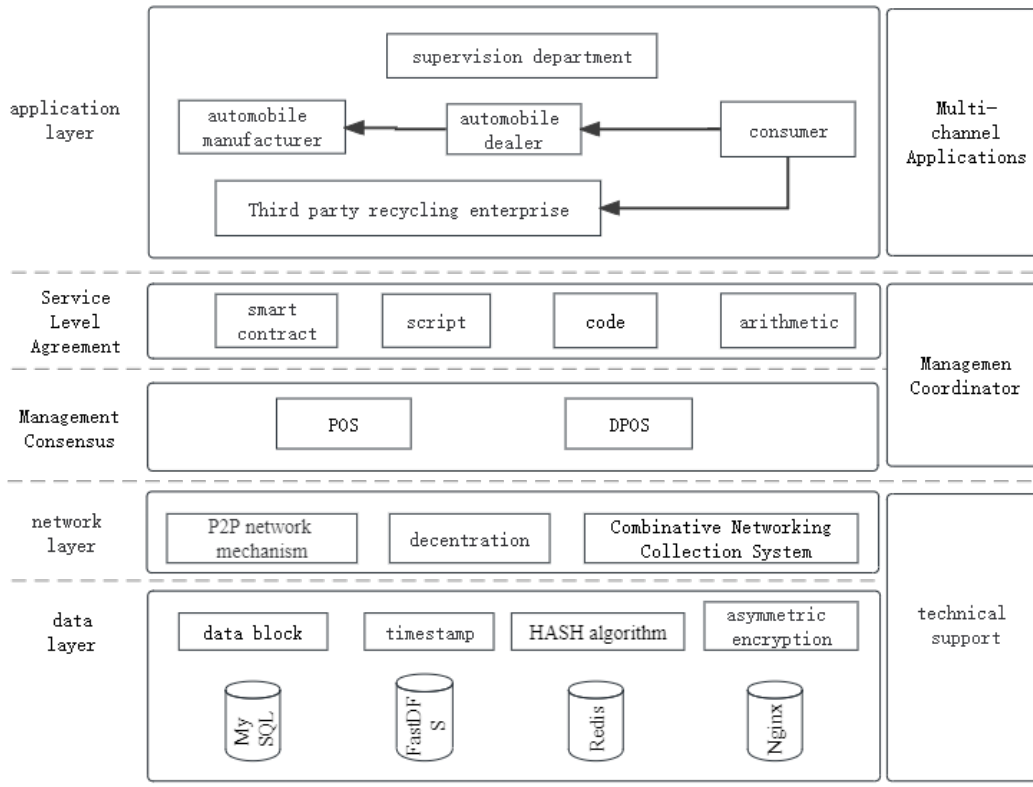


Figure 1: Blockchain model of new-energy vehicle recycling management

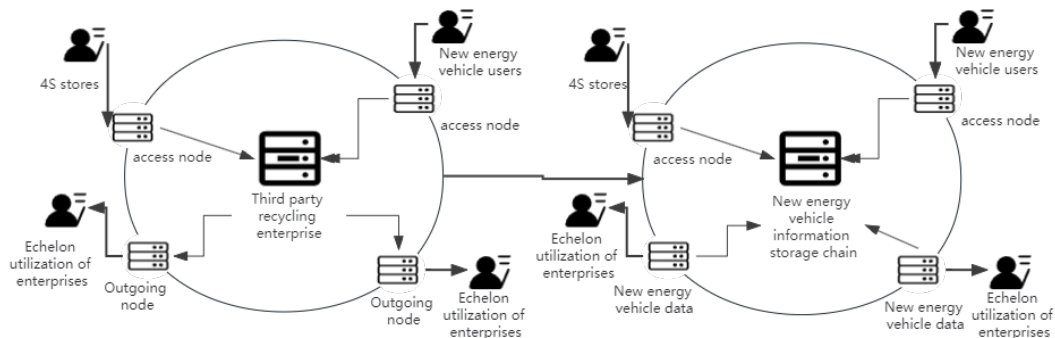


Figure 2: Distributed networking mechanism of new-energy vehicle recycling

mechanism of new-energy vehicle recycling is shown in Figure 2.

### 3.3 Consensus Layer

The consensus layer of blockchain technology is the core component of blockchain system, which is mainly responsible for ensuring the data consistency and security of each node in the network. The consensus mechanism of the consensus layer is mainly POS and DPOS, which are responsible for the management, coordination, identification and authentication of P2P networks. It can ensure data information sharing and solve the trust problem caused by information incoordination in the traditional recovery process. By adopting the combination of public chain and private chain, the identity verification and data security of recycled vehicles are ensured. An encryption algorithm based on multi-party computing can also be adopted to ensure the sharing and privacy security of vehicle information. Combined with the advantages of blockchain technology, it provides more secure services for upstream departments such as car sellers and downstream enterprises such as 4S stores, and promotes the benign development of the market.

### 3.4 Contract Layer

Contract layer Contract mechanism is mainly a set of smart contracts, scripts, codes, algorithms and other technical operations in one. The traditional vehicle recycling market has problems such as asymmetric information and cumbersome process, which lead to low recycling efficiency. The smart contract of blockchain technology can standardize the recycling protocol and process, ensure the legality and compliance of the recycling process, prevent the occurrence of improper behavior, and improve the efficiency of the recycling market. The application of smart contract technology can realize the programmability, data transparency and immutability of automobile storage information chain (Shi et al., 2019; Xu et al., 2020). After the smart contract is written by the programmer, it will be automatically sent to every node in the data storage network of new energy vehicles. In other words, it will be applied to the structure of the blockchain network. In general, the contract mechanism can ensure the consistency of data between nodes and effectively ensure the accuracy and reliability of data in the highly decentralized and decentralized new energy vehicle data storage network (Wang et al., 2020). For example, smart contracts can automatically complete the signing of recycling agreements, verification of vehicle information, settlement of funds and other processes, and realize the automation of supervision to ensure the legality and compliance of the recycling process, which can promote the benign

development of the recycling market.

### 3.5 Application Layer

In the vehicle blockchain recycling management model, the application layer docking car manufacturers, dealers, third-party recycling enterprises, consumers and regulatory authorities and other subjects, these participants are facing difficulties in recycling management, information asymmetry, poor supervision and other problems.

Automobile manufacturers to establish a traceable vehicle blockchain recycling information platform. When producing new energy vehicles, vehicle information is entered into the blockchain, including vehicle model, production date, parts information, etc. After the vehicle is decommissioned, the manufacturer can record the recycling information and disposal methods on the blockchain, ensuring the authenticity and traceability of the vehicle recycling information. Car dealers can share vehicle recycling information through blockchain technology, mainly 4S stores. Dealers can enter information about recovered vehicles into the blockchain and share information with manufacturers, third-party recycling companies and other parties. In this way, the information in the entire recycling process can be shared and transparent in real time, effectively avoiding information asymmetry. At the same time, third-party recycling enterprises can establish a trusted recycling information platform on the blockchain, including information about recycled vehicles, processing methods, recycling certificates, etc. In this way, recycling enterprises can achieve the safe transmission and storage of recycling information through blockchain technology, ensuring the authenticity and credibility of recycling certificates. Finally, consumers can query the recycling information and treatment methods of their purchased vehicles through the blockchain platform to understand the entire recycling process. In this way, consumers can participate in vehicle recycling more actively, achieve the participation and transparency of vehicle recycling, and promote the smooth progress of vehicle recycling.

In the process, all the processes and subjects must be completed with the cooperation of the regulatory authorities. Regulatory departments are composed of government departments, such as traffic control, quality inspection, industry and commerce, and environmental protection. The regulatory authorities require automobile manufacturers, automobile manufacturers, automobile dealers and other four main entities to comply with the relevant recycling management regulations and standards during the recycling process of new energy vehicles. And carry out regular inspection and evaluation to ensure the legality and standardization of its recycling management work. The regulatory authorities need to carry out comprehensive supervision and management of the application layer of new energy vehicle recycling, and also need to strengthen communication and collaboration with other subjects to jointly promote the smooth progress of vehicle recycling.

## 4. CONCLUSION

The proposed new energy vehicle recovery model based on blockchain technology uses the data layer, network layer and consensus layer to establish the information storage chain of new energy vehicles, effectively improving the information traceability efficiency of retired and scrapped new energy vehicles. Compared with the traditional vehicle recovery model, this model has the advantages of more safe, reliable, efficient and convenient. It not only greatly improves the efficiency of automobile information tracing, but also improves the recovery rate of automobile. There are also shortcomings in this paper, such as the need for enterprises to store data on the public blockchain, which may cause data privacy leakage, which needs to be paid attention to in the future in-depth research.

## REFERENCES

Ding, X. 2017. Development analysis of recycling and dismantling

industry of new energy scrapped Vehicles in China. *Comprehensive Utilization of Resources in China*, 35(12), Pp. 93-95.

Li, J.J. 2012. Improving transparency and traceability of product eco-design using blockchain. *Science and Technology Management Research*, 42(19), Pp. 181-191.

Shi, J., Shao, B., Miao, J. 2019. Research on competitive information sharing platform of small and medium-sized enterprises based on blockchain. *Library and Information Work*, 63(20), Pp. 112-120.

Volvo Cars cooperated with CATL and LG Chem to Use blockchain to trace cobalt materials in batteries. *Automobile & Accessories*, 2019, 1267(21), Pp. 16.

Wang, H.R., Chen, S.J., Yan, Z., et al. 2020. Blockchain based charging rights transaction for electric vehicle charging stations: mechanism, model and method. *Proceedings of the CSEE*, 40(2), Pp. 425-436.

Wang, Q., Li, F.J., Ni, X.L., et al. 2023. Interoperability and across the chain block chain technology research. *Computer Science and Exploration*: 5(23), Pp. 1-29.

Wang, Y.C. 2020. "Decharm" blockchain: decentralization, new centralization and re-centralization. *Journal of Xi'an Jiaotong University (social science edition)*, 40(3), Pp. 38-45.

Wang, Y.P. 2021. Block chain under the environment of supply chain evolution research. *Lanzhou jiaotong university*.

Wang, Y., Deng, C., Yan, Y., et al. 2020. New energy vehicle recycling model based on game theory. *Logistics Technology*, 41(04), Pp. 80-83.

Xie, Z., Fan, F. 2021. Blockchain boosting the governance of major public health emergencies: value, logic and future. *Dongwu academic*, 66(5), Pp. 32-40.

Xu, M., Gaom Z., Wangm W., et al. 2020. Intelligent substation configuration version management based on blockchain technology. *Power System Protection and Control*, 48(2), Pp. 60-67.

Xum W.W. 2022. Research on dismantling and recycling technology of new energy vehicles based on patent analysis. *World Nonferrous Metals*, 606(18), Pp. 144-148.

Yan, Y., Di, X. 2023. Under the government rewards and punishment mechanism of reverse logistics in auto industry evolutionary game analysis. *Journal of shenyang university of technology (social science edition)*, 5(22), Pp. 1-13.

Yang, C., Liu, H., Bian, S. 2012. Discarded product strategy in remanufacturing systems. *Journal of computer integrated manufacturing system*, 17(4), Pp. 875-880.

Yang, X.T., Wang, M.T., Xu, D.M., et al. 2019. Information storage model and query method of agricultural product traceability system based on block chain. *Transactions of the Chinese Society of Agricultural Engineering*, 35(22), Pp. 323330.

Zeng, P., Wang, X., Dong, L., et al. 2021. A blockchain scheme based on DAG structure security solution for IIoT. *2021 IEEE 20th International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom)*. IEEE, 2021, Pp. 935-943.

Zuo, X. 2022. Based on block chain community integrated energy system distributed energy management system. *North China Electric Power University (Beijing)*.