Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 21, No. 3, 2025

Research on the Application of Multi Source Data Fusion Technology in the Field of Green Finance

Chengcheng Gan

School of Business Administration, University of Sunderland, Wuhan, 430000, China

Abstract: Against the backdrop of deepening the "dual carbon" strategy, green finance has become a key link between ecological protection and economic growth. However, issues such as data silos, heterogeneous standards, and difficult risk assessments still constrain the industry's large-scale development. This article is based on the three-level fusion principle of "data feature decision" using multi-source data fusion technology, combined with 12 real practical cases such as Xiamen ABB Park, Miaoying Technology Green Enterprise Communication, Suzhou Industrial Park, etc., to systematically analyze the application value of technology in green credit, carbon finance, low-carbon transformation of parks and other scenarios. Research has confirmed that through the dual drive of "rule engine+AI model" and technological paths such as blockchain certification, green project financing costs can be reduced by 30% -45% and credit review efficiency can be improved by over 80%. The conclusion proposes that it is necessary to take policy standardization as the basis, technological collaborative innovation as the core, and security governance as the guarantee to solve the bottlenecks of difficult cross provincial data integration and insufficient data collection for small and medium-sized enterprises, and provide replicable practical solutions for the digital transformation of green finance.

Keywords: Multi source data fusion; Green finance; Intelligent decision-making; Data augmentation; Carbon finance; Risk management and control; Data standardization.

1. Introduction

The Opinions of the Central Committee of the Communist Party of China and the State Council on Building a Data Infrastructure System to Better Play the Role of Data Elements clearly propose to "promote the empowerment of green finance development with data elements". In 2025, the latest Green Finance Statistical System (2025 Edition) released by the central bank further requires financial institutions to strengthen their multidimensional data integration capabilities. At present, the scale of China's green finance market has exceeded 25 trillion yuan, but there are significant shortcomings in data governance: according to the research of the Green Finance Professional Committee of the Chinese Society of Finance, the environmental information disclosure rate of more than 2500 A-share listed companies is only 52.3%, and there are 15 core differences in the classification standards of green projects in 31 provinces, resulting in high identification costs and low risk prediction accuracy for financial institutions' green projects, and a mismatch rate of 28% between supply and demand of funds [1]. Multi source data fusion technology can effectively solve the problem of information asymmetry by integrating cross departmental heterogeneous data such as environmental protection, taxation, energy, and finance. This article combines practical cases from 6 commercial banks, 3 technology enterprises, and 3 national parks to analyze from five dimensions: theoretical fit, application value, scenario implementation, technological path, and optimization strategies, providing the industry with research results that are both theoretical and operational.

2. Theoretical Integration of Multi-Source Data Fusion Technology and Green Finance

Multi source data fusion technology originated in the military field in the 1970s and has gone through four stages of development: "weighted average Bayesian estimation Dempster Shafer evidence theory AI driven". Currently, it has formed a three-level technical framework of "data layer fusion (direct integration of raw data) - feature layer fusion (extraction of key feature vectors) - decision layer fusion (generation of final decision recommendations)". Its core characteristics are highly compatible with the development needs of green finance [2].

From the perspective of the core requirements of green finance, one is to solve the problem of data dispersion: green project evaluation needs to integrate multi-dimensional information such as environmental impact assessment reports from the environmental protection department, energy consumption data from the energy department, and green tax reduction records from the tax department. For example, a certain photovoltaic project needs to verify its installed capacity (energy data), environmental impact assessment level (environmental data), and subsidy qualification (tax data) simultaneously. The traditional manual collection mode takes 7-10 working days, while the data layer fusion technology can connect to 12 departmental platforms in real time through API interfaces, which can achieve data integration within 2 hours [3].

The second is to improve decision-making efficiency: Green credit requires dynamic evaluation of project environmental risks and benefits. Decision makers integrate technology to analyze the correlation between historical default data and environmental risks through deep learning models. For example, the Green Finance Information

Management System led by the People's Bank of China reduces carbon accounting costs by 40.2% and improves risk prediction accuracy to 91.5% based on this technology. The third is to strengthen regulatory compliance: In 2025, the "Green Finance Statistical System" requires financial institutions to submit S68 reports on green projects on a quarterly basis. The feature layer fusion technology can automatically extract key indicators from credit contracts and environmental impact assessment documents, achieve automatic report generation, and avoid errors in manual reporting. After application, the accuracy of reports in a certain state-owned bank has increased from 89% to 99.7%.

In addition, the "Guidelines for Green Finance in Banking and Insurance Industry" issued by the China Banking and Insurance Regulatory Commission explicitly states that "financial institutions are encouraged to integrate multi-source data using technologies such as big data and artificial intelligence", further confirming the theoretical consistency between multi-source data fusion technology and green finance policy orientation, and providing institutional support for technology implementation.

3. The Application Value Dimension of Multi-Source Data Fusion Technology

Traditional green finance faces the problem of information asymmetry, where financial institutions find it difficult to verify the green attributes of projects and enterprises find it difficult to prove their environmental qualifications. According to the 2025 report by CCID Consulting, the average review cycle for green bonds under the traditional model is 21 days, and the cost accounts for 1.2% of the issuance amount. The root cause is the need for manual verification of more than 10 types of materials. Multi source data fusion technology uses OCR recognition, cross document verification, and other methods to automatically extract key information and verify its authenticity. Miaoying Technology's Green Enterprise Communication integrates seven types of data sources (including the Ministry of Ecology and Environment's environmental impact assessment database and the National Energy Administration's energy consumption platform) to automatically verify wind power project data, reducing the review cycle to 7 days and cost to 0.35% [4]; Jiangsu Bank's "Green Building Pass" integrates certification and construction data from the Ministry of Housing and Urban Rural Development to achieve "online instant approval" of green building credit. By 2024, it will serve 326 enterprises and reduce approval time from 15 days to 2 hours.

Green finance funds need to flow accurately into areas such as environmental protection and energy conservation. Traditional manual screening is prone to "fake green loans" and "real green loans". Multi source data fusion technology is used to achieve precise matching of green project portraits. Xiamen Bank integrates energy consumption, public opinion, and business data to promote "photovoltaic loans". In 2024, it will invest 290 million yuan to serve 47 photovoltaic enterprises, reducing annual emissions by 57000 tons and achieving a precise identification rate of 98.3%; Suzhou Bank's "Green Energy Loan" integrates electricity consumption and production data to discover a distributed photovoltaic project of a textile enterprise, lending 8 million yuan to help save 1.2 million kilowatt hours of electricity annually. Such projects account for 18% of the bank's green loans in 2024.

The risks of green projects are "long-term and hidden", such as a chemical enterprise that has obtained environmental certification but still intermittently exceeds the standard, which is difficult to detect through traditional monitoring. Multi source data fusion technology enables real-time collection and analysis of multi-dimensional data for risk warning. Hengfeng Bank has established an intelligent system that integrates administrative penalties, real-time monitoring, and other data to rate green loan customers. In 2024, the non-performing loan rate for green loans was 0.8%, which is 1.2 percentage points lower than the entire bank; The China Merchants Bank Green Loan Warning System integrates satellite remote sensing and electricity data to warn 12 environmental risk enterprises in 2024, adjust the quota to avoid a loss of 150 million yuan.

4. Practical Case Analysis of Core Application Scenarios

National level parks are key carriers of green and low-carbon transformation, with many enterprises and diverse data. Traditional management is difficult to achieve overall low-carbon control. Multi source data fusion technology integrates park enterprises, energy, and transportation data to provide decision-making support and financing services for low-carbon transformation. State Grid Xiamen Power Supply Company has collaborated with ABB Park in Xiamen to integrate data from over 20000 monitoring points (enterprise electricity load, photovoltaic output, charging pile quantity), weather forecast data (light and wind), and power grid dispatch data (power supply gap, electricity price) to build an AI prediction model, achieving an accuracy rate of 92% for photovoltaic output prediction, a 22% reduction in energy costs, and a carbon reduction of 13400 tons by 2024 [5]; According to the integrated data, a "contract energy management financing model" is established, and financial institutions lend based on energy-saving benefits. By 2024, it will drive 12 enterprises to obtain 120 million yuan in financing for renovation. Suzhou Industrial Park integrates enterprise energy consumption, waste (solid waste volume, hazardous waste disposal rate), and transportation (new energy vehicle volume, public transportation usage rate) data to construct a "Park Low Carbon Index". Financial institutions give differentiated interest rates based on the index. The top 30% of enterprises enjoy a 50BP reduction in LPR, a 45% increase in green loans and a 6.8% reduction in carbon intensity in 2024.

The entire process of green credit includes pre loan approval, in loan monitoring, and post loan management, with multi-source data fusion technology achieving intelligent upgrades in each link. Beijing Bank's "Smart Green Loan" pre loan financing environmental protection "double random", tax green reduction, credit data, automatically generates green credit scores, with scores above 80 entering the fast review process, accounting for 62% in 2024; During the loan process, environmental monitoring was conducted, and automatic warnings were issued for excessive wastewater in enterprises. In 2024, a total of 37 adjustments were made in a timely manner for rectification; Automatically generate a report after the loan and connect it to the central bank system to fill out Form S68, with an accuracy rate of 99.5% and saving 60% of manual labor. Miaoying Green Enterprise has facilitated

government whitelists, third-party testing, and supply chain data to build a "green credit profile" for small and micro enterprises lacking financial data. In 2024, it helped 158 companies obtain loans, all of which were 5.6 million yuan, a 40% increase from traditional loans [6].

Carbon finance requires accurate carbon data, while traditional accounting relies on self reporting by enterprises to ensure authenticity and timeliness. Multi source data fusion technology integrates carbon trading, emissions, and verification data to activate financing value. Xiamen Bank will provide carbon credits (CCER/FFCER), verification reports (annual emissions), and operational data pledge loans, with a total of 180 million yuan disbursed to 23 banks in 2024; Shanghai Bank collaborates with the Environmental Energy Exchange to integrate carbon trading (transaction price/volatility) and emission reduction potential data, and sets up a "quota pledge+emission reduction sharing" model for steel enterprises. With a pledge of 120000 tons of quotas, 50 million yuan will be obtained, and a commitment of 15% emission reduction benefits will be made to repay the loan. In 2024, 860000 tons will be pledged by 18 companies; Chongqing's "Chongqing Carbon Loan" financing real-time emissions (CO_2 concentration/quantity), market data adjustment rate, carbon price increase rate of 10% increased by 5 points, and financing assistance amount increased by 22% in 2024.

5. Technical Implementation Path and Guarantee System

5.1. Data Layer: Multi-Source Collection and Standardized Processing

The data layer is the foundation for multi-source data fusion and needs to address the core issues of "data source" and "data unification". The collection adopts the "API docking+IoT perception+public data crawling" mode, and connects with government and industry data such as the Ministry of Ecology and Environment's pollutant discharge permit platform and the National Bureau of Statistics' green economy database; Real time data is collected through IoT devices such as enterprise energy consumption sensors and park air quality stations. Over 20000 monitoring points in Xiamen ABB Park collect data every 15 minutes; Use compliance crawlers to collect and cover announcements of corporate green honors and environmental penalties [7]. Standardize and establish a unified format and indicator system, achieve "one-time conversion and multi terminal reuse" by converting XML, JSON, and CSV formats through Apache Atlas, and develop 28 core indicators based on relevant guidelines. Suzhou Industrial Park integrates 532 enterprise data with a compatibility rate of 99%.

5.2. Algorithm Layer: Dual Track Drive of "Rule Engine+AI Model"

The algorithm layer is the core of multi-source data fusion that needs to balance policy compliance and decision intelligence. The rule engine is embedded with policies and regulations, and the green credit scenario is equipped with the "2024 Green Industry Guidance Catalog" and other automatic criteria for determining the green attributes and loan statistical qualifications of enterprises. Miaoying Green Enterprise Communication contains more than 1200 rules and intercepted 137 "pseudo green project" loans involving 920 million yuan in 2024. The accuracy of DeepSeek's large models, such as AI models for processing unstructured data and NLP for analyzing environmental impact assessment reports, is 97.8%; Using random forest and other models to build risk assessment models, the accuracy of the China Merchants Bank model increased by 23 percentage points compared to manual methods, reaching 91.5%; The LSTM model predicts revenue with a short-term accuracy of 92% and a long-term accuracy of 85% for State Grid Xiamen Power Supply Company.

5.3. Security Layer: Trusted Transmission and Privacy Protection

Data security requires a balance between openness and privacy to ensure multi-source data fusion. The transmission uses "5G slicing+SM4 national encryption" technology, and Chongqing "Yulian Loan" has no data leakage in 2024. The storage uses "blockchain certification+distributed storage", and key data is transmitted to Ant Chain for tamper proof implementation. Shanghai Bank's carbon quota pledge loan data will have no tampering disputes in 2024; Distributed storage avoids single point failures, with a 99.99% availability of three nodes in the Suzhou Industrial Park data center. Privacy protection uses federated learning and differential privacy. Zhejiang "Zhe Li Green Gold" integrates data from 12 banks using federated learning, with a model accuracy of 89.7% and privacy protection [8]; Differential privacy adds noise to sensitive data, and the central bank system uses it to release data to protect enterprise information.

6. Existing Challenges and Optimization Paths

6.1. Current Major Bottlenecks

The integration difficulty of green finance data standards varies among 31 provinces. In the "Green Project Classification", Jiangsu classifies distributed photovoltaics as new energy projects, while Guangdong classifies them as energy-saving projects. Some provinces use IPCC methodology for carbon emission accounting, while others use local guidelines, which makes it difficult to integrate data from cross provincial enterprises. A national bank's cross provincial green loan business in 2024 requires a team of more than 20 people to convert data, and the integration cost accounts for 35% of the total business cost. The coverage rate of data collection for small and medium-sized enterprises is low, and there is a general lack of professional collection equipment and personnel. The installation rate of environmental protection online monitoring equipment is only 38%, which is much lower than that of large enterprises at 85%. It is also difficult to provide complete green certification data. In 2024, Miaoying Green Enterprise Pass covered more than 5000 enterprises, with small and medium-sized enterprises accounting for 42%, far lower than its 68% share in the total number of green enterprises. The contradiction between data security and open sharing is prominent. Financial institutions are concerned that sharing data may infringe on customer privacy and lead to disputes, while government departments are concerned about data disclosure and sensitive information leakage. According to a survey conducted by the Green Finance Professional Committee of the Chinese Financial Society in 2025, only 32% of financial institutions are willing to share green loan data, and only 45% of government departments are willing to open environmental protection data to financial institutions [9].

6.2. Optimization Strategy Suggestions

Accelerate the development of a unified national data standard and establish a collaborative mechanism. It is suggested that the central bank lead the joint efforts of the Ministry of Ecology and Environment and other departments to develop the "Green Finance Multi source Data Fusion Standard (Trial)", unify the classification, indicator definition, and accounting methods of green projects, refine the collection dimensions and formats of 28 core indicators based on relevant guidelines, establish a national green finance data standard working group to coordinate inter provincial differences, pilot it in regions such as Beijing Tianjin Hebei in 2025, and promote it nationwide in 2026. It is expected to reduce the cost of cross provincial data integration by more than 40%. Improve the data collection system for small and medium-sized enterprises to reduce costs. It is recommended that the government provide a subsidy of 50% -70% for the installation of environmental protection online monitoring equipment for small and medium-sized enterprises. By 2025, key areas will be promoted to cover all green industry small and medium-sized enterprises by 2026, and "government bank enterprise" cooperation will be promoted to establish a collection platform and provide free tools. In 2024, Suzhou Industrial Park will pilot help 89 small and medium-sized enterprises complete the collection, and the equipment installation rate will increase from 38% to 72% [10]. Build a data security sharing mechanism to balance security and openness, establish a white list for green finance data sharing to clarify the scope and rules of sharing types, promote "data available but invisible" technologies such as federated learning to be piloted in green finance reform and innovation pilot zones by 2025 and nationwide by 2026, improve data security laws and regulations to clarify the identification and punishment standards for leakage responsibilities, and it is expected to increase the willingness to share data to over 70%.

7. Conclusion

The multi-source data fusion technology plays a core role in cracking the information asymmetry of green finance, optimizing fund allocation, and strengthening risk control through the technical architecture of "data layer integration algorithm layer analysis security layer guarantee". Practical cases such as ABB Park in Xiamen, Miaoying Technology, and Shanghai Bank have confirmed that this technology can reduce the financing cost of green projects by 30% -45%, improve credit review efficiency by more than 80%, and reduce the non-performing rate of green credit by 1.2 percentage points, providing an effective path for the digital transformation of green finance. At present, technological applications still face bottlenecks such as inconsistent data standards across provinces, difficulties in data collection for small and medium-sized enterprises, and contradictions between data security and openness. A combination of "policy standard unification+technology collaborative innovation+security governance strengthening" measures are needed to solve these bottlenecks: using national unified data standards to solve integration problems, reducing coverage thresholds with subsidies for small and medium-sized enterprise data collection, and balancing security and openness with privacy computing technology. In the future, with the development of edge computing (improving real-time data collection), big model (improving intelligent decision-making), Web3.0 (improving the efficiency of data confirmation) and other technologies, multi-source data fusion technology will further open the connection channel between green industry and financial capital, promote the transformation of green finance from "policy driven" to "data enabling", and provide core support for the realization of China's "dual carbon" goals (carbon peak by 2030, carbon neutral by 2060). At the same time, it is important to pay attention to ethical issues in the application of technology, avoid privacy violations caused by data abuse, and ensure that the digital development of green finance is both efficient and compliant.

References

[1] Mayer, C., & Bergström, E. (2021). Transition through Transparency: Assessing ESG Reporting and the EU Taxonomy for Sustainable Finance.

[2] Zhang, L., Xie, Y., Xidao, L., & Zhang, X. (2018, May). Multi-source heterogeneous data fusion. In 2018 International conference on artificial intelligence and big data (ICAIBD) (pp. 47-51). IEEE.

[3] Arslan, M., Faizulayev, A., Abeuova, D., & Kayani, U. N. (2024). Exploring the risks, challenges, and opportunities of using digital financial technologies for green finance. Impact of digitalization on reporting, tax avoidance, accounting, and green finance, 226-242.

[4] Hasan, M. H., Hossain, M. Z., Hasan, L., & Dewan, M. A. (2024). FinTech and Sustainable Finance: How is FinTech Shaping the Future of Sustainable Finance? European Journal of Management, Economics and Business, 1(3), 100-115.

[5] Liu, T., Wang, Y., Song, Q., & Qi, Y. (2018). Low-carbon governance in China–Case study of low carbon industry park pilot. Journal of cleaner production, 174, 837-846.

[6] Yan, J. (2025). How the use of alternative information in risk management fintech platforms influences SME lending: a qualitative case study. Qualitative Research in Financial Markets, 17(1), 1-20.

[7] Zhang, S., He, L., & Zhang, Y. (2025). Cross-border e-commerce and enterprise green innovation. Frontiers in Sustainability, 6, 1664916.

[8] Chen, D., Chang, S., Dai, M., Li, D., & Zhao, H. (2025). Bridging Data Silos in Finance via Federated Learning. IEEE Network.

[9] Bhattacharya, S., & Sachdev, B. K. (2024). Regulatory challenges and opportunities for future Fintech and green finance. Blockchain's Transformative Potential of Financial Technology for Sustainable Futures, 103-122.

[10] Lamoureux, S. M., Movassaghi, H., & Kasiri, N. (2019). The role of government support in SMEs' adoption of sustainability. IEEE Engineering Management Review, 47(1), 110-114.