Research on Power Data Product Business Models in Differentiation Stage

Qi Shen, Qing Yuan, Ziyuan Xie, Pengyu Quan, Sen Zhang, Xiaobao Yu

School of Economics and Management, Shanghai University of Electric Power, Shanghai, China

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Abstract: Driven by the digital economy and "dual carbon" goals, value extraction from power data has become a pivotal engine for the transformation and upgrading of the energy industry. However, the realization of power data value is not an instantaneous process; instead, it undergoes a differentiated evolution spanning resource utilization, assetization, and capitalization. Based on an analysis of the inherent logic of value evolution for power data products, this paper explores value innovation around the concept of "data temperature" at different developmental stages, and proposes targeted business models and competitive strategies. By examining advanced practices in Guizhou, Jiangsu, Beijing and other regions, the study summarizes the typical characteristics and implementation paths of business models in each stage, and discusses the coordination between business model innovation and policy frameworks. The conclusions aim to provide theoretical support and practical guidance for the market-oriented allocation of power data as a key production factor and the healthy development of the industry.

Keywords: Electricity data, business model, nine-grid

1. Introduction

As a foundational and pillar industry vital to the national economy and people's livelihood, the power sector has accumulated vast amounts of high-frequency, high-value data across its generation, transmission, transformation, distribution, and consumption stages. Against the backdrop of the "dual carbon" goals, transforming these dormant power data into "new-quality productive forces" —capable of driving energy transition, optimizing social governance, and empowering industrial upgrading—has become a focal point of both academic and industrial circles.

Against the backdrop of ongoing market-oriented reforms for data elements, research on pricing electricity data assets has exhibited distinct phased evolutionary characteristics. Early studies focused on pricing models during the resource utilization stage. Lü et al. (2025) applied activity-based costing to trace and allocate costs across the entire lifecycle of electricity data—from collection and cleaning to storage and application—but failed to account for the diminishing marginal cost property of data. As data assetization accelerated, Ding et al. (2026) proposed a multi-dimensional value assessment methodology, analyzing current data valuation practices in the power sector from three perspectives: valuation targets, entity stages, and functional applications, using the SV method to measure contributions while neglecting value variations across different application scenarios. In capitalization pricing efforts, Wang et al. (2025) linked electricity market data with meteorological data, developing a Daily High Temperature Income Index (DHTI) based on multiple linear regression and establishing a corresponding weather derivatives contract framework, thereby positioning electricity data as a pricing anchor for tradable financial products. However, their study lacked exploration of differentiated capitalization pricing mechanisms for various types of electricity data assets.

For research on stage-specific characteristics, Jin et al. (2022) systematically reviewed the practical developments and research landscape of data valorization within the "data resource utilization—assetization—capitalization" framework, providing a theoretical foundation for stage-based valuation. Ding et al. (2026) established a research framework centered on four stages—data resource utilization, assetization, commoditization, and capitalization—systematically examining the relationships between each stage and data valuation, and evaluating the application of valuation methods such as the cost approach, income approach, market approach, and physical option analysis in power systems, thereby offering a comprehensive theoretical framework and research direction for assessing the value of power data assets. However, existing studies still lack unified stage classification criteria and cross-stage value transmission models.

However, the development and application of power data products are currently not on the same level but exhibit distinct phase-specific characteristics. From the collection and governance of raw data, to the creation of tradable assets, and ultimately to leveraging financial and industrial capital, the underlying logic of business model construction and profit mechanisms differ fundamentally. Building on this, this study adopts the "Three Transformations" framework for the evolution of power data value and introduces the innovative concept of "data temperature" to systematically explore business model strategies for power data products across different developmental stages, aiming to provide theoretical support for innovation and entrepreneurship practices in related fields.

2. Classification of Data Development Stages

The development and utilization of power data constitutes a dynamic process characterized by progressively increasing value density and expanding application scenarios. Based on the general principles governing the realization of data element value, this process can be divided into three progressively differentiated stages:

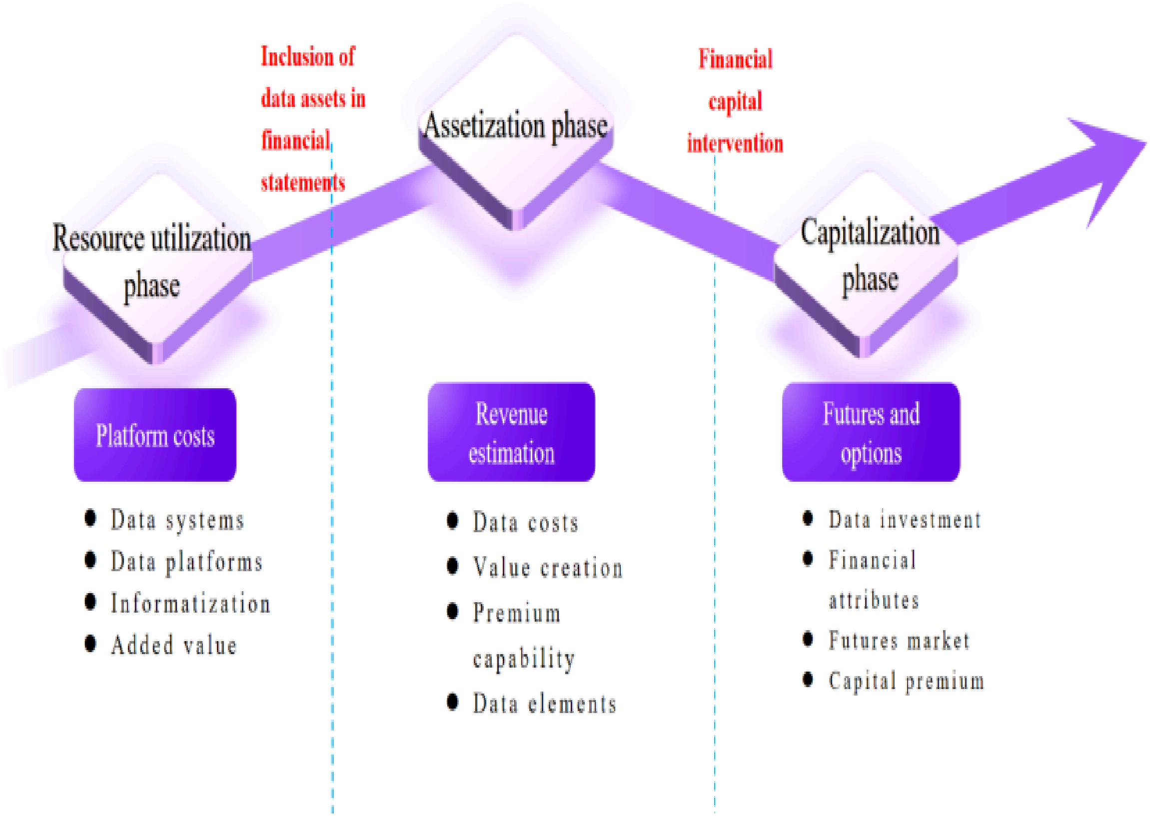

Figure 1. Data Development Stage Classification

3. Value Innovation Orientation of Power Data Products

In the evolutionary process of the differentiation stage, how to avoid homogeneous competition of power data products and explore the profound humanistic care and socio-economic value behind data constitutes the core concern of the key concept proposed in this study—"data temperature". The term "data temperature" refers to going beyond cold meter readings to gain insights into human activity patterns, industrial operation dynamics, and social and livelihood demands hidden behind data through correlation analysis and algorithmic mining.

(1)"Warm Service" for residential users

During the transition from resource-based to asset-based development, power data products for residential users should embody a sense of "warmth". Traditional power data only reflect total household electricity consumption, yet with big data analytics and non-intrusive load monitoring technology, power data products can break down consumption into lighting, air conditioning, kitchen appliances and other individual loads. The business model built on this is not simply about selling data, but providing energy-saving advice and caring services. For instance, abnormal fluctuations in electricity use patterns of elderly people living alone can trigger community care alerts; customized energy efficiency bills can be sent to households to help reduce living costs. Such products represent a warm transformation from metering to service.

(2)"Green Temperature" for Enterprise Users

In the assetization and capitalization stages, power data products for industrial enterprises should focus on the "green temperature" under the dual-carbon goals. The core of the business model lies in quantifying enterprises' green production capacity through power data. On the one hand, by analyzing the correlation between time-of-use power consumption curves and production plans, it delivers algorithmic models for energy consumption optimization to help enterprises cut costs and improve efficiency. On the other hand, it develops products for green power and green certificate trading potential analysis based on refined power consumption data, enabling enterprises to participate in the carbon market and preserve and appreciate the value of green assets. Data products under this model serve as a navigator for enterprises to strengthen competitiveness amid the wave of green transition.

4. Business Model Construction and Competitive Strategies in the Differentiation Stage

Referring to the Business Canvas Nine-Box Analysis Framework , power data products at different stages exhibit distinct competitive strategies in customer segmentation, value proposition, distribution channels, and revenue sources.

(1) Case Deconstruction of the Assetization Stage: A Case Study of the Guizhou Coal Mine Early Warning System(Figure 2)

In the initial phase of assetization, establishing a business model relies on deep penetration into high-value, high-risk vertical industries.

Value Proposition: Addressing the Industry Pain Point of Lack of Informatized Real-Time Means for Mine Safety Supervision. The core value of the "Coal Mine Enterprise Power Big Data Analysis and Early Warning System" built by Guizhou Power Grid is not simple power sales data, but providing auxiliary decision-making basis for "whether there is illegal production".

Business Model Logic: This model is a typical B2G or B2B service. By constructing a classification and estimation model of electricity consumption, power data is converted into regulatory language. Its profit model mainly comes from system development and operation and maintenance service fees, as well as subscription fees for value-added data analysis reports.

Competitive Advantages: Relying on the high real-time performance and strong correlation of power data, it has built insurmountable technical and data barriers for other third-party monitoring methods.

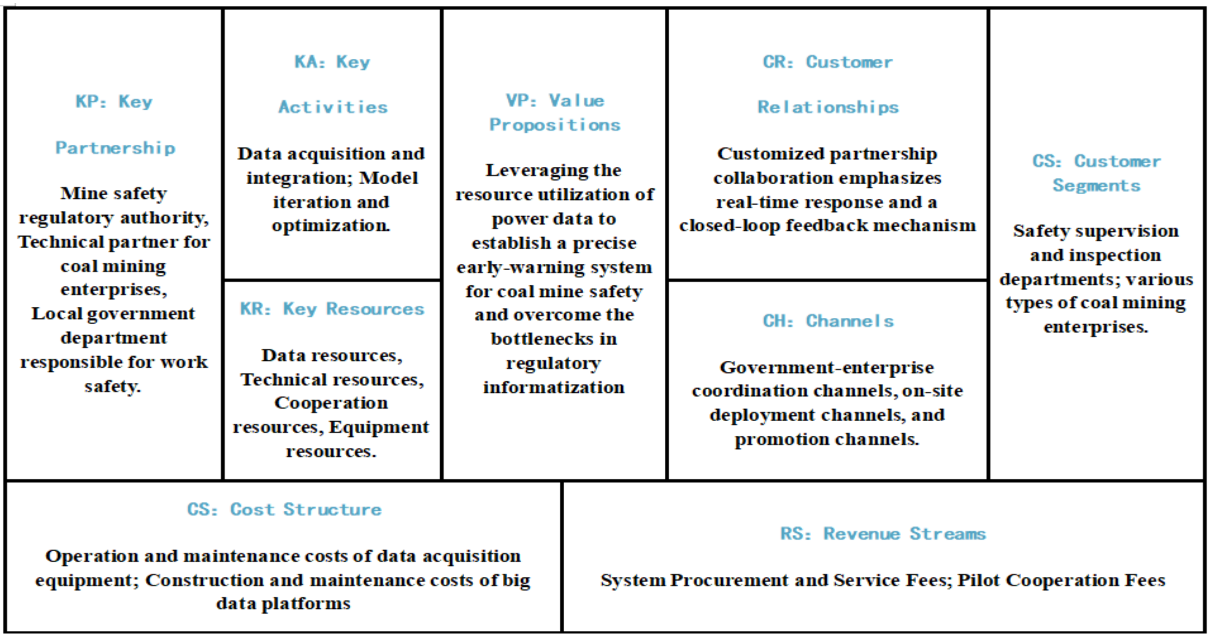

Figure 2. Personalized nine-grid for the Assetization Phase

(2) Case Deconstruction in the Capitalization Stage: Taking Wuxi Photovoltaic Data Set and Beijing Urban Brain as Examples(Figures 3 and 4)

Jiangsu Wuxi—Asset Registration and Capital Monetization: The "Green Power and Green Certificate Trading Potential Analysis Dataset for Photovoltaic Enterprise Users" developed by Wuxi Power Supply Company has obtained the data asset registration certificate, marking the transition of power data from independent business systems to a standardized asset catalog. At this stage, the core of the business model lies in right confirmation and compliant circulation. Through sorting out data resources and completing compliance reviews, the dataset has become a tradable subject eligible for listing on data trading platforms, laying a legal and financial foundation for subsequent capitalization operations including data pledge financing and equity investment at appraised value.

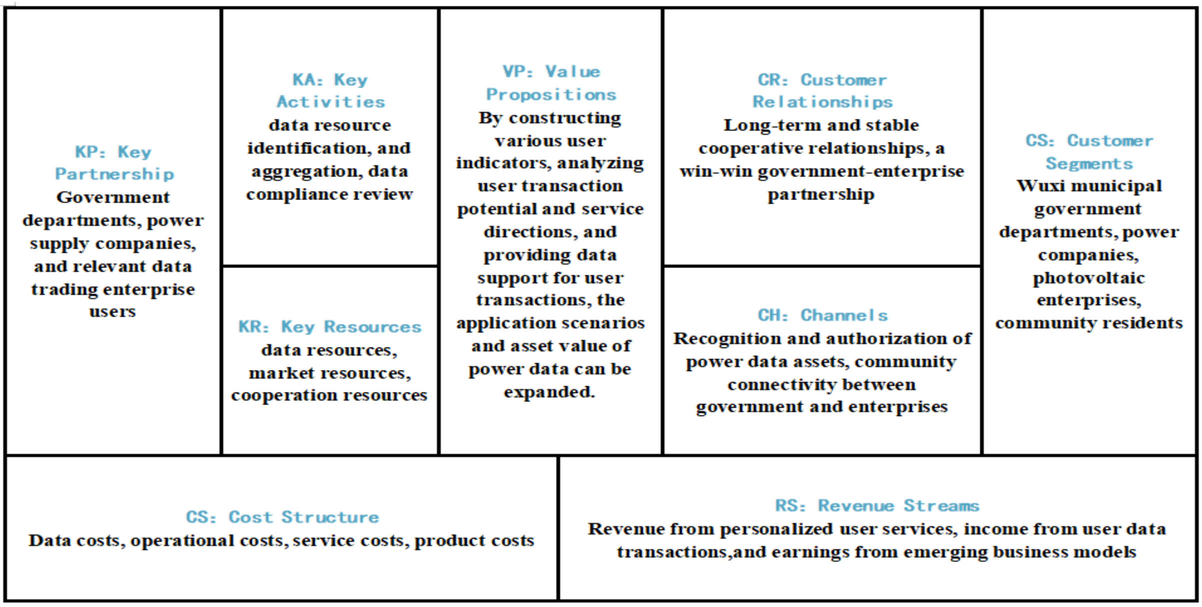

Figure 3. Personalized nine-grid for capitalization stage—Wuxi Photovoltaic dataset

Beijing Haidian—Ecological Integration and Intelligent Analysis: The "Smart Energy Urban Brain" developed by Haidian Power Supply Company is a typical representative of the advanced capitalization stage. Its business model goes beyond simple data trading and evolves into a co-builder of the urban governance ecosystem. By integrating multi-source data such as power, government affairs and images, it has constructed a "four horizontal and seven vertical" indicator system and an AI voice interaction model.

Competitive Strategy: The competitive advantage under this model lies in ecological stickiness. Once power data is deeply embedded in the decision-making process of urban operation and management, its replacement cost is extremely high, thus forming a sustainable value cycle relying on public services.

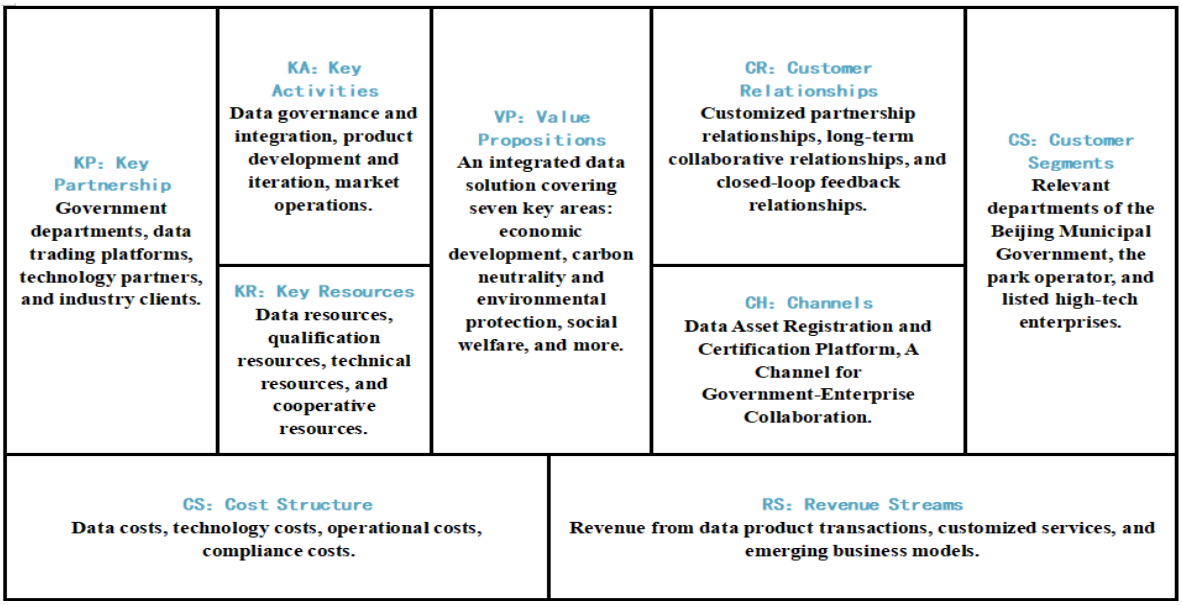

Figure 4. Personalized Nine-Cell Grid for Capitalization Stage—Beijing City Brain

5. Conclusion

In the differentiated evolution of data resource utilization, assetization and capitalization, the focus of business models shifts from internal management and vertical empowerment to ecological co-construction. The concept of "data temperature" proposed in this study offers a new approach to addressing homogeneous competition among power data products and tapping in-depth social value. The sustainable development of power data products relies on dual driving forces of technological and institutional innovation. It is essential to leverage AI and big data to enhance in-depth and human-oriented data insights, and adopt refined policy and institutional arrangements to ensure the secure and compliant circulation of data elements. This will maximize their value, thereby empowering the digital economy and fostering high-quality life.

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