# Digital–Green Coordination for Low-Carbon Industrial Chain Transfer: An Exploratory Case Study of Meizhou's Integration into the Guangdong–Hong Kong–Macao Greater Bay Area

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**Abstract.** Under China's dual-carbon targets, less-developed regions face the challenge of undertaking industrial chain transfer without reinforcing low-end specialization or carbon lock-in. Taking Meizhou's integration into the Guangdong–Hong Kong–Macao Greater Bay Area as an exploratory case, this paper develops a digital–green coordination framework linking industrial chain transfer with carbon reduction. The framework distinguishes the complementary roles of digitalization and greening. Digitalization improves information transparency, industrial matching, cross-regional coordination, and process monitoring, whereas greening guides project selection and low-carbon upgrading through entry standards, carbon-related constraints, and related incentives. Their relative importance varies across the transfer process. During project introduction, green screening plays a stronger gatekeeping role; during construction, digital coordination and green finance can reduce coordination and upgrading costs; and during operation, carbon accounting and low-carbon demonstration scenarios can support continuous carbon management and value conversion. Three mechanisms are identified: digital platforms embedded with green standards, data-enabled green finance for low-carbon upgrading, and carbon-accounting systems linked to low-carbon demonstration scenarios. The analysis suggests that Meizhou and comparable recipient regions should move from scale-oriented industrial reception toward more selective, traceable, and low-carbon integration. As an exploratory study, the framework clarifies possible mechanisms and generates propositions for future empirical testing.

**Keywords:** Industrial chain transfer; Carbon reduction; Digital–green coordination; Carbon lock-in; Guangdong–Hong Kong–Macao Greater Bay Area

## 1 Introduction

Industrial chain transfer has become an important way for less-developed regions to participate in regional production networks and benefit from industrial restructuring. Under China's carbon peaking and carbon neutrality goals, however, industrial transfer

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can no longer be viewed simply as the relocation of production capacity. Recipient regions need to strengthen local industrial capabilities while avoiding low-end path dependence and carbon lock-in. This concern is consistent with low-carbon transition research showing that infrastructure choices, production systems, and institutional arrangements can create persistent high-carbon trajectories [1].

Meizhou provides a relevant setting for examining this challenge. Located in northeastern Guangdong and within Guangdong's former Central Soviet Area, the city is seeking closer integration with the Guangdong–Hong Kong–Macao Greater Bay Area. Compared with the Greater Bay Area's core cities, Meizhou has a smaller economic scale, a weaker industrial base, and more limited innovation capacity. In 2024, high-tech and advanced manufacturing accounted for 23.5% and 33.5% of the value added of industrial enterprises above designated size in Meizhou, compared with 32.0% and 57.1% in Guangdong as a whole [2]. This gap suggests that Meizhou's integration into the Greater Bay Area should involve more than attracting transferred industries. It also requires improving the quality of industrial reception and avoiding low-value-added and carbon-intensive development paths. Meizhou is therefore treated as an analytically informative case rather than a statistically representative one.

Digital–green coordination provides a way to examine how these objectives might be reconciled. Digital technologies can reduce information asymmetry, improve supply-chain matching, strengthen process monitoring, and support cleaner production. Existing studies show that the digital economy can improve carbon-emission performance through green innovation, energy efficiency, and cleaner energy structures, while Industry 4.0 technologies provide additional tools for cleaner production [3-5]. Green governance plays a different role by shaping project entry, strengthening carbon-related requirements, and supporting low-carbon upgrading. In this sense, digitalization mainly improves coordination and monitoring, whereas greening provides the standards and constraints that guide the direction of industrial transfer.

Existing research has examined industrial transfer, digital transformation, and carbon reduction in considerable depth, but these topics are often studied separately. Less attention has been paid to how digital tools and green constraints can be combined throughout the industrial transfer process, especially in less-developed recipient regions. This gap is important because such regions are expected to absorb industrial resources from major growth poles while also meeting tighter ecological and carbon constraints. Without effective coordination, industrial transfer may increase short-term industrial capacity while reinforcing low-value-added specialization and carbon-intensive production.

Against this background, this paper uses Meizhou's integration into the Guangdong–Hong Kong–Macao Greater Bay Area as an exploratory case to develop a digital–green coordination framework linking industrial chain transfer with carbon reduction. The study does not estimate causal effects. Instead, it clarifies the underlying mechanisms and develops propositions for future empirical testing. The framework focuses on three mechanisms: digital platforms embedded with green standards, data-enabled green finance for low-carbon upgrading, and carbon-accounting systems linked to low-carbon demonstration scenarios. The paper contributes by shifting attention from the scale of industrial reception to its quality under carbon constraints, bringing digital coordination

and green governance into a common analytical framework, and examining the opportunities and constraints faced by less-developed non-core cities entering advanced regional production networks.

## 2 Regional Context and Analytical Approach

### 2.1 Regional Position, Transfer Foundation, and Upgrading Gap

Meizhou is located in northeastern Guangdong and is one of the cities in Guangdong's former Central Soviet Area. Compared with the core cities of the Guangdong–Hong Kong–Macao Greater Bay Area, it has a smaller economic scale, a weaker industrial base, and more limited innovation capacity. At the same time, it has ecological resources, available land, industrial parks, and links with neighboring inland provinces. In 2024, Meizhou's GDP reached 150.818 billion yuan, with a permanent resident population of 3.8416 million. The primary, secondary, and tertiary sectors accounted for 18.8%, 28.3%, and 52.9% of GDP, respectively [6], suggesting that industrial upgrading remains an important development task.

Regional support policies have strengthened Meizhou's links with the Greater Bay Area. The Guangzhou–Meizhou paired-assistance plan identifies the Guangzhou–Meizhou Industrial Transfer Cooperation Park (Guangmei Industrial Park) as an important platform for cross-regional industrial cooperation and supports infrastructure connectivity and Meizhou's inclusion in the Greater Bay Area's 1.5-hour economic circle [7]. Together with county-level co-construction parks, these arrangements provide channels for project introduction, industrial clustering, and access to supply-chain and service networks in Guangzhou and other Greater Bay Area cities.

Meizhou has also shown signs of manufacturing upgrading. In 2024, high-tech manufacturing accounted for 23.5% and advanced manufacturing for 33.5% of the value added of industrial enterprises above designated size, compared with 32.0% and 57.1%, respectively, in Guangdong as a whole [2,6]. This comparison provides a contextual benchmark for assessing Meizhou's upgrading gap within Guangdong. It suggests that Meizhou has an initial industrial foundation for regional cooperation but still lags behind the provincial average, particularly in advanced manufacturing.

These conditions make Meizhou a useful case for examining industrial chain transfer in less-developed recipient regions. It is neither a core manufacturing city of the Greater Bay Area nor a mature industrial hub with strong endogenous innovation capacity. Instead, it seeks to enter a more advanced regional production network through paired assistance, industrial cooperation platforms, and policy support. The case therefore allows examination of how a non-core city may improve the quality of industrial reception while avoiding low-end path dependence.

### 2.2 Low-Carbon Transition Pressure

Industrial chain transfer can create development opportunities for recipient regions, but it may also increase the risk of carbon lock-in when transferred activities are concentrated in low-value-added or energy-intensive segments. In 2024, the value added of

Meizhou's six major energy-intensive industries, as defined in China's industrial statistical system, recorded a modest positive growth rate of 0.2% [6]. Although the increase was limited, energy-intensive sectors remain part of the local industrial structure. Aligning industrial expansion with carbon-reduction requirements is therefore an important policy issue.

Meizhou's ecological positioning further strengthens the case for selective industrial reception. The Guangzhou–Meizhou paired-assistance plan supports the development of green and low-carbon industrial bases, including a Greater Bay Area green ecological industry base, a Guangdong authentic Chinese medicinal materials planting and processing base, and an eastern Guangdong high-end flower industry base [7]. These arrangements indicate that regional integration cannot be assessed solely by project quantity, investment scale, or short-term output growth. Industrial transfer also needs to consider ecological protection, green standards, and low-carbon upgrading.

The central tension is therefore clear: Meizhou needs to strengthen its participation in regional industrial-chain networks while avoiding the passive reception of low-end or carbon-intensive production capacity. This tension motivates the analysis of digital–green coordination developed below.

### 2.3 Analytical Approach and Data Sources

This paper adopts an exploratory, mechanism-based case study approach to examine how digital–green coordination may link industrial chain transfer with carbon reduction in less-developed recipient regions. It does not estimate causal effects. Instead, the analysis develops a framework based on Meizhou's regional conditions, policy context, and industrial upgrading challenges.

Meizhou is selected because it combines three features relevant to the research question: a relatively weak industrial base, institutional connections with the Greater Bay Area through paired assistance and industrial cooperation platforms, and simultaneous pressure to undertake industrial transfer while avoiding carbon lock-in. The case is used to identify possible mechanisms and boundary conditions rather than to claim universal applicability.

The analysis draws on four types of materials. First, official statistical data from the Meizhou Municipal Bureau of Statistics and the Guangdong Provincial Bureau of Statistics are used to describe economic scale, industrial structure, manufacturing upgrading, and low-carbon transition pressures. Second, national, provincial, and municipal policy documents are used to identify institutional arrangements related to regional integration, paired assistance, industrial cooperation, green development, and carbon reduction. Third, publicly available park- and enterprise-related materials—including industrial park information, project-introduction materials, government news releases, and publicly reported enterprise cases—are used to identify practical coordination needs and possible application scenarios. Fourth, academic literature on industrial chain transfer, carbon lock-in, digital transformation, green finance, Industry 4.0, and regional low-carbon transition provides the conceptual basis for framework development.

The available evidence is best suited to examining policy design, regional conditions, and macro- to meso-level governance mechanisms. Publicly available park- and

enterprise-related materials provide supplementary information on transfer platforms and project implementation, but they cannot capture firm-level behavioral responses or park-level operational outcomes in the same way as interviews, surveys, or internal operational data. Accordingly, the paper does not claim to verify the firm-level effects of digital–green coordination. Instead, it uses the Meizhou case to develop an exploratory framework and propositions that can later be examined through interviews, enterprise surveys, park-level operational data, multi-case comparisons, or regional panel data.

## 3 Theoretical Logic of Digital–Green Coordination

Digital–green coordination refers to the coordinated integration of digital technologies and green governance mechanisms into industrial chain transfer. Digitalization and greening play distinct but complementary roles. Digitalization improves information processing, industrial matching, process monitoring, and cross-regional coordination, whereas greening shapes industrial entry, carbon-related requirements, environmental standards, and incentives for low-carbon upgrading. Digital technologies can make green governance more measurable and traceable, while green requirements give digital transformation a clearer low-carbon orientation.

This relationship is particularly relevant for less-developed recipient regions. Such regions need to attract industrial resources and participate in regional production networks, but they also face the risk of receiving low-value-added or carbon-intensive production links. Coordinating digital and green governance may therefore help improve the quality of industrial transfer while reducing the risk of carbon lock-in.

### 3.1 Digitalization and Greening as Complementary Governance Mechanisms

Industrial chain transfer involves multiple actors, including local governments, industrial parks, incoming firms, local suppliers, financial institutions, and environmental regulators. Differences in information, capabilities, and objectives among these actors can increase transaction costs and weaken coordination. Recipient regions may lack reliable information about firms' technological capacity, energy performance, compliance records, and environmental risks, while incoming firms may have insufficient knowledge of local factor conditions, supplier networks, infrastructure, and policy services.

Digital technologies can reduce these information and coordination problems by improving data collection, information sharing, and process monitoring. Digital platforms, industrial Internet systems, and smart monitoring tools can integrate information on firms, land use, energy consumption, environmental performance, financing demand, and supply-chain relationships. By converting dispersed information into comparable data, these tools can support project selection, factor allocation, supply-chain matching, and post-entry monitoring. This argument is consistent with studies showing that Industry 4.0 technologies can improve connectivity, data processing, and operational optimization in sustainable production systems [8].

However, digitalization does not automatically produce low-carbon outcomes. Without effective green constraints, more efficient project introduction and industrial expansion may still reinforce carbon-intensive production. Carbon lock-in arises when technologies, infrastructure, production systems, and institutions constrain future emission reduction and low-carbon transformation [1]. Greening therefore helps set the direction of industrial transfer by influencing which projects are admitted and the energy, carbon, and environmental requirements under which they operate.

Green standards can be incorporated into project screening, industrial entry, and park management. Carbon-related requirements may encourage firms to improve energy efficiency, adopt cleaner technologies, and reduce carbon intensity, while green finance and related incentives can support equipment renewal, process optimization, and technological upgrading. This is consistent with the view that well-designed environmental regulation may stimulate innovation and improve resource productivity rather than merely increase compliance costs [9,10].

For Meizhou, digitalization can improve the transparency and coordination of industrial transfer, while greening can reduce the risk that integration into the Greater Bay Area becomes a process of passively receiving low-end or high-emission capacity.

### 3.2 Stage-Specific Coordination

The relative importance of digitalization and greening changes across the industrial transfer process. Their relationship is therefore better understood as stage-specific rather than as a fixed combination of policy tools.

During the introduction stage, green constraints play a stronger gatekeeping role. The main issue is not simply how many projects can be attracted, but which projects are consistent with local upgrading and low-carbon objectives. Green standards, energy-efficiency requirements, carbon constraints, and industrial entry rules can guide project screening. Digital tools complement this process by collecting enterprise information, comparing project characteristics, and tracing compliance records. At this stage, greening sets the direction, while digitalization improves the quality and transparency of screening.

During the construction stage, coordination becomes a more immediate concern. Recipient regions need to align land use, infrastructure, financing, environmental facilities, supply-chain matching, and administrative services. Digital platforms can help reduce coordination costs and improve implementation efficiency. At the same time, green requirements need to be translated into concrete arrangements for energy-saving facilities, cleaner production processes, environmental monitoring, and related construction standards. Digitalization therefore supports implementation, while greening shapes the requirements under which projects are developed.

During the operation stage, digitalization and greening become more closely connected. Digital systems can make energy use, emissions, production processes, and supply-chain relationships more visible and traceable. These data can support carbon accounting, environmental monitoring, green finance, performance evaluation, and continuous upgrading. Digitalization thus improves the precision of green governance,

while green requirements create practical applications for digital monitoring and data use.

The stage-specific pattern is therefore not one of equal emphasis throughout the transfer process. Green constraints are more prominent during project introduction, digital coordination becomes particularly important during construction, and the two become more closely integrated during operation. **Figure 1** summarizes this evolution.

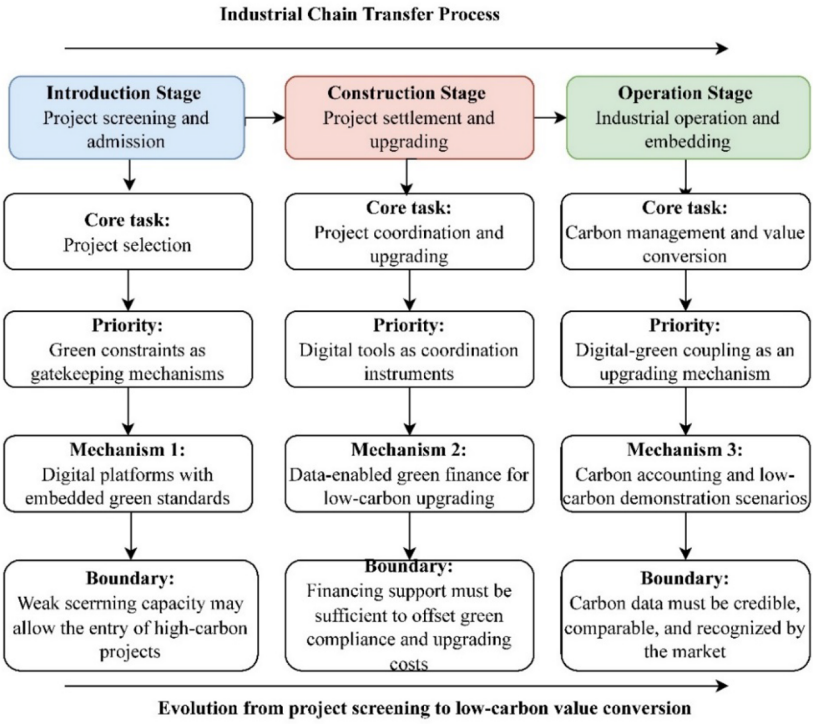



**Fig. 1.** Stage-based evolution of digital–green coordination in industrial chain transfer.

**Note:** Green constraints play the primary role in project screening during the introduction stage; digital tools improve coordination during construction; and digitalization and greening become more closely connected through monitoring, carbon accounting, and low-carbon upgrading during operation.

### 3.3 Boundary Conditions and Mechanism Tensions

The effectiveness of digital–green coordination is not automatic. It depends on several local and regional conditions.

First, digital infrastructure affects whether information can be collected, connected, and used in governance. Fragmented or largely symbolic platforms are unlikely to improve project screening, supply-chain coordination, or carbon monitoring.

Second, green governance capacity affects whether standards can be implemented effectively. Weak enforcement may fail to prevent high-emission projects from entering, whereas excessively rigid standards without supporting measures may raise compliance costs and discourage investment.

Third, enterprise capabilities shape how firms respond to digital and green requirements. Firms with stronger technological and managerial capacity are better positioned to benefit from digital monitoring, green finance, and low-carbon upgrading. Firms with weaker foundations may instead experience these requirements primarily as additional compliance costs.

Fourth, fiscal and financial support affects the feasibility of equipment renewal, digital systems, energy-saving technologies, and environmental facilities. Limited access to finance may therefore constrain digital and green upgrading, particularly in less-developed regions.

Fifth, regional market recognition determines whether low-carbon upgrading can generate economic returns. Carbon accounting, green certification, and low-carbon demonstration projects create stronger incentives when their results are recognized by core enterprises, financial institutions, consumers, and procurement systems in the Greater Bay Area.

These conditions also create tensions for less-developed recipient regions. Such regions need industrial expansion but must avoid carbon-intensive development; they need green standards but cannot rely on excessively restrictive entry barriers; and they need digital tools despite relatively weak infrastructure and governance capacity. Digital–green coordination should therefore be understood as a conditional governance approach whose effectiveness depends on the interaction among digital infrastructure, green governance capacity, enterprise capability, financial support, and regional market recognition.

Building on this theoretical logic, the next section develops three coordination mechanisms: digital platforms with embedded green standards, data-enabled green finance for low-carbon upgrading, and carbon-accounting systems linked to low-carbon demonstration scenarios.

## 4 A Stage-Based Digital–Green Coordination Framework

Building on the theoretical logic above, this section develops a stage-based framework linking industrial chain transfer with carbon reduction. Industrial chain transfer is treated not simply as the spatial relocation of production capacity, but as a process involving project selection, platform development, industrial integration, carbon management, and low-carbon value creation.

This issue is particularly relevant to Meizhou. Its share of advanced manufacturing remains below the provincial average, while energy-intensive sectors are still present in the local industrial structure [2,6]. The policy challenge is therefore to attract suitable industries while embedding digital tools and green requirements into different stages of the transfer process.

Each stage involves a different governance priority. The introduction stage centers on project screening and the prevention of low-value-added or carbon-intensive capacity inflows. The construction stage emphasizes coordination efficiency and support for low-carbon upgrading. The operation stage requires carbon performance to be measurable, traceable, and connected to economic and governance uses. Correspondingly, the framework identifies three mechanisms: project screening through digital platforms with embedded green standards, data-enabled green finance for low-carbon upgrading, and carbon accounting linked to low-carbon demonstration scenarios.

**Table 1** summarizes these mechanisms and their relevance to Meizhou's integration into the Guangdong–Hong Kong–Macao Greater Bay Area.

**Table 1.** Stage-based mechanisms of digital–green coordination for industrial chain transfer and carbon reduction.

| Stage | Core governance problem | Coordination mechanism | Application to Meizhou |
|---|---|---|---|
| Introduction stage | Fragmented information and weak project screening | Green-oriented project screening through digital platforms using enterprise databases, energy-use data, compliance records, industrial entry standards, and carbon-intensity indicators | Support selective project admission and reduce the inflow risk of low-end or high-carbon projects |
| Construction stage | Financing constraints and insufficient upgrading capacity | Data-enabled green finance, including green loans, transition finance, equipment-renewal finance, and supply-chain finance based on operational and carbon-performance data | Convert enterprise data and carbon performance into financing support for green upgrading |
| Operation stage | Incomplete carbon data and weak value conversion | Carbon accounting and low-carbon demonstration scenarios supported by carbon accounts, smart monitoring, green certification, low-carbon parks, green supply chains, and digital traceability tools | Support Meizhou's development as a traceable and low-carbon supporting base for the Greater Bay Area |

The following subsections explain how these mechanisms can be applied to project selection, financial support, carbon management, and low-carbon value creation.

### 4.1 Project Screening through Digital Platforms with Embedded Green Standards

The first mechanism operates mainly during the introduction stage. Before project admission, local governments and industrial parks need to assess enterprise quality, industrial relevance, technological potential, and environmental risk. The main task is to identify projects that are consistent with local industrial upgrading and low-carbon development objectives.

Information on incoming firms is often fragmented or difficult to compare. Recipient regions may have limited knowledge of firms' technological capabilities, energy efficiency, environmental compliance records, and upgrading potential. These information gaps can lead to the admission of projects that expand short-term output but create

longer-term carbon-reduction pressure. This risk may be particularly pronounced in less-developed regions, where growth incentives are often stronger and screening capacity more limited.

Digital platforms can help address these problems by integrating information on firms, land use, energy consumption, environmental performance, supply-chain demand, supplier networks, and policy services. By converting dispersed information into structured and comparable data, such platforms can support project comparison, industrial matching, and post-entry monitoring. This argument is consistent with studies showing that digital and Industry 4.0 technologies can improve connectivity, data processing, and operational optimization in sustainable production systems [8].

Green standards should be incorporated into these platforms rather than treated as separate administrative requirements. Relevant indicators may include industrial entry thresholds, energy efficiency, carbon intensity, environmental compliance, and cleaner production performance. Once included in project evaluation, these indicators allow potential projects to be assessed not only by investment scale or expected output, but also by industrial compatibility, upgrading potential, and carbon performance.

For Meizhou, this approach may help shift investment attraction from a scale-oriented model toward more selective and low-carbon project admission. Guangmei Industrial Park and county-level co-construction parks could combine digital project databases with green evaluation indicators to identify firms that fit Meizhou's industrial foundation, ecological positioning, and integration needs with the Greater Bay Area. Linking project admission with land use, energy consumption, environmental compliance, and industrial-chain matching could also strengthen post-entry monitoring.

This leads to the following proposition:

**Proposition 1.** In less-developed recipient regions, digital platforms with embedded green standards may improve the selectivity and traceability of industrial chain transfer by reducing information asymmetry and strengthening low-carbon project screening.

### 4.2 Data-Enabled Green Finance for Low-Carbon Upgrading

The second mechanism operates mainly during the construction stage and early operation. Once projects are introduced, firms need to invest in equipment renewal, energy-saving technologies, cleaner production processes, digital management systems, and environmental facilities. These investments are necessary for low-carbon upgrading but may create substantial financial pressure, especially for small and medium-sized firms with limited collateral, unstable cash flows, or incomplete credit records.

Data-enabled credit assessment can help alleviate this constraint by converting operational and environmental information into credit-relevant data. Digital platforms can integrate information on production activities, transactions, tax payments, energy use, carbon performance, and environmental compliance. Such data may allow financial institutions to assess firms' operating conditions, repayment capacity, and transition potential more accurately. Compared with credit evaluation based mainly on collateral, data-enabled assessment can reduce information asymmetry between firms and financial institutions.

Green financial instruments can further connect environmental and carbon performance with financing conditions. Financial institutions may develop green loans, transition finance, equipment-renewal loans, and supply-chain finance based on firms' digital records and environmental performance. Firms with lower carbon intensity, higher energy efficiency, stronger compliance records, or greater upgrading potential may obtain more favorable financing conditions. This mechanism is consistent with the broader role of green finance in directing capital toward environmentally beneficial investment [11,12].

For Meizhou, linking enterprise data, carbon performance, and financial services could support both industrial transfer and green upgrading. Local governments and financial institutions could use such information to direct capital toward higher-quality projects and low-carbon transformation, helping firms ease financing constraints, strengthen technological upgrading, and participate more effectively in the Greater Bay Area's industrial division of labor.

The mechanism may nevertheless be weakened if green requirements raise compliance costs without adequate financial support. Its effectiveness depends on whether data systems can connect firms, banks, government departments, and industrial platforms, and whether green financial instruments are accessible to firms with genuine upgrading needs.

This leads to the following proposition:

**Proposition 2.** In less-developed recipient regions, data-enabled green finance may strengthen firms' low-carbon upgrading capacity by converting operational data and carbon performance into credit-relevant information and financing support.

### 4.3 Carbon Accounting and Low-Carbon Demonstration Scenarios for Value Conversion

The third mechanism operates mainly during the operation stage. The key question at this point is whether transferred industries can become part of a low-carbon regional production network. Effective carbon management requires continuous, measurable, and traceable information. In many less-developed regions, however, enterprise-level carbon data remain incomplete and monitoring systems fragmented, making it difficult to determine whether industrial transfer supports low-carbon upgrading or merely shifts emissions across regions.

Carbon-accounting systems provide practical tools for carbon management. At the enterprise or industrial-park level, they can record energy use, carbon emissions, emission intensity, reduction measures, and green performance. They can also be connected with digital monitoring, environmental monitoring, and financial-service platforms. Carbon performance can thereby become a visible and comparable indicator for project evaluation, enterprise management, policy support, and financial decision-making. Recent studies likewise emphasize measurable indicators, clear accounting boundaries, and traceable emission information for low-carbon decision-making [13].

Carbon data can also serve market functions in procurement, financing, certification, and supply-chain cooperation. Low-carbon demonstration scenarios can connect carbon management with practical economic uses. Low-carbon industrial parks, green

supply chains, smart energy management, green building materials, agricultural product processing, and ecological product value realization can provide settings for combining digital monitoring with green governance. In these settings, carbon data can support product certification, green procurement, supply-chain matching, and financial incentives. Digital traceability tools, including blockchain-based applications, may further improve transparency and trust in sustainable supply chains [14].

For Meizhou's integration into the Greater Bay Area, these scenarios are particularly relevant. Firms in the Greater Bay Area increasingly require low-carbon suppliers, traceable production processes, and greener supporting bases. If Meizhou develops credible carbon-accounting systems and low-carbon demonstration scenarios, it may strengthen its role as a green supporting base and move beyond simple capacity reception toward higher-quality industrial-chain cooperation.

The effectiveness of this mechanism depends on whether carbon data are credible, comparable, and connected to market demand. If carbon information remains confined to administrative reporting, it may improve compliance without creating wider economic value. Likewise, if downstream firms do not recognize local green certification or carbon-accounting results, low-carbon performance may not translate into supply-chain advantages. Carbon accounting therefore needs to be linked with regional procurement, green certification, financial services, and supply-chain governance.

This leads to the following proposition:

**Proposition 3.** In less-developed recipient regions, carbon-accounting systems and low-carbon demonstration scenarios may transform carbon-reduction performance into development value when carbon data are measurable, credible, comparable, and connected to regional supply-chain demand.

### 4.4 Integrated Logic of the Framework

The three mechanisms address different governance problems across the transfer process. Digital platforms with embedded green standards support project selection and monitoring during the introduction stage. Data-enabled green finance supports low-carbon upgrading during construction and early operation. Carbon accounting and low-carbon demonstration scenarios connect carbon performance with governance, finance, and regional cooperation during operation.

The framework also emphasizes the interdependence between digitalization and greening. Digitalization improves the measurability, connectivity, and traceability of industrial transfer, while greening provides the criteria, constraints, and incentives that guide upgrading. Their coordination may help Meizhou reduce the risks of low-end path dependence and carbon lock-in while improving the quality of its integration into the Greater Bay Area.

The framework is exploratory rather than an empirically verified causal model. Its effectiveness depends on local digital infrastructure, green governance capacity, enterprise upgrading capability, financial support, and cross-regional market recognition. Future research can examine the propositions through multi-case comparison, enterprise surveys, park-level operational data, or econometric analysis using regional and firm-level datasets.

# 5 Implementation and Policy Implications

The proposed framework suggests that Meizhou's integration into the Guangdong–Hong Kong–Macao Greater Bay Area should place greater emphasis on the quality and carbon performance of industrial transfer rather than conventional investment attraction alone. Implementation should follow the stages of the transfer process, combining green project screening, digital coordination, financial support, carbon management, and low-carbon demonstration scenarios.

## 5.1 Strengthening Green-Oriented Project Screening in the Introduction Stage

During the introduction stage, Meizhou should shift from quantity-oriented investment attraction toward more selective project admission. The main task is to identify industries and firms that are compatible with local factor conditions, ecological capacity, and long-term upgrading needs. This requires a digital screening system that integrates enterprise information, industrial-chain demand, land supply, supplier networks, environmental compliance, energy use, and carbon-performance indicators.

A dedicated Guangzhou–Meizhou industrial-chain coordination platform could support project comparison, industrial matching, green access review, and post-entry monitoring rather than serving only as an investment-promotion tool. Such a platform would help identify projects suited to Meizhou's industrial foundation and reduce the risk of receiving low-end or carbon-intensive production capacity.

Green standards should be incorporated directly into project screening. Indicators related to energy efficiency, environmental compliance, carbon intensity, cleaner production, and industrial compatibility can inform project admission, park management, and enterprise evaluation. Project decisions would then consider not only investment scale and expected output, but also upgrading potential and longer-term carbon implications.

## 5.2 Enhancing Digital Coordination and Green Finance in the Construction Stage

During the construction stage, policy should focus on reducing implementation and upgrading costs. After projects enter industrial parks or cooperation platforms, firms require coordinated access to land, infrastructure, financing, environmental facilities, suppliers, administrative services, and technical support. Fragmented service provision can delay project implementation and weaken industrial coordination.

Digital systems can connect project implementation, park management, enterprise services, energy monitoring, and supply-chain coordination. Local governments and industrial parks can use these systems to track project progress, identify bottlenecks, match suppliers, and provide more targeted services.

Green financial support can also make greater use of enterprise operational and environmental data. Information on transactions, tax payments, energy use, environmental compliance, and upgrading plans can be incorporated into credit assessment and

policy support. Green loans, transition finance, equipment-renewal loans, and supply-chain finance can then be directed toward firms with credible upgrading plans and stronger low-carbon potential.

For Meizhou, the practical objective is to establish a workable link between enterprise data and credit assessment. Operational and environmental information should help firms obtain financing for equipment renewal, digital transformation, and cleaner production rather than remain isolated within separate administrative systems. Green finance should therefore respond to firms' actual transition needs rather than function merely as a policy label.

### 5.3 Developing Carbon Accounting and Low-Carbon Scenarios in the Operation Stage

During the operation stage, Meizhou should strengthen continuous carbon management and the practical use of low-carbon performance. Transferred industries should be evaluated not only by output, tax contribution, and employment, but also by energy efficiency, carbon intensity, environmental performance, supply-chain compatibility, and upgrading potential.

Enterprise- and park-level carbon-accounting systems can record energy consumption, carbon emissions, emission intensity, reduction measures, and green performance. Connecting these systems with digital monitoring, environmental platforms, financial services, and supply-chain management would make carbon information more comparable and more useful for governance and business decisions.

Meizhou can also develop low-carbon demonstration scenarios, including low-carbon industrial parks, green supply chains, smart energy management, green building materials, green agricultural processing, and ecological-product value realization. These settings can support the combined use of carbon accounting, digital monitoring, green certification, and low-carbon supply-chain management.

Such scenarios may strengthen Meizhou's functional links with the Greater Bay Area. If local firms can provide credible carbon data, traceable production information, and recognized green certification, Meizhou may strengthen its position as a green supporting base within regional industrial chains. Carbon accounting should therefore serve not only regulatory purposes, but also procurement, finance, certification, and regional cooperation.

### 5.4 Implementation Conditions and Governance Boundaries

Several conditions are necessary for effective implementation. First, digital systems need to be interoperable. Enterprise databases, carbon-accounting systems, financial platforms, and industrial-chain coordination platforms should be connected through appropriate data-sharing arrangements among government departments, industrial parks, financial institutions, and firms.

Second, green standards should be enforceable but sufficiently adaptive. Weak standards may fail to prevent high-carbon project inflows, whereas overly rigid requirements without supporting measures may raise compliance costs and discourage

investment. Green access requirements should therefore be combined with transition support, technical services, and financial incentives.

Third, policy support should reflect differences in enterprise capability. Firms vary in digital readiness, technological capacity, management quality, and financial strength. Support measures should therefore consider firm size, industry type, carbon intensity, and upgrading potential rather than rely on a uniform policy package.

Fourth, cross-regional recognition is essential. Carbon-accounting results, green certification, and low-carbon performance indicators generate wider value only when recognized by downstream firms, financial institutions, and supply-chain partners. Meizhou should therefore strengthen coordination with Guangzhou and other Greater Bay Area cities so that local standards and data systems are compatible with regional procurement requirements, green finance practices, and supply-chain governance.

Overall, Meizhou should shift the focus of industrial transfer from scale expansion toward the quality, traceability, and carbon performance of transferred industries. A stage-based approach can support more selective and low-carbon regional integration and may also offer lessons for other less-developed regions seeking to enter advanced production networks under carbon constraints.

## 6 Conclusion

This paper develops an exploratory digital–green coordination framework to examine how industrial chain transfer can be linked with carbon reduction in the context of Meizhou's integration into the Guangdong–Hong Kong–Macao Greater Bay Area. For less-developed recipient regions, industrial transfer is more than the relocation of production capacity. The challenge is to strengthen participation in regional production networks while improving the quality and carbon performance of incoming industries.

The Meizhou case suggests that digitalization and greening play distinct but complementary roles in this process. Digitalization can reduce information asymmetry, improve industrial matching, and strengthen process monitoring, while greening can shape project admission, carbon-related requirements, and incentives for low-carbon upgrading. Used together, they may help recipient regions move beyond passive capacity reception toward more selective and low-carbon industrial integration.

Their relative importance also changes across the transfer process. Green standards are particularly important for project screening during the introduction stage. During construction, digital coordination and green finance can support project implementation and low-carbon upgrading. During operation, carbon accounting and low-carbon demonstration scenarios can strengthen continuous carbon management and connect low-carbon performance with procurement, finance, certification, and regional cooperation. On this basis, the framework highlights three mechanisms: digital platforms with embedded green standards, data-enabled green finance, and carbon-accounting systems linked to low-carbon demonstration scenarios.

The study makes three main contributions. It shifts attention from the scale of industrial transfer to the quality of industrial reception under carbon constraints; brings digitalization and green governance into a common analytical framework while

distinguishing their roles across different stages; and draws attention to the opportunities and constraints faced by less-developed non-core cities entering advanced regional production networks. For Meizhou and comparable regions, industrial integration should therefore be assessed not only by investment scale or project quantity, but also by industrial relevance, upgrading potential, supply-chain compatibility, and carbon performance.

Several limitations should be acknowledged. The study is based on a single exploratory case and relies mainly on official statistics, policy documents, publicly available park- and enterprise-related materials, and secondary literature. It therefore focuses on macro- and meso-level governance mechanisms rather than firm-level behavioral responses and does not provide causal tests based on operational data. Future research could examine the proposed mechanisms through multi-case comparisons, enterprise surveys and interviews, industrial-park operational data, and city- or firm-level panel analysis. These approaches would provide a stronger basis for evaluating and extending the propositions developed here.

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