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Research on the Impact of Circular Economy on Industrial Parks in Resource-based Cities in Western China

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ABSTRACT: At the critical stage of transformation and development for resource-based cities, exploring the driving mechanism of the circular economy model for industrial parks holds significant strategic importance. Currently, Liupanshui City faces challenges such as low industrial linkages, extensive energy utilization, and insufficient factor guarantees, urgently requiring structural optimization to enhance economic development efficiency. Based on empirical research and cross-regional case benchmarking, this paper systematically analyzes the implementation pathways of circular economy within industrial parks, providing decision-making references for the high-quality development of resource-based cities in western China.

Keywords: *Western China, Resource-based, Industrial Park, Circular Economy, Industrial Chain*

1. Introduction

As a typical old industrial base and resource-based city established during the "Third-line Construction" period, Liupanshui City has basically formed a "coal, electricity,

steel, and building materials" pillar industry system. Like other old industrial and resource-based cities, it also faces the imperative to accelerate high-quality economic development through industrial transformation and upgrading.

2. Overview of Industrial Parks

2.1. Overview of Provincial Industrial Parks

As of 2024, Guizhou Province has 12 chemical industrial parks (CIPs): 2 in Guiyang, 2 in Bijie, 2 in Qiannan, 1 in Anshun, 1 in Zunyi, 1 in Qiandongnan, 1 in Liupanshui (Liupanshui Panbei Chemical Industrial Park), 1 in Qianxinan, and 1 in Tongren.

2.2. Overview of Liupanshui's Industrial Parks

Since the establishment of its first economic and technological development zone (ETDZ) - Liupanshui High-Tech Industrial Development Zone (LIUPANSHUI HIDZ) in May 1992, the city has set up a total of 8 ETDZs or industrial parks. Geographically divided into three zones:

1. Eastern Liuzhi Zone: Liuzhi SEZ Economic Development Zone (1 park).
2. Northern Shuicheng-Zhongshan Zone: Shuicheng Economic Development Zone, LIUPANSHUI HIDZ, Zhongshan Industrial Park, Fa'er Park (4 parks).
3. Southern Panzhou Zone: Pannan Industrial Park, Panbei Economic Development Zone, Hongguo Economic Development Zone (3 parks).

The 8 parks vary in size with a total planned area of 642.295 square kilometers. Total population is approximately 160,000. There are 4,492 enterprises employing over 25,000 people (about 1/6 of the park population), averaging 5.56 employees per enterprise. There are 72 management agencies with 466 staff, averaging 6.47 staff per agency. Apart from LIUPANSHUI HIDZ, the other 7 parks have recorded no production safety accidents since their establishment or integration, indicating a generally stable safety situation.

3. Economy in Industrial Park

In August 2019, Liupanshui was approved to build a national-level industrial transformation and upgrading demonstration zone, the only one in Guizhou. Guided

by the principle of "Based on Coal, Enhancing Coal, Not Limited to Coal," the city adheres to "upgrading traditional industries while nurturing emerging industries," accelerating the shift from resource advantages to economic and developmental strengths. Efforts focus on building seven comprehensive industry chains: Textiles, New Materials, Internet of Things (IoT), Agricultural Product Processing, New Energy Chemicals, Tourism Equipment, and Modern Logistics. Following the strategy of "building, strengthening, and complementing chains," the parks aim for "clustering and high-end" development of primary and potential industries.

3.1. Economic Performance of Industrial Parks

The 8 parks vigorously develop circular economy. Total industrial output value reached 99.371 billion yuan (CNY). Five parks have entered the "10-billion-yuan park" tier: Zhongshan Industrial Park, Shuicheng Economic Development Zone, Hongguo Economic Development Zone, Fa'er Park, and Pannan Industrial Park. Output value of industries above designated scale was 82.949 billion CNY, and cumulative fixed asset investment was 38.729 billion CNY.

3.2. Characteristic Advantages of Industrial Parks

Eastern Zone: Focuses on four major industrial chains leveraging coal resources: "Coal-Electricity-Lithium/Silicon," "Coal-Coke-Hydrogen," "Coal-Electricity-Building Materials," and "Coal-Electricity-Chemicals (Textiles)." "Coal-Electricity-Lithium" and "Coal-Coke-Hydrogen" are prioritized. Key advantages include these two chains and the Chinese medicine industry.

Northern Zone: Primarily features chains based on "Materials (Basic & New Materials), Modern Chemicals, Agricultural Product Processing, Circular Economy (Industrial Solid Waste), and Mining Equipment." Key advantages include Materials, Coal-Chemicals, Coal-Aluminum, Mining Equipment, Circular Economy (Industrial Solid Waste), and Eco-Specialty Food Processing ("Liangdu Three Treasures": red-heart kiwi fruit, roxburgh rose, and tea).

Southern Zone: Focuses on "Modern Energy, Modern Chemicals, Energy Equipment, Eco-Specialty Products, and IoT." Key advantages are Modern Energy, Modern

Chemicals (Coking + New Coal Chemicals), Eco-Specialty Food Industry (roxburgh rose, ham, baijiu liquor), and IoT industry.

3.3. Investment Attraction in Industrial Parks

Dedicated Teams for Investment Chains: Treating investment attraction as a "top leader" project, implementing mechanisms like "one project, one dedicated team, one timeline" and "chain leader responsibility system." Dedicated teams create industrial chain blueprints ("two maps, two pools, two databases"), formulate detailed attraction plans, target key enterprises, ensuring each project is attracted, lands, produces results, and drives cluster development.

Business-led Chain Extension and Strengthening: Expanding channels through existing business referrals, commissioned third-party marketing, or leveraging municipal liaison offices to "build bridges and ties," facilitating industrial project introductions and completing the value chain through business-led attraction.

Optimizing Business Environment for Quality and Efficiency: Establishing systems like "leadership designated contact service for enterprises" and "government services entering parks," ensuring "prompt park response to enterprise feedback." Regular coordination brings departments or equipment into parks, offering doorstep services for enterprises. Monthly "enterprise salons" facilitate experience exchange, resource sharing, enhance cohesion, and promote integrated industrial development.

4. Shortcomings and Bottlenecks in Industrial Park Development

4.1 Circular Economy Development in Parks

Project layout is scattered; industry clusters centered on backbone enterprises have not formed; inter-enterprise linkages are weak; industrial chains are incomplete; development lacks holistic synergy.

Example: Mugang Park houses industries like building materials, hardware processing, security products, leather processing, garment processing, packaging printing, plastic food bags, etc., but linkages are weak.

Example: Panbei Economic Development Zone was approved as a CIP focusing on new energy, new materials, and modern chemicals, yet a core enterprise-based cluster is lacking.

4.2 Significant Scope for Improvement in Energy Industry

Electricity Shortage Persists: Liupanshui bears major "West-East Power Transmission" duties. Coal supply for power generation remains tight.

Ambitious Growth Required for Billion-Ton Coal City: Speeding up cultivation and release of high-quality coal production capacity, aiming for city-wide coal mine capacity reaching 120 million tons/year by 2025 signifies substantial potential.

Strategic Importance of an Energy Investment Group: While the city has government-backed companies (platforms) for urban construction, public welfare, agriculture, tourism, transport, water conservancy, planning, water affairs, investment guarantee, etc., their involvement in energy industry layout is minimal. Coal is Liupanshui traditional strength and primary industry. Establishing an Energy Investment Group to marketize and strengthen energy-related industries (coal mining, power generation, coalbed methane, coal chemicals, solid waste reuse, mining equipment, coal logistics) is profoundly significant for developing park-centric circular economy.

4.3 Institutional and Mechanism Issues

Incomplete Separation of Public Service Functions: After institutional reforms, parks transferred some social management functions to local governments but still retain urban management, land acquisition/resettlement, petition stability maintenance, rural revitalization assistance, river chief duties.

Imbalance Between Authority and Responsibility: Parks undertake infrastructure/public facility construction and management, urban/rural planning, etc., without corresponding project/planning approval authority or dedicated supervision institutions. Process complexity and coordination difficulties hinder project implementation and operations (e.g., lengthy land procedure approvals through district natural resources departments).

Insufficient Factor Support: Total park area is 642.295 km² (average 80.29 km²), with large disparities among parks (11.73~203.35 km²). 5 parks are below average (LIUPANSHUI HIDZ, Pannan Industrial Park, Panbei EDZ, Fa'er Park, Liuzhi SEZ EDZ). Lack of guaranteed land supply impedes large project attraction. Limited industrial structure in some parks restricts development (e.g., Fa'er Park focuses solely on large-scale industrial solid waste recycling, situated low in the chain).

4.4 Fiscal and Policy Challenges

Single Revenue Source: Operated as district-level budget units relying primarily on district fiscal appropriations for operational expenses. Tax revenues meant for parks are not directly allocated. Facing economic headwinds, shrinking district government fund and state-owned capital revenues increase fiscal pressure.

Insufficient Construction Investment: Parks lack funding for project preparation/pre-feasibility studies and specific park application costs, resulting in severe underinvestment in water, electricity, roads, and telecommunications infrastructure. Difficulty fulfilling investment attraction subsidies affects effectiveness. Platform companies struggle to finance necessary projects.

Platform Financing Difficulties: Reliance on platform companies for project financing has led to high debt loads. Issues include unclear fixed asset ownership, overlapping guarantee liabilities, poor post-loan management tracking, increasing financing costs, difficulties optimizing debt structures, and grim financing prospects amidst a weak market and low enterprise vitality.

4.5 Enterprise Cultivation Issues

Late Start: e.g., Shuicheng EDZ shows deficits in internal capital accumulation/generation and attracting/utilizing external funds.

Weak Industrial Chain Foundation: e.g., Guizhou Liuzhi SEZ EDZ aims to form clusters around primary/potential industries but progress is slow; upstream/downstream development is insufficient; potential chain development faces difficulties due to indistinct resource advantages.

Small Enterprise Scale: e.g., Pannan Industrial Park has few resident enterprises, mostly order-based; few qualify for statistics. Some supported enterprises are small; operating enterprises have unstable production; some lack orders/shut down. e.g., In LIUPANSHUI HIDZ, resident enterprises constitute 44.04% of market entities (60 firms, only 25 above designated scale; 2023 industrial output above scale just 3.949 billion CNY), dominated by wholesale/retail/hospitality/service sectors. Industrial enterprises are just 3.13% of total market entities. Overall scale is small, lacking scale benefits and competitiveness.

4.6 Bottlenecks in Investment Attraction

Most parks struggle with low-magnitude, small-scale, low-tax, low-linkage projects, hindering industrial synergy and agglomeration.

In-depth Project Planning Deficiency: Shallow analysis of chain dynamics, poor attractiveness to external investors, insufficient assessment of market/enterprise needs, resulting in non-targeted project proposals.

Lagging Infrastructure: Inadequate water, electricity, road infrastructure and poor accessibility in some parks create logistics bottlenecks, increasing costs and weakening product competitiveness. Some new/small platform companies have weak financing/limited infrastructure investment capacity, making short-term improvements hard and deterring investment.

Limited Attractiveness of Production Factor Guarantees: Significant year-on-year hikes in industrial electricity/gas prices in some parks; weak water provision during dry seasons increase costs, undermining investor confidence. Land approval issues arise due to local fiscal constraints and enterprise reluctance to prepay fees, hindering project landing/construction.

Insufficient Development Attractiveness: Weak industrial foundations and unclear agglomeration effects deter large/quality projects demanding strong industrial chains. Moreover, investment policies (land, fiscal) are less competitive compared to places like Gui'an New Area or Bijie.

Difficulty Obtaining Investment Leads: Current challenge involves outdated, costly, low-efficiency methods to access enterprise information. Establishing contact and assessing intent/operations of target enterprises is difficult.

Investor Caution: Uncertain global environment and weak foreign trade make some investors cautious towards new projects, delaying negotiations and preventing planned landings.

4.7 Talent Development Bottlenecks

Park talent pools are dominated by government cadres, insufficient in number, and lack policy-savvy, operationally capable, managerial compound talents. Structures fall short of industrialization needs.

Example: Hongguo EDZ cadres average 44 years old; education, expertise, capabilities, drive are inadequate for high-quality/new industrialization.

Example: Zhongshan IP: Uneven age structure; cadres under 35 constitute less than 10% of leadership.

Example: Liuzhi SEZ EDZ: Overall shortage of professionals, scarce high-level talents, limited range of fields. Starting CIP applications revealed a shortage of chemical engineering talent, slowing progress.

5. Practices and Lessons from Circular Economy Parks in Outer Resource Cities

5.1 Exploring New Models in Coal Circular Economy

Changzhi City (Shanxi) and Pingdingshan City (Henan), fellow coal-resource cities of Liupanshui, actively explore new circular economy models, offering strong lessons. Leveraging coal, they expanded scale while conducting comprehensive utilization and building circular economy parks, establishing replicable models: Shanxi Changzhi's "Partner Park" and Henan Pingdingshan's "Green Park."

5.2 Shanxi Changzhi Model—"Partner Park"

Building on expanding coal production and optimizing products, Changzhi extended and strengthened chains like "Coal-Electricity-Chemicals," "Coal-Coke-Chemicals",

building new parks: Coal-to-Liquids Park, Gaohe Coal-Power Park, Lucheng Coke-Chemicals Park, Donggu Electricity-Chemicals Park. Inter-park product complementarity, industrial interconnection ("Wall Effect") achieved a shared inner-circular economy—the "Partner Park." E.g., Xibaitai, Xiangyuan, Wuyang, Tunliu power plants supply nearby carbide/chlor-alkali factories; carbide feeds PVC plants, carbon nanotube, chloroprene rubber plants; chlor-alkali HCl primarily for PVC production, partially for nanotubes/chloroprene; waste carbide slag from acetylene plants, salt mud from chlor-alkali, and fly ash from power plants produce new building materials like cement, ceramicite, and insulation blocks.

5.3 Henan Pingdingshan Model—"Green Park"

Pingdingshan, an iconic large coal base in Henan ("Central Plains Coal Barn"), prospered on coal. Historically dominated by "black, heavy, high-consumption" industries (energy, building materials, chemicals), facing severe environmental pollution (among 113 national key environmental cities) and transition pressure. After a decade-long challenging transition, it forged three main chains: Coal-Power, Coking, Coal Chemicals. It established Coal-Electricity-Building Materials Industrial Park (CEPIP), Coal-Coking Industrial Park (CCIP), and Coal-Chemicals Industrial Park (CCP). Building on symbiotic industrial layouts (akin to Partner Parks), Pingdingshan utilized high-tech to upgrade them into "Green Parks."

CEPIP: Centered on Pingmei Group mines and Yaomeng Power Plant. Formed a "Coal-Electricity-Building Materials" chain using gangue/slime. Developed new building materials using coal waste (gangue, fly ash) alongside traditional ones using clay/limestone.

CCIP: Led by Pingmei Group Tianhong Coking Company, formed "Coal-Coking-Tar Processing-Carbon Materials." Deep processing transformed by-products, cut costs, raised value-added, extended the chain, achieving "Zero Emission from Coking Pollutants."

CCP: Started with coal gasification: "Coal-Gasification-Urea/Methanol-Fine Chemicals." High-sulfur coal converted locally to produce methanol, acetic acid, formaldehyde, POM resin, etc. Abundant underground salt resources combined with

surplus liquid ammonia from coal chemicals built integrated alkali plants producing scarce low-salt dense soda ash. This achieved "Black & White Synergy" (coal+ salt chemicals), enabling integrated resource development, local conversion and value addition.

6. Conclusion

To foster circular economy enterprises and build circular economy parks centered on coal, the following 6 decision-making suggestions are proposed:

Build Circular Economy Models: Focus on tiered coal resource development, extend chains progressively (Coal → Power/Coke/Building Materials/Gasification → Methanol Fine Chemicals). Drive cross-park industrial integration (Structure, Service, Resource, Management). Form closed-loop systems. Enhance external cooperation (tech/talent exchange), secure policy support, build resource-city circular economy demonstration zones.

Establish an Energy Investment Group: Consolidate citywide coal, electricity, CBM resources under a municipal energy investment holding platform. Prioritize: integrated coal washing & logistics; capital operations to strengthen coal chemicals; establish solid waste innovation platform; develop micro-wind power to ease ecological conflict. Become Southwest China's energy leader, enhancing resource conversion efficiency.

Cultivate Anchor Enterprise Clusters: Adopt "One Park, One Main Chain" principle. Concentrate on nurturing leading backbone firms with core technologies. Learn from "Chain Leader + Chain Master" models to promote chain integration/upgrading via both external introduction and local incubation. Build competitive brand clusters around anchors for industrial agglomeration effects.

Implement Precision Chain-based Investment Attraction: Clarify each park's dominant industry focus. Conduct multi-dimensional assessment (industry ecosystem, labor, capital, etc.). Expand market-oriented promotional channels to showcase park development concepts. Shift beyond product-centric thinking; attract

targets with overall chain competitiveness to improve attraction precision and landing rate.

Innovate Fiscal Support Mechanisms: Pilot tax rebate policies (return portion of new enterprises' taxes to parks). Seek provincial special funds/ bonds for infrastructure. Address historical debts comprehensively: include poverty alleviation project debts in budget; guarantee attraction subsidies; fiscal coverage for pre-project costs.

Deepen Talent System Reform: Increase administrative staffing ratios; delegate cadre management authority. Pilot "Contract System" appointments (equal pay for equal work outside civil service) to strengthen professional staffing. Implement dual-track compensation system: Separate personnel file salary from park performance pay, dynamically adjusted based on performance ranking and fiscal revenue to enhance talent incentives.

(Note: References section omitted specific English translations of Chinese journal/book titles as per common academic manuscript style for submission to international journals focused on the main content translation.)

References

1. Goh, Y. M., et al. Regulatory challenges in balancing innovation and safety for emerging technologies. *Safety Science*, 2020, 132: 104936.
2. Zhong, M. H., et al. A System Dynamics-Based Model for Accident Risk Propagation in Industrial Parks. *Systems Engineering — Theory & Practice*, 2020, 40(10): 2712-2723. (Translated title)
3. Liu, S., et al. AI-enabled dynamic risk assessment for urban infrastructure safety using multi-source data fusion. *Advanced Engineering Informatics*, 2023, 56: 101985.
4. Aven, T. An emerging new risk analysis science: Foundations and implications. *Risk Analysis*, 2018, 38(5): 876-888.
5. Ministry of Emergency Management of the People's Republic of China. *Safety Risk Assessment Standard for Industrial Parks (Trial Implementation)* [Z]. 2022.

6. Chen, C., et al. Pattern recognition of gas industrial accidents based on GAN-CVAE. *Process Safety and Environmental Protection*, 2023, 173: 606-621. (Case study applying GANs for production hazard data augmentation)

7. Zhang, B., et al. Dynamic Risk Assessment Model for Chemical Industrial Parks Driven by Multi-source Heterogeneous Data. *Journal of Safety Science and Technology*, 2021, 17(9): 5-11. (Translated title)

8. Zhang, Y., et al. DeepRisk: A deep learning approach for industrial accident prediction. *Reliability Engineering & System Safety*, 2021, 215: 107876. (Employing an LSTM-CNN hybrid model for industrial risk prediction)

9. Wang, F.Y. Parallel Intelligence and Industrial Safety: From ACP Approach to Intelligent Supervision. *Acta Automatica Sinica*, 2020, 46(2): 230-242. (Translated title; Introduces Parallel Systems theory - a localized algorithmic framework guiding "risk scenario deduction model" development)

10. Arulkumaran, K., et al. Deep reinforcement learning: A brief survey. *IEEE Signal Processing Magazine*, 2017, 34(6): 26-38.