COP31 TÜRKİYE ANTALYA

SDG Solutions 面向SDG的解决方案

SDG GOOD PRACTICES

The Road to Zero Carbon

Across Factories, Industrial Parks, Buildings, and Transport

零碳之路：场景驱动

从工厂到园区、从建筑到交通的系统解决方案

November 2026 Antalya, Turkey

2026年11月 土耳其·安塔利亚

About This Report

This report examines integrated zero-carbon practices across a range of scenarios. Within clearly defined physical boundaries, these practices combine clean energy use, substantial energy efficiency improvements, smart energy management, and resource recycling, with the goal of achieving carbon neutrality for the entire scenario or delivering significant emissions reductions. Grounded in clear scenario boundaries, driven by multi-technology integration, and validated by quantifiable emissions reductions, this report presents replicable, scalable zero-carbon solutions from Chinese enterprises.

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关于本报告

本报告聚焦不同场景驱动下的综合性零碳实践：在明确边界的特定物理空间内，系统性集成清洁能源利用、能效深度提升、智慧能源管控、资源循环利用等技术手段，最终实现场景整体碳中和目标或取得显著降碳成效。本案例集以清晰场景边界为依托、多技术融合为路径、可量化减排成果为验证，系统呈现来自中国企业的可复制、可推广的零碳解决方案。

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About China Sustainability Tribune

China Sustainability Tribune (CST; Journal No.: CN10-1603/F, ISSN 2096-6520), supervised by the Ministry of Commerce of the People's Republic of China (MOFCOM), is a business management journal focusing on corporate social responsibility (CSR) and sustainable development. Founded in January 2019, it has become a flagship publication in China in the field of CSR and sustainable development.

Guided by the motto of "Global Vision, Win-Win Cooperation" and a commitment to "future-oriented thinking and action," CST strives to build a think tank and action network for sustainable development. It gathers and disseminates sustainability information and insights, identifies and amplifies impactful SDG solutions, and works to make sustainability a core business philosophy and action—as well as a shared social awareness and choice.

About "GoldenKey—SDG Solutions"

Launched in 2020 by China Sustainability Tribune, the GoldenKey—SDG Solutions initiative (GoldenKey) is dedicated to identifying, refining, and disseminating innovative solutions by Chinese enterprises that contribute to the UN Sustainable Development Goals (SDGs). Over the past six years, it has evolved into a platform that not only collects and evaluates corporate SDG solutions but also helps transform them from standalone actions into replicable and scalable solutions. Through international exchanges and communication via UN platforms, the platform has gathered 2,813 SDG solutions to date, building a bridge that connects businesses, governments, academia, experts, and international organizations. GoldenKey serves as a gateway for Chinese enterprises to engage in global sustainable development through experience sharing, capacity building, and value communication.

关于《可持续发展经济导刊》

《可持续发展经济导刊》（期刊号：CN10-1603/F， ISSN 2096-6520）是由中华人民共和国商务部主管的聚焦企业社会责任和可持续发展的商业管理类期刊，创刊于 2019 年 1 月，是中国在企业社会责任和可持续发展领域的一面旗帜。

《可持续发展经济导刊》以“全球视野，合作共赢”为宗旨，定位于“面向未来的思想和行动”致力于建设可持续发展的思想智库和行动网络，汇聚并传递可持续发展信息和思想，发现并提升以可持续发展为目标的实践行动价值，推动可持续发展成为商业核心理念和行动，成为社会共同意识和选择。

关于“金钥匙——面向 SDG 的解决方案”

“金钥匙——面向 SDG 的解决方案”由《可持续发展经济导刊》于 2020 年发起，致力于发现、提炼和传播中国企业面向联合国 2030 年可持续发展目标（SDG）的创新实践。六年多来，金钥匙持续开展企业可持续发展实践征集、评价与能力提升，推动优秀实践从“企业行动”向“可借鉴、可推广的解决方案”转化，并通过联合国相关平台开展国际交流与传播。目前，平台已汇聚 2813 项企业实践，逐步形成连接企业、政府、高校、专家及国际组织的可持续发展解决方案平台，为中国企业参与全球可持续发展提供实践交流、能力提升与价值传播的桥梁。

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Zero-Carbon Scenarios: From Individual Technological Breakthroughs to Systemic Transformation

The green and low-carbon transition is not merely about localized optimization or isolated technological upgrades; it is a comprehensive, systemic restructuring of energy systems, industrial logic, lifestyles and governance rules. Zero-carbon scenarios are a key vehicle for translating this grand transformation from top-level design into practical action. Targeting near-zero emissions, they break down abstract, long-term decarbonization goals into tangible, actionable and verifiable measures across diverse settings—including industrial parks, factories, villages, tourist attractions, buildings and transportation hubs. By doing so, they provide end-to-end support for realizing China's dual-carbon strategy.

- Serve as real-world testing grounds to scale technologies beyond the proof-of-concept stage. Technologies such as solar PV, energy storage, heat pumps and electric heavy-duty trucks have long moved beyond proof of concept. However, only real-world scenarios can demonstrate whether they can be integrated into actual load profiles, climatic conditions and operational schedules. Once a scenario is proven viable, the lasting value is not just the emission reductions of a single project, but the replicable technology combinations and cost-reduction pathways it offers for similar scenarios.
- Force the formation of closed-loop governance rules and business models at the micro level. An engineering solution may meet technical standards but remain idle after construction if its benefit-sharing mechanisms do not match the capabilities of the operating entity. Similarly, even a precisely measured mechanism will fail if the responsibilities and incentives among multiple stakeholders are not mutually reinforcing. A scenario's success depends on finding workable compromises among technical feasibility, governance rules, business sustainability and social acceptance. Once validated, these compromises become transferable institutional assets, driving cross-sector coordination of carbon-reduction resources at the individual scenario level.
- Establish replicable, auditable models to lower the costs of exploring similar scenarios. Each case addresses practical questions—how to select technologies, design rules, share costs, and coordinate stakeholders. While the answers may not be universally applicable, they map out the boundaries of feasibility, making the transition from isolated demonstrations to large-scale replication of zero-carbon solutions possible.
- Serve as vital platforms for public low-carbon education. In scenarios with direct public engagement, such as tourist attractions and communities, mechanisms such as carbon inclusion programs and revenue sharing can turn low-carbon practices from an advocated concept into an everyday necessity, rapidly building a society-wide consensus on low-carbon development.

Since 2023, China's dual-carbon policy has steadily pivoted from "dual control" of energy consumption to "dual control" of carbon emissions. In 2025, the National Development and Reform Commission called for the accelerated development of zero-carbon industrial parks, communities and villages, leading to the official launch of the first 52 national-level zero-carbon industrial parks. Concurrently, advances in carbon footprint standards, certification and pilot programs laid the groundwork for institutional implementation during 2026-2030. In 2026, five government departments jointly issued a guideline on building zero-carbon factories, marking the nationwide rollout of zero-carbon scenarios. Today, dual control is no longer just about allocating emission reduction quotas; it translates macro-level targets into operable and verifiable decarbonization units through these tangible scenarios.

Drawn from the "GoldenKey—SDG Solutions" initiative, this casebook features 14 solutions across six categories: zero-carbon parks, zero-carbon factories, zero-carbon tourist attractions and villages, zero-carbon transport, green construction and power grid projects, and zero-carbon buildings. A significant proportion of these solutions are from State Grid subsidiaries, highlighting a major shift: power grid companies are evolving from reliable electricity suppliers into full-scenario zero-carbon enablers. The grid is no longer merely external infrastructure; it is deeply embedded in internal operations, participating in technology selection, rule design, and operational coordination. This integration addresses a common pain point in most zero-carbon scenarios: the mismatch between green power supply and demand, and the inability to precisely track carbon data.

The true value of these solutions lies not in the emission reduction numbers of individual projects, but in the quantifiable, auditable, and transferable templates they provide, offering viable pathways for future zero-carbon development. Ultimately, the depth of carbon neutrality hinges on whether zero-carbon principles become embedded in the routine operations of diverse scenarios. This casebook captures the most vivid, real-world examples of this pivotal journey.

零碳场景：从技术单点攻关到系统性变革

绿色低碳转型不是局部优化或单一技术迭代，而是一场覆盖能源体系、产业逻辑、生活方式、治理规则的全方位系统性重构。零碳场景正是这场变革从顶层设计走向微观实践的核心载体，它以近零排放为目标，将抽象的长期减碳目标，拆解为园区、工厂、乡村、景区、楼宇、交通枢纽等不同单元中可感知、可落地、可验证的具体行动，为双碳战略落地提供全链条支撑。

- **为技术从“可用”走向“可规模化”提供真实验证场。**光伏、储能、热泵、电动重卡等技术早已过了原理验证阶段，但能否嵌入真实负荷、气候条件和运营节奏，只有在具体场景中才能检验。场景跑通后留下的不是单个项目的减排量，而是同类场景可以借用的技术组合和成本摊薄路径。
- **倒逼治理规则和商业模式在具体单元中形成闭环。**一个方案工程上达标，若收益分配与运营主体能力不匹配，建成即闲置；一个机制计量精确，若多主体权责和激励没有闭环，规则就运转不起来。场景能否成立，取决于技术可行性、治理规则、经营可持续性和社会接受度能否达成可运行的协同，而这些协同一旦被验证，就成为可迁移的制度资产，并推动跨部门减碳资源在具体单元中形成统筹合力。
- **形成可复制、可审计的模板，降低同类场景的探索成本。**每个案例回答的是“技术怎么选、规则怎么定、成本怎么摊、主体怎么协调”这类具体问题。答案未必普适，但为后来者划出了可行边界，使零碳建设从个别示范走向批量复制成为可能。
- **全民低碳科普的重要载体。**在景区、社区等与公众直接接触的场景中，通过碳普惠、收益分红等机制让低碳从理念倡导变成日常刚需，快速构建起全社会的低碳共识。

2023 年以来，中国双碳政策的重心从能耗双控稳步转向碳排放双控。2025 年，国家发改委发文，加快建立一批零碳园区、零碳社区、零碳乡村；首批 52 个国家级零碳园区正式落地；碳足迹标准、认证和试点同步推进，为“十五五”实施相关制度奠定基础。2026 年五部门联合印发零碳工厂建设指导意见，零碳场景实践正式进入全国探索推广阶段。双控不再只回答“谁该减多少”，而是通过各类场景载体，把宏观指标转化为一个个可运行、可验证的减碳单元。

本案例集依托“金钥匙——面向 SDG 的解决方案”优秀行动编制，收录 14 个案例，覆盖零碳园区、零碳工厂、零碳景区与乡村、零碳交通、绿色建造与电网工程、零碳建筑六类场景。国网系统单位的实践占相当比重，印证了电网企业正从以保供电为主转向全场景零碳赋能方——电网不再是场景外部的基础设施，而是深度进入内部运行，全程参与技术选型、规则设计与运营协调，解决了多数零碳场景长期存在的“绿电配不上、数据算不清”的共性痛点。

这些案例的价值，从来都不在于单个项目的减排数字，而在于提供了一批可计算、可审计、可迁移的实践模板，为后来者提供零碳建设的可行路径。碳中和的深度，终究要看零碳逻辑是否真正进入各类场景的常态运行，这本案例集记录的，正是这一关键进程中最鲜活的真实样本。



▲ Fishery-solar hybrid power station supplies the green electricity direct-supply project

Zero-Carbon Breakthrough in a National-Level Industrial Park in Eastern China

90% 的绿色拼图：东部国家级零碳园区破局之道

State Grid Liyang County Electric Power Supply Company
国网江苏省电力有限公司溧阳市供电公司

Scenario and Challenges

Liyang High-Tech Zone is among the first batch of national-level zero-carbon industrial park pilots, which require clean energy to account for at least 90% of total energy consumption. In 2025, electricity accounted for 81.3% of the park's energy consumption, with annual electricity use reaching 1,000 GWh. Natural gas accounted for 11.59%, heating 7.1% and diesel 0.01%. Leading power battery manufacturers in the park operate around the clock, but solar power is in surplus during the day and unavailable at night. Self-built solar alone cannot meet the target, nor can green electricity substitution alone address shortfalls in fossil fuels such as natural gas and heat. Land scarcity, limited local wind and solar resources, temporal mismatches in green electricity supply, and coarse-grained carbon accounting are typical challenges for zero-carbon transition in manufacturing parks across eastern China.

Integrated Solution

Taking the lead, State Grid Liyang County Electric Power Supply Company developed a coordinated solution built around three pillars.

Expanding green power sources on the supply side: Distributed solar PV systems have been developed across available spaces throughout the park, including factory rooftops, river embankments and parking shelters. This has created one of the largest industrial park microgrid clusters in Jiangsu Province, generating 440 GWh of electricity annually and meeting 44% of the park's electricity demand. The company also developed one of China's first green electricity direct-supply projects, establishing a dedicated supply channel between an external fishery-solar hybrid power station and a leading company in the park. This arrangement supplies 500 GWh of green electricity annually. Combined with on-site solar generation, it establishes a green electricity supply base that covers 94% of the park's electricity needs.

Boosting green power integration through digital intelligence on the grid side: The company introduced time- and location-specific electricity carbon emission factors and built China's first hourly electricity carbon emission factor platform certified by SGS. Powered by AI agents, the platform enables hourly electricity carbon accounting, load forecasting, and automated optimal dispatch. Three strategies help maximize local green electricity consumption and reduce the carbon intensity of purchased power: guiding enterprises to shift production to off-peak periods in response to surplus solar generation; storing green electricity at favorable times; and enabling enterprises with different production schedules to share and consume surplus electricity.

Joint energy and carbon management on the user side: Eighteen natural gas-fired thermal oil boilers in the park were retrofitted into biomass heating systems, achieving near-zero heat-source emissions. Industrial waste heat was recovered in partnership with steelmakers and supplied to the park's heating network. Meanwhile, the thermal power plant adopted co-firing of biomass and industrial solid waste to reduce fossil fuel consumption. Energy-saving renovation initiatives were also rolled out to continuously improve overall energy efficiency.



▲ Distributed solar PV installations at the Liyang National-Level Zero-Carbon Industrial Park

Outcomes and Value

Environmental value: By August 2026, clean energy accounted for more than 90% of the park's total energy consumption, achieving the national pilot target ahead of schedule. This share is expected to stabilize at 94.93% by the end of 2027. Green electricity traceability and carbon footprint verification enable enterprises to meet the green electricity requirements of the EU Battery Regulation and overcome green trade barriers.

Economic value: In 2025, the microgrid generated more than USD 1.43 million in early-stage construction returns, reducing the park's electricity cost by USD 0.03 per kWh.

Social and communications value: The park has strong peak-shaving and valley-filling capabilities and can serve as a flexible distributed resource to support the safe and stable operation of the regional power grid. Its achievements have been featured in reports by CCTV's Economic Half Hour and CGTN, among other media outlets. Transformers produced in the park—among the first in China to receive carbon-neutral certification—have also been successfully exported to Europe.

Replication and Transferability

This solution applies to zero-carbon industrial parks characterized by land scarcity and dense manufacturing loads. Its modular and standardized design makes it highly replicable.

Prerequisites: The park should have a concentration of manufacturing facilities and available rooftops or marginal spaces for distributed solar PV installations. It should also have access to external green electricity resources and a grid operator capable of coordinating source-grid-load dispatch.

Transferability: This model is well suited to industrial clusters, and can be extended to industrial parks in sectors such as chemicals and equipment manufacturing. It offers a practical approach for developing zero-carbon industrial parks in areas with limited land and scarce green electricity resources.

Energy Efficiency Stewards: A New Driver of Green Transformation in Pharmaceutical Industrial Parks

“能效主理人”驱动医药园区绿色转型

State Grid Hangzhou Qiantang Area Power Supply Company
国网杭州市钱塘区供电公司



▲ Aerial view of Hangzhou Pharmaceutical Port Industrial Park

Scenario and Challenges

Pharmaceutical companies in industrial parks typically run their own energy supply stations and have high energy demand, stringent production environment requirements, and substantial carbon emissions. Under China's "dual carbon" goals and dual-control requirements on energy consumption, the green transition of pharmaceutical parks has become increasingly urgent. Yet companies operate independently. The traditional fragmented, individual approach to saving energy and cutting carbon brings high transition costs, makes green power hard to access, and offers limited decarbonization options. Isolated upgrades cannot address these challenges; park-level systemic solutions are urgently needed. Take Hangzhou Pharmaceutical Port Industrial Park as an example: for a single company, upgrading its own energy station and introducing green power can each cost several million yuan and take up valuable land. Pharmaceutical workshops are extremely sensitive to temperature, humidity, and cleanliness; fluctuations in renewable energy could ruin an entire batch of drugs, causing losses in the tens of millions of yuan (approximately USD 1.5 million). Moreover, pharmaceutical production is continuous and requires a stable environment year-round.

Integrated Solution

With the power grid as the central hub, the project established an “Energy Efficiency Steward" team to drive multi-stakeholder collaboration among government authorities, the industrial park, enterprises, and the grid. This shifted the optimization focus from individual companies to the park as a whole.

First, the centralized energy supply stations were developed. Together with the industrial park, the team visited over 100 enterprises to build consensus and convened four-party coordination meetings. By facilitating expedited site selection, approvals, and park-level subsidies, the team helped establish four centralized energy supply stations. This reduced land use and enabled newly settled enterprises to access energy infrastructure on a plug-and-play basis.

Second, intelligent coordination was achieved across power source, grids, loads, and storage. Leveraging Hangzhou's strengths as a "City of Computing Power," the project developed an intelligent computing and energy dispatch platform. Algorithms seamlessly coordinate 10 MW of solar PV, 20 MWh of energy storage, and 72 MW of energy supply capacity, enabling millisecond-level interaction within the park's microgrid. This precise control maintains constant temperature and humidity, ensuring a stable and reliable supply of green power.

Third, advanced materials and improved energy efficiency were realized. The solar PV installations were upgraded with cadmium telluride (CdTe) technology, turning 50,000 m2 of rooftops and curtain walls into power generators. Lithium bromide-based energy supply stations replaced conventional gas-fired heating stations, recovering 12,000 tons of waste heat and steam annually. Additionally, 16 office buildings underwent intelligent low-carbon retrofits, with automated systems dynamically adjusting office electricity loads.

Together, these measures form a closed-loop decarbonization model encompassing centralized energy supply, green power consumption, intelligent control, and energy efficiency improvement.



▲ The "Energy Efficiency Steward" team supports energy conservation and emissions reduction upgrades at Hangzhou Pharmaceutical Port Industrial Park

Outcomes and Value

Environmental value: Green power consumption at the park rose to 32%, while annual carbon emissions dropped by 15,000 tons. These improvements strengthen the park’s resilience against international carbon trade barriers and support the achievement of China’s dual-carbon goals.

Economic value: Total pharmaceutical output grew 7.1-fold, the number of resident enterprises increased 6.7-fold, and electricity sales grew 4.2-fold. Compared to parks of similar scale, the project saved approx. USD 1.43 million in investment, while reducing enterprise electricity, construction, and land costs by 23%, 51%, and 30%, respectively.

Social value: Recognized as a typical case for green and low-carbon energy transition, the project has attracted in-depth media coverage from mainstream outlets. Its success has inspired Hangzhou Linkong Biotech Valley and the Life and Health Industrial Park to adopt the same model for their own green transformations, demonstrating strong scalability and replicability.

Replication and Transferability

The model is suitable for pharmaceutical industrial parks with high energy demand, environmentally sensitive operations, and enterprises that build their own energy supply stations. It can also be extended to other zero-carbon parks and life and health industrial parks.

Prerequisites: The industrial park should have clearly defined boundaries, a well-established metering system, and an identifiable operating entity. A coordination mechanism involving government authorities, the park, enterprises, and the power grid must be in place, alongside professional energy services and intelligent dispatch capabilities.

Transferability: Core modules can be adopted or adapted, including the multi-party coordination mechanism of the "Energy Efficiency Steward" team, centralized energy supply stations, an intelligent dispatch platform for source-grid-load-storage, and energy efficiency improvement modules. Specific elements—such as solar PV formats, energy storage capacity, and the scope of building retrofits—can be tailored to local conditions. If this model is adopted by the more than 700 pharmaceutical parks across China, it could unlock tens of billions of yuan in cost savings (more than USD 1 billion), providing a replicable benchmark for the industry’s green transition.

Electrothermal Coupling: A New Path to Industrial Park Decarbonization

“绿色皮肤”生长记——“电热耦合”重塑园区降碳新路径

Solareast Holdings Co., Ltd., State Grid Lianyungang Power Supply Company
日出东方控股股份有限公司、国网连云港供电公司

Scenario and Challenges

Industrial parks are key platforms for decarbonizing the industrial sector, with heat loads accounting for over 50% of their total energy consumption. For years, industry decarbonization efforts have focused disproportionately on electricity, concentrating resources on projects such as solar PV and energy storage. This "electricity over heat" bias has left the substantial carbon-reduction potential of thermal energy largely untapped—a common shortfall in the low-carbon transition of industrial parks.

Three major challenges stand in the way. **First, thermal energy is "invisible."** Electricity can be precisely metered, but heat loads cannot. The distribution, available volume, and timing of waste heat remain poorly understood. **Second, systems do not work together.** Electricity and heat systems run independently, making precise coordination impossible. **Third, dispatch cannot be optimized.** Heat loads vary widely across business types, with pronounced temporal and spatial mismatches, and fine-grained dispatch capabilities are missing.





Integrated Solution

Moving beyond the "electricity over heat" approach, the project centers on electrothermal coupling and precise allocation, introducing three key measures:

Smart energy and carbon management platform: The project developed an AI-powered platform for smart energy and carbon management across multiple levels and scenarios. It integrates four real-time inputs—electricity prices, load forecasts, heat forecasts, and renewable generation—and incorporates three constraints: equipment operation, energy storage dispatch, and production processes. A three-tier dispatch system covering day-ahead, intraday, and minute-level operations enables refined, multi-energy coordinated management.

Modular, standardized deployment: The project introduced six building-block modules that parks can combine and match according to their energy-use profile and needs. A standardized five-step implementation process ensures efficient, science-based retrofits.

Flexible business collaboration: The project offers multiple partnership models, including energy management, managed energy services, equipment leasing, and joint ventures. It defines key mechanisms for capital investment, daily operations, and revenue sharing, significantly lowering the financial threshold for park decarbonization retrofits.

Outcomes and Value

Environmental value: The demonstration park's zero-carbon laboratory building reduces CO_2 emissions by 1,200 tons annually, while the entire park cuts emissions by more than 5,100 tons a year. The park's solar PV systems generate over 9.7 GWh annually, meeting 80% of its electricity needs with self-generated renewable power. Electricity purchases from the external grid have fallen to one-third of the pre-retrofit level.

Economic value: The park saves and generates more than USD 710,000 annually, and projects typically pay back within four to five years. The company's technical cooperation projects have generated more than USD 28.57 million in output value.

Social value: The model is suitable for regions with extreme climates and has received the Second Prize of the State Science and Technology Progress Award. The project has delivered the industry's first zero-carbon laboratory building and one of Jiangsu Province's first batch of zero-carbon factories. It was recognized as an outstanding engineering practice case by the Building Energy Research Center (BERC) of Tsinghua University, and its achievements have been presented at the United Nations Climate Change Conference.

Replication and Transferability

The solution is highly replicable and adaptable, and is well suited for low-carbon retrofits of industrial parks across China.

Prerequisites: The park should have clearly defined energy-use boundaries, a basic electricity metering system, and an established operations and management entity.

Transferability: The six building-block modules can be mixed and matched according to each park's energy-use profile and needs. The solution has already been deployed across several benchmark sites, including Solareast's Lianyungang headquarters, Beijing Daxing International Airport, Huawei Software Park, and Tesla Gigafactories. It offers industrial parks worldwide a practical, scalable Chinese solution for moving beyond the "electricity over heat" bias and developing their own low-carbon "green skin."



Fresher! Greener!—From a Glass of Milk to a Manufacturing-Wide Energy Transition

鲜起来！绿起来！——从一杯牛奶到全域制造的能源转型

State Grid Pingyang Electric Power Supply Company

Zhejiang Yiming Food Co., Ltd.

国网浙江省电力有限公司平阳县供电公司、浙江一鸣食品股份有限公司

Scenario and Challenges

Zhejiang Yiming Food Co., Ltd. is a leading national agricultural enterprise integrating dairy farming, dairy production, logistics and distribution, and chain retail. To ensure product freshness, the company must deliver fresh milk directly from its farms to nearly 2,000 retail outlets nationwide within 24 hours.



However, fresh milk production is concentrated during daytime peak hours, driving up energy costs and carbon emissions. The company's existing energy management practices were imprecise and lacked traceability, making it difficult to pinpoint and fix energy waste. Facing high investment thresholds and increasingly stringent green market-access requirements, the company found itself trapped by hesitation, resource constraints, and capability gaps. How to maintain product freshness while overcoming high energy consumption had become a core challenge to the company's high-quality development.

Integrated Solution

State Grid Pingyang Electric Power Supply Company partnered with Yiming Food and brought in the State Grid (Wenzhou) Integrated Energy Service Co., Ltd. to implement three initiatives under a model featuring zero upfront investment by the enterprise, fully outsourced operations, and long-term revenue sharing.

Hardware decarbonization: The project fully funded rooftop distributed PV facilities, generating 2.3 GWh annually. A behind-the-meter energy storage system was installed to charge during off-peak hours and discharge during peak periods, cutting peak-rate electricity purchases. On the production side, energy-inefficient equipment was phased out and waste heat recovery introduced.

Energy efficiency management: An integrated smart energy management platform was deployed to consolidate data on electricity, solar power, energy storage, water, and gas. It prioritizes solar power accommodation and intelligently dispatches energy storage. The platform also monitors parameters such as temperature, pressure, and water levels, issuing alerts when anomalies arise. Energy consumption is tracked down to each production process.

End-to-end carbon traceability: A carbon metering platform was established to dynamically calculate emission factors every 15 minutes and accurately measure carbon emissions per bottle of milk. By integrating upstream and downstream data, it calculates product carbon footprints across the full life cycle. This meets the requirements for green factory re-evaluation and helps the company obtain "carbon footprint label" certification.

Outcomes and Value

Environmental value: Energy consumption per RMB 10,000 (about USD 1,429) of output across the industrial park decreased by nearly 15%, and carbon emissions were reduced by 26,000 tons over the full project cycle. Aorui Fresh Milk obtained "carbon footprint label" certification, with greenhouse gas emissions 14% below the industry average. The company also passed the national-level green factory re-evaluation.

Economic value: With no upfront construction costs, the company has reduced expenses through green electricity substitution, energy storage for peak shaving and valley filling, and refined energy efficiency management. In 2025, its net profit attributable to shareholders of the parent company increased by 77% year on year.

Demonstration value: In Pingyang, the "Yiming Model" has expanded beyond the food industry into sectors such as pet products and automotive and motorcycle parts. To date, it has helped businesses save a cumulative USD 14.2 million and reduce carbon emissions by nearly 290,000 tons. It has also supported Pingyang County in developing six national-level, seven provincial-level, and 48 municipal-level green factories, extending the model's reach from a single dairy producer to the broader manufacturing sector.

Replication and Transferability

Prerequisites: Rooftop space must be available for PV installation, and distribution rooms must be equipped for smart upgrades. Smart platform deployment and data integration also require enterprise cooperation. Carbon footprint traceability requires a basic level of data collection capability upstream and downstream.

Transferability: The solution is adaptable across industries and does not depend on any specific production process. PV and energy storage capacities can be tailored to local conditions, and data collection points on the energy efficiency platform can be flexibly configured by production line. It offers a replicable and scalable model for food processors, small and medium-sized manufacturers worldwide seeking a light-touch transition to net-zero operations.

Wuhan BOE:
AI-Driven Green and Circular Energy Management
武汉京东方：AI 驱动的绿色循环智慧能源管理实践

BOE Technology Group Co., Ltd.
京东方科技集团股份有限公司



▲ The Wuhan BOE Factory

Scenario and Challenges

Located in the Wuhan Linkonggang Economic-Technological Development Zone, Wuhan BOE covers an area of about 75.47 hectares. It is a 10.5-generation LCD panel manufacturing facility. In the past, the factory relied largely on manual experience to manage energy use, resulting in gaps in monitoring, delayed responses and inefficient resource utilization. Its central challenge was to significantly reduce energy consumption and carbon emissions without compromising production.

Integrated Solution

Guided by its vision of "to be the most respected company on earth," BOE has established a comprehensive trinity system encompassing sustainability strategy, organization, and branding. Under its "Empower IoT with Display" strategy, the company has identified six strategic pillars, including open innovation and environmental sustainability. It launched ONE, the display industry's first sustainability brand, marking its transition from a "top industry practitioner" to a "global co-builder of sustainability standards."

BOE has also set its dual-carbon strategy and six action pathways. To date, 21 of its subsidiaries have been recognized as national-level green factories, and two as zero-carbon factories. Wuhan BOE's green initiatives demonstrate how this corporate strategy is being translated into action on the factory floor. At the project level, Wuhan BOE developed "Energy Efficiency Nebula," a smart green energy management system built around four capabilities: comprehensive monitoring, AI-driven decision-making, resource recycling and production-energy coordination.

Comprehensive monitoring. A full-process energy flow monitoring network is deployed, with high-precision sensors installed at every key point, from the main power supply line to individual critical pieces of equipment. This makes the flow of every kilowatt-hour visible. The integrated digital energy platform monitors energy flows at millisecond-level intervals throughout the entire process, from energy procurement and conversion to end use, eliminating monitoring blind spots between the high-voltage supply side and production equipment.

AI-driven decision-making. Powered by AI algorithms, the system can optimize energy use autonomously. The cooling system can realize automatic adjustment according to weather conditions and production loads. Air compressors can be intelligently scheduled based on actual demand to adjust unit loads and minimize blow-off waste. Fans in cleanrooms can automatically adjust their speeds in response to air quality, avoiding energy waste from excessive ventilation.

Resource recycling. After the closed-loop improvements of water and waste resource management, production wastewater is recycled and reused in stages, creating a circular process of "production-wastewater-recycling-production." A waste heat recovery system captures heat from compressor cooling water and uses it to preheat hot water for air conditioning, replacing the previous gas-fired boilers. In addition, a 38 MW distributed solar PV plant is installed across 227,500 m^2 of rooftop space, converting sunlight into green electricity.

Production-energy coordination. Data barriers between energy and production systems have been removed, enabling real-time coordination between energy dispatch and production planning. This allows for precise calculation of energy consumption per unit of output and early warnings of abnormal energy use.

Another notable industry breakthrough at Wuhan BOE is that it became BOE's first "chlorine-free factory." Through process innovation, the company has successfully reduced and, in some cases, eliminated chlorine use in the etching process. By reducing reliance on substances with high environmental impacts, the initiative makes manufacturing cleaner, safer and more sustainable. This means that a display panel has a smaller potential environmental footprint from the very beginning of its production.

Outcomes and Value

Environmental value. AI-based control of the cooling station alone reduces CO_2 emissions by 5,126 tons annually. Combined with solar-generated green electricity and water recycling, these measures have significantly reduced energy consumption and carbon emissions per unit of output value.

Economic value. Intelligent compressor scheduling saves 21 GWh of electricity. AI-driven cooling optimization saves approximately 12.6 GWh of electricity per year. Natural gas consumption has decreased by 31.3%. Following upgrades to the Ultrapure water (UPW) system's multi-stage water recovery network, the reclaimed water utilization rate has reached 70%, reducing fresh water consumption by 5.6 million tons annually. The distributed PV power station generates 42 GWh of electricity annually.

Social and institutional value. The average time required to identify and investigate energy efficiency anomalies has fallen from six hours to less than 30 minutes. Manual inspection workloads have decreased by 70%, shifting operations and maintenance from experience-based management to data-driven management. Equipment operating efficiency is now monitored digitally and online in real time, achieving 100% coverage. The project's "five-stage UPW recovery model" and "digital twin control logic for AI-powered cooling stations" have been replicated at other BOE facilities, including Hefei BOE Display Technology Co., Ltd. The facility in Hefei has increased its annual water-saving rate by 40%. Beyond setting an example of how high-tech manufacturing can coexist harmoniously with the urban environment, the project has also turned its green practices into a source of long-term competitiveness through brand-building and communications.

Replication and Transferability

Prerequisites. The facility should have a basic energy metering system, a clearly defined operations and management entity, and the ability to digitally integrate production and energy data.

Scalability. The solution applies to a wide range of energy-intensive manufacturing facilities. AI algorithm parameters and resource recycling measures can be adjusted to local climatic and industrial conditions, while the core framework of "comprehensive monitoring + AI-driven decision-making + resource recycling + production-energy coordination" is broadly applicable. Its key value lies in demonstrating that green transformation in manufacturing does not necessarily depend on large-scale equipment replacement. Through digital and intelligent upgrades, process innovation and energy mix optimization, manufacturers can achieve multiple benefits: lower costs, higher quality and carbon reduction.

A High-Precision "Carbon Abacus": Driving Collaborative Decarbonization Across the NEV Value Chain

高精“碳算盘”，赋能新能源汽车产业链协同降碳

State Grid Hefei Electric Power Supply Company
国网安徽省电力有限公司合肥供电公司

Scenario and Challenges

As the global green transition accelerates, regulations such as the EU Carbon Border Adjustment Mechanism (CBAM) are making carbon costs increasingly explicit and passing them through to the automotive industry. Hefei leads China in new energy vehicle (NEV) production, producing 1.371 million NEVs in 2025—8.3% of the national total. An assessment of the local NEV industry identified three major barriers to value-chain decarbonization: First, internationally used electricity emission factors assign an excessively high default carbon intensity to China's electricity, saddling products with an inflated carbon footprint before they even reach export markets; second, long, fragmented manufacturing chains create significant barriers to carbon data sharing, with no consistent accounting methodology or coordinated decarbonization mechanism; third, emissions from electricity used to charge NEVs count toward automakers' Scope 3 emissions, adding disclosure pressure as the NEV fleet grows.



▲ Case sharing at the 4th Shanghai International Carbon Neutrality Expo in Technologies, Products and Achievements



▲ SGS and Classification Society Assessment Statement

Integrated Solution

Under the "Hedian Lingpao" electricity service brand, electricity data, certification services, and low-carbon incentives are embedded in value chain collaboration, creating a closed-loop decarbonization model spanning data, manufacturing, and use.

Data stage: In collaboration with the State Grid Anhui Electric Power Research Institute, the company has developed China's first database of electricity carbon emission factors differentiated by time period, geographic region, and voltage level. Drawing on measured carbon emissions from power generation and real-time grid operating data, the database upgrades electricity carbon accounting from annual calculations to dynamic measurement at 15-minute intervals. It has received a third-party review statement confirming compliance with international standards such as the GHG Protocol and ISO 14067.

Manufacturing stage: The initiative has established a collaborative mechanism led by chain-lead enterprises, supported by the power sector, and backed by third-party verification. According to each company's digitalization level, it calculates the carbon footprints of 14 types of components from 15 suppliers, using either a metering-weighted average method or a product-batch traceability method. Based on time-specific electricity carbon factors, it then guides production scheduling to shift energy-intensive processes to midday hours when solar PV output peaks, achieving physical emissions reductions.

Use stage: By combining 8,760-hour charging data from chain-lead enterprises with time-specific electricity carbon factors, the initiative identifies midday as a low-carbon charging window. Through the "Wanmei Charging" platform, V2G discharge incentives, and carbon reward points, it encourages residential and commercial users to shift EV charging to lower-carbon periods.

Outcomes and Value

More precise carbon accounting: With locally measured electricity carbon factors, the first five component types assessed have cut production-stage carbon footprints by 18%–22%, and electricity emissions from vehicle manufacturing are expected to fall by about 8%. All 15 value-chain companies have obtained Bureau Veritas product carbon footprint verification, helping automakers cut CBAM carbon tariff costs.

Lower-carbon production planning: One company cut emissions by 13% simply by rescheduling production of its structural support plates.

Greener EV charging: NEV charging emissions fell by 5% on average, and by up to 80%, easing Scope 3 disclosure pressure for automakers. The project has also integrated over 8.7 GWh of renewable electricity.

Replication and Transferability

The solution rebuilds product carbon footprints with locally measured data and secures international recognition, making it suitable for wider application across regions and industries.

Prerequisites: A well-established electricity data infrastructure, clearly defined operating entities, and access to third-party verification services.

Core modules: The time-specific electricity carbon factor database, a consistent accounting methodology, and a collaborative mechanism involving the chain-lead enterprises, the power grid, and third-party verification should be retained. Incentive schemes and event formats can be adapted to local conditions.

Transferability: The solution can be extended to other manufacturing sectors—equipment manufacturing, home appliances, and hardware—as well as to operations where electricity is a shared input, such as zero-carbon industrial parks and data centers.





Industrializing "Eco-Plastics" for a Greener Value Chain

“生态塑料”产业化方案，驱动塑料全产业链减污降碳

Kingfa Sci. & Tech. Co., Ltd.
金发科技股份有限公司

Scenario and Challenges

Plastic production, use, and disposal pose a global environmental and climate challenge. Hundreds of millions of tons of plastics are produced worldwide each year, yet less than 10% is recycled, and roughly 20 million tons leak into the environment. To overcome the linear "produce-use-dispose" model, the industry faces a critical hurdle: converting vast amounts of mixed, heavily contaminated plastic waste into high-performance recycled materials. Doing so cost-effectively—while reducing carbon emissions through low-carbon manufacturing and meeting international standards for recycled content and carbon footprints—is essential. Kingfa addresses this global challenge through its "eco-plastics" industrialization solution, transforming it into a measurable and replicable systemic solution.

Integrated Solution

Guided by its overarching "eco-plastics" strategy, Kingfa integrates three material pathways—high-performance modification, recycling, and bioplastics—into a unified industrial capability. Supported by a four-in-one model of green design, low-carbon manufacturing, recycling, and certification, the company has built a closed-loop carbon reduction system spanning the entire value chain: from collection and sorting to recycling, modification, application, and traceability.

Green R&D and design: Kingfa operates a "13551" R&D system, comprising one central research institute, three international R&D centers, and other R&D resources. Guided by life cycle assessment (LCA), it balances material performance, lifespan, cost, and environmental impact. In 2025, Kingfa invested about USD 400 million in R&D and held 2,886 valid invention patents. Its "plastics replacing steel/wood" lightweight solutions help reduce weight and extend range in sectors like automotive, the low-altitude economy, and cold-chain logistics.

Low-carbon manufacturing: Kingfa has developed a "green factory" management model. In 2025, it invested USD 32.43 million in environmental protection. The company generated and consumed 83.34 GWh of solar power and purchased 70.15 GWh of green electricity. The Scope 1 and 2 carbon intensity of modified plastics per unit of product in China decreased to 0.1305 tCO_2e/t, down 29.32% from 2022.

Recycling and reuse: Kingfa has established an integrated process covering sorting, selection, washing, recycling, and application. Its AI-powered sorting systems can identify more than 100 material types, with >99.5% purity. For recycled bumpers, the physical paint removal rate exceeds 98%, and the recycled material purity reaches more than 98% of that of virgin materials, meeting automotive-grade requirements. In 2025, Kingfa produced 379,000 tons of high-performance recycled plastics and sold 256,300 tons (with the rest used internally). Its global recycled plastics capacity reached 519,000 tons. The company has established closed-loop post-consumer recycled (PCR) plastics supply chains in Qingyuan, Guangdong; Pizhou, Jiangsu; Malaysia; and Spain. Kingfa has also built a hundred-ton-scale demonstration plant for waste plastic dissolution and recycling, and completed the industrial design of a smart enzymatic recycling facility. These initiatives expand recycling pathways for different waste streams.

Bio-based and biodegradable plastics: Kingfa has established an integrated value chain spanning bio-based monomers, polymerization, and modification. It operates stable capacities of 50,000 tons/year for bio-based succinic acid (Bio-SA) and 10,000 tons/year for bio-based 1,4-butanediol (Bio-BDO). The company holds capacities of 180,000 tons/year for PBAT/PBS and 30,000 tons/year for PLA. In 2025, sales of major biodegradable plastic products reached 226,300 tons. Kingfa drives value chain integration to support the green transformation of downstream industries.

Certification and sustainable supply chains: Kingfa became the first supplier in China and the second globally in its industry to obtain ISCC PLUS certification. It conducts on-site audits covering over 90% of core suppliers, with a 100% sign-off rate on its supplier code of conduct. The company has developed a network of over 500 high-quality recycled plastics suppliers and over 60 recycling collection points, partnering with over 50 global OEMs and 200+ Tier 1 suppliers.

Outcomes and Value

Environmental value: In 2025, Kingfa's output of 379,000 tons of recycled plastics was equivalent to an annual reduction of approximately 950,000 tons of CO_2e. Since 2004, the company has supplied roughly 2.55 million tons of high-performance recycled plastics, reducing oil consumption by more than 14 million tons and carbon emissions by 3.2 million tons.

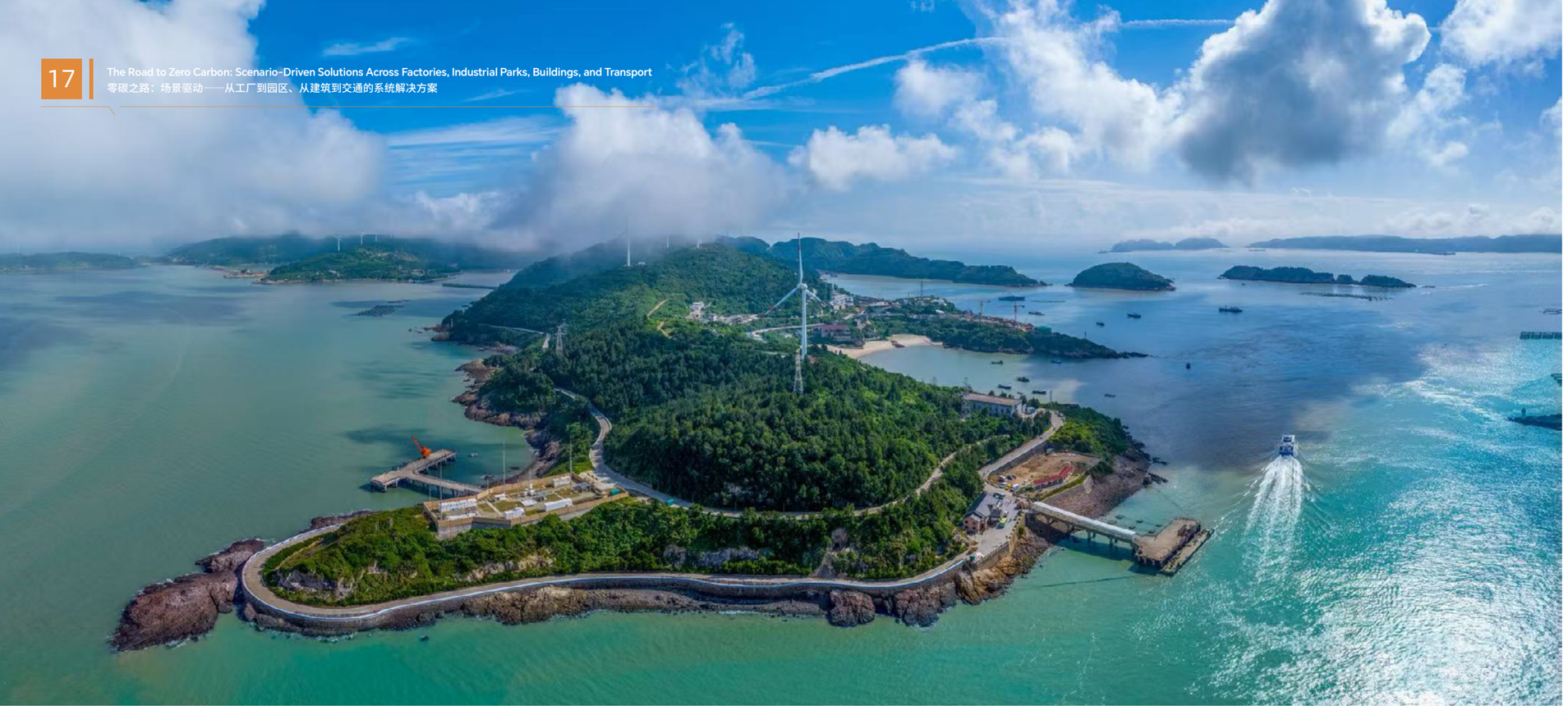
Economic value: In 2025, Kingfa produced 309,400 tons of green plastics, recycled 272,000 tons of waste plastics, and produced 379,000 tons of recycled plastics, achieving 30.9%, 27.2%, and 37.9% of its respective 2030 targets. In the same year, overseas bases recorded finished product sales of 297,500 tons and revenue of USD 605 million, up 27.41% and 35.20% year-on-year, respectively.

Social value: Kingfa's project, Key Technologies and Applications for Low-Carbon, High-Quality Recycling and Remanufacturing of Plastic Waste, received the Second Prize of the State Science and Technology Progress Award. The company ranked in the top 20% of the global chemicals industry in the S&P Global Corporate Sustainability Assessment (CSA), received an AA rating from Wind and an AAA rating from the China Securities Index. At COP30, it delivered a keynote on green, low-carbon advanced materials at the UN Newsroom. It was also named among China's Top 100 ESG Best Practices of Listed Companies.

Replication and Transferability

Prerequisites: The solution requires clearly defined physical boundaries, such as a factory or industrial park; a robust energy and carbon emissions metering system; a stable waste plastics collection and transportation network; and an operating entity capable of managing the entire value chain.

Transferability: The solution suits factories, industrial parks, and industrial clusters facing significant waste plastics management pressure and mandatory or incentive-based requirements for recycled plastics use. Applicable sectors include automotive, packaging, and consumer electronics manufacturing. It is also suitable for global companies or overseas bases that must comply with international regulations. Core modules, including closed-loop recycling, low-carbon manufacturing, certification, and carbon footprint support, should be retained. Other elements, such as bio-based/biodegradable capacity and solar/hydrogen configurations, can be tailored to local resources and regulations. Supported by a global network of 23 production and R&D bases serving over 130 countries and regions, Kingfa has proven its cross-border replication capability, offering scalable Chinese experience for similar scenarios worldwide.



From Zero-Carbon Island to Climate Action: Green Power Builds a New Green Consumption Ecosystem on Dachen Island

从零碳海岛到气候行动现场——绿电赋能大陈岛绿色消费新生态

State Grid Taizhou Jiaojiang Electric Power Co., Ltd.
国网浙江省电力有限公司台州市椒江区供电公司

Scenario and Challenges

Dachen Island lies off Taizhou Bay and is a national AAAA-rated tourist attraction, receiving 230,000 visits in 2025. Its zero-carbon transition covers the entire island—from power generation, transmission, and use to visitor consumption. The transition faces three pain points. First, green power supply stops at generation: its value never reaches the consumer side. Second, what visitors see does not translate into what they understand: green power remains a piece of engineering, so tourists can see the wind turbines but cannot grasp what zero carbon really means. Third, low-carbon behavior goes unmeasured and unrewarded, so emission reductions remain confined to the supply side. Such dilemmas are typical of islands with a solid green power base and steady tourist flows.

Integrated Solution

The case reshapes the scenario across energy supply, end use and consumer behavior, extending decarbonization to the behavior side.

Green power substitution: The project has built 34 wind turbines, an island green hydrogen project, and the world's first 35 kV flexible low-frequency AC transmission project, cutting carbon emissions by nearly 50,000 tons a year.

All-electric retrofits: Thirty-one guesthouses have completed all-electric retrofits, cutting energy costs by nearly 20%. Large yellow croaker farming is now fully electrified, raising output by 300 tons and reducing emissions by 50 tons a year. With 25 electric buses and 300 shared electric vehicles in service, accommodation, dining and transport all run on green power.

Carbon points scheme: A booklet, the Dachen Field Observation Log, covers six sites, including the Reclamation Monument and the Dual Carbon Exhibition Hall. Visitors earn points by scanning QR codes when they walk, cycle, take the bus, or stay in all-electric guesthouses. Points can be redeemed for guesthouse stays, meals, yellow croaker, and other local goods and services. In this way, low-carbon behavior is converted into spending, and merchants respond by expanding their green offerings—closing the loop.

These measures are delivered through multi-party collaboration: the government provides policy support, the power supply company builds the green power foundation and metering infrastructure, and tourism businesses, merchants, and village collectives handle day-to-day operations.

Outcomes and Value

Environmental value: The green power projects cut carbon emissions by nearly 50,000 tons a year: 45,000 tons from the 34 wind turbines, 4,480 tons from flexible low-frequency transmission, and 9.77 tons from hydrogen. One night in an all-electric guesthouse saves 0.87 kg of standard coal equivalent (kgce) and cuts carbon emissions by 7.09 kg.

Economic value: In 2025, the island received 230,000 visits, and tourism revenue exceeded USD 28 million. The full yellow croaker industry chain generated output worth about USD 160 million and raised average annual income for local fishers and farmers to about USD 12,000.

Social and brand value: Dachen Island has been approved as China's only island standardization pilot for carbon emissions and rated a Grade A town in Zhejiang's provincial low-(zero-) carbon pilot program.

Replication and Transferability

The model has proved workable on an offshore island and is ready to be extended to similar islands and scenic areas.

Prerequisites: Green power supply capacity; stable tourism flows and local consumption options for point redemption; and a unified metering and redemption system, supported by policy.

Transferability: The model suits islands, scenic areas and communities with clear boundaries, stable visitor flows and local businesses that can accept redemptions. Three elements must be preserved: the green power foundation, the carbon points rules and the local business redemption channel. The number of sites and the strength of incentives can be tailored to local conditions. The model is particularly relevant to small island states bearing the costs of sea-level rise.

Valuing Green Mountains and Clear Waters: A Zero-Carbon Ecotourism Model for Taining

让绿水青山有“价”——绘就泰宁“零碳生态旅游”新底色

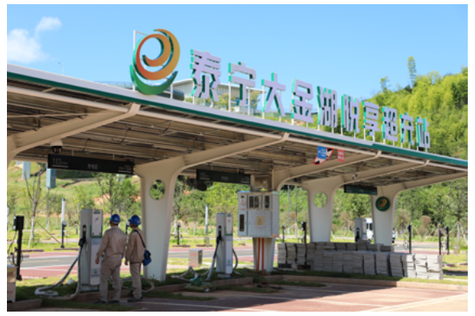
State Grid Taining County Electric Power Supply Company
国网福建省电力有限公司泰宁县供电公司



▲ Renewable-powered microgrid of Jin Jiang International Resort Hotel

Scenario and Challenges

Dajin Lake in Taining, Sanming, sits at the heart of the "China Danxia" UNESCO World Heritage Site. In the decade since its World Heritage inscription, the scenic area has welcomed 34.832 million visitors. Tourism's rebound has pushed electricity load up by about 60% year on year. Yet its solar PV, energy storage, and EV charging facilities belong to different owners and run separately, with no unified control. Grid reliability requires urgent line capacity upgrades, but within the heritage site, line routes and construction must minimize disturbance to vegetation, habitats, and the landscape. Fuel-powered tour boats also emit nitrogen and sulfur oxides, which may speed up weathering of the iron-rich red rock. Balancing reliable power with ecological protection has become a core challenge for ecologically sensitive scenic areas.



▲ The integrated PV-storage-charging-V2G station at Nanhui Visitor Distribution Center

Integrated Solution

The company rethinks the scenic area's energy infrastructure by weighing economic returns against ecological benefits and applying a closed loop of planning, construction, dispatch, and accounting.

Upfront planning and dual-account assessment: The company engages at the earliest planning stage, identifying ecological constraints and forecasting electricity demand to keep development within carrying capacity, and weighs financial returns against ecological benefits to confirm project feasibility. It maximizes existing resources before targeted capacity expansion: low-demand sites go zero-carbon on distributed solar PV, while high-demand sites cut emissions through coordinated solar PV and energy storage.

Renewable-powered microgrids and integrated stations: The Jin Jiang International Resort Hotel now runs Fujian province's first all-green-power microgrid; the Nanhui Visitor Distribution Center hosts an integrated PV-storage-charging-V2G station; and sightseeing boats have switched from fuel to electric propulsion. Together, these measures enable green power self-use, storage-based peak shaving, and centralized charging.

Platform-based dispatch and low-impact construction: The "Zero-Carbon Dajin Lake" platform coordinates PV, storage, charging facilities, and electricity loads under one system. For the 5.6 km line supporting the 110 kV Wenchang Substation, three large electric UAVs lifted all materials for the 29 towers, with zero hill cutting and zero tree felling.

Electricity-carbon accounting and value conversion: An electricity-carbon model and high-precision carbon monitoring enable the company to separately quantify its emission reductions and avoide ecological damage. It also links these to green electricity certificates, carbon reduction credits, and Sanming forestry carbon tickets.

Outcomes and Value

Environmental value: The electrification rate across the scenic area rose from 24% to 31%. Annual GHG emissions fell by 528,000 tons, and clean energy adoption avoided a further 1,913 tons. The approach also saved more than 400 m3 of timber and prevented damage to nearly 10,000 m2 of vegetation.

Economic value: The conventional solution would have cost about USD 1.59 million, while the new electricity-based solution cost only about USD 470,000—saving roughly USD 1.11 million. The hotel micro-energy network and visitor distribution center generate annual returns of about USD 84,000 and USD 136,000, respectively. Overall equipment utilization rose to 28.9%, and the demand-side load factor reached 63%.

Social and institutional value: A collaborative mechanism featuring government leadership, proactive grid engagement, and active user participation has taken shape. Taining County has introduced measures to advance new-type power system development. The practice has drawn coverage from over 20 media outlets, including Xinhua News Agency, as zero-carbon tourism gains popularity in summer.

Replication and Transferability

The model has been implemented and validated at Dajin Lake, a 5A-rated scenic area within a UNESCO World Heritage Site, and suits energy infrastructure operation in ecologically sensitive tourist destinations.

Prerequisites: Clearly defined site boundaries and operating responsibilities; sufficient space for solar PV, energy storage, and EV charging facilities; and access to load, electricity consumption, and carbon data.

Transferability: The core modules include dual-account comparison of economic and ecological benefits, microgrid-parking-charging integration, platform-based dispatch, and electricity-carbon accounting. Low-impact construction practices such as electric UAV lifting and transport should be prioritized in ecologically sensitive areas.

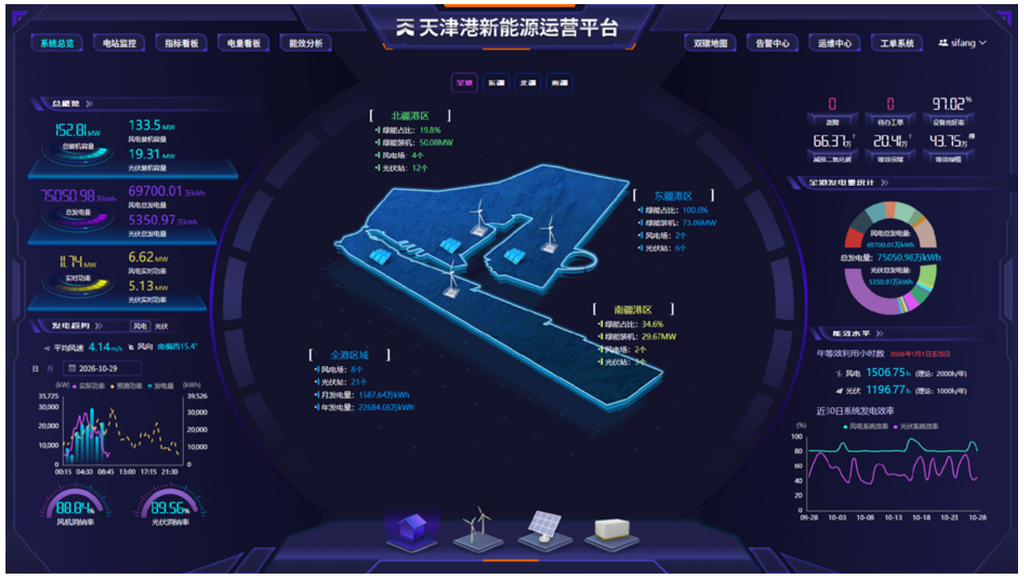


▲ "Zero-Carbon Dajin Lake" microgrid management platform

Powering Port Transport: A Model for Flexible Scheduling of Electric Heavy-Duty Trucks

港途电行——构筑港区电动重卡柔性调度样板

State Grid Tianjin Economic Research Institute
Tianjin Port Power Co., Ltd.
国网天津市电力公司经济技术研究院、天津港电力有限公司



Scenario and Challenges

Ports are critical hubs for global cargo distribution. Short-haul heavy-duty truck operations within port areas face three major structural challenges. First, charging piles are often built without sufficient data to guide siting and capacity planning, creating a mismatch: queues at some piles while others sit idle. Second, individual heavy-duty trucks require charging power exceeding 300 kW. Concentrated fast charging during peak periods forces large-scale hardware upgrades, driving up retrofit costs. Third, wind and solar output does not align with charging schedules, leaving green electricity underutilized while charging still relies on thermal power. Electrification has merely shifted tailpipe emissions without achieving genuine decarbonization on the energy-use side. This is a common challenge facing ports worldwide in the transition to electric heavy-duty trucks.

Integrated Solution

The project moves beyond the traditional approach of simply installing charging piles and undertaking large-scale grid hardware upgrades. Instead, it restructures the underlying coordination among port operations, the power grid, and electricity loads, integrating four innovative pathways:

Intelligent planning of charging networks: Using multi-source spatiotemporal big data to plan charging station locations, the project has developed a network-wide module for real-time monitoring and navigation of charging station status. This guides heavy-duty trucks to distribute charging demand across available facilities and improves utilization of existing charging infrastructure.

Flexible power regulation in the distribution network: The project has established real-time data interfaces with the port area's distribution network and developed an adaptive charging power adjustment mechanism. By coordinating with energy storage systems to shave peak demand, digital and flexible control replaces conventional hardware-intensive grid expansion and upgrades.

Time-based incentives to promote green electricity consumption: By connecting to the port area's wind and solar monitoring system, the project has introduced time-based green electricity incentives to encourage off-peak charging. A green electricity statistics module precisely matches charging loads with clean energy generation, maximizing the local consumption of wind and solar power.

Coordinated vehicle-pile-station-grid scheduling platform: The project has broken down data barriers among port operations, the power grid, vehicle fleets, and renewable energy systems. By integrating charging scheduling, load management, green electricity matching, and carbon accounting, it enables intelligent scheduling and closed-loop performance review across the entire process.

The project has addressed the challenge of coordinating the dynamic loads of high-power electric heavy-duty trucks with distribution networks and wind and solar resources. It has independently developed three core algorithms for site planning, power regulation, and green electricity supply-demand matching, and completed a full demonstration loop for vehicle-grid coordination.

Outcomes and Value

Environmental value: The local consumption rate of renewable energy in the port area has increased to over 80%. The project reduces CO2 emissions by 250,000 tons annually and cuts nitrogen oxide and particulate matter emissions by 30,000 tons. It also eliminates direct tailpipe emissions from fuel-powered heavy-duty trucks.

Economic value: Each charging station saves approximately USD 143,000 in infrastructure investment, while grid upgrade investment in each area is reduced by more than USD 2.86 million. Logistics companies also lower their energy costs by taking advantage of time-based green electricity incentives.

Social and institutional value: The project has established a demonstration scenario for a zero-carbon terminal at Tianjin Port and developed standardized operating procedures and technical specifications. It holds more than 20 independent invention patents and has initiated two standards related to zero-carbon ports, and received a Silver Medal at the 51st International Exhibition of Inventions Geneva. The project has also built a collaborative operating loop jointly developed by port operators, the grid, and logistics stakeholders.

Replication and Transferability

The solution has completed full-scale demonstration and validation at Tianjin Port, providing a reference for the electrification of enclosed freight hubs worldwide.

Prerequisites: The site should have clearly defined boundaries and operate as a closed or semi-closed environment, with relatively fixed heavy-duty truck routes. Metering data interfaces for vehicles, charging piles, the distribution network, and renewable energy systems should be accessible. Energy and freight operators should also be in place to implement coordinated scheduling and electricity price incentive mechanisms.

Transferability: In addition to coastal and inland river ports, the solution can be adapted to on-site short-haul heavy-duty truck operations in mines, steel plants, and large freight parks. In regions with limited local wind and solar resources, externally sourced green electricity can be used instead. Energy storage configurations and electricity pricing strategies can also be tailored to local needs. By balancing logistics efficiency, grid security, and climate benefits, the solution offers a replicable Chinese model for the zero-carbon transition of similar freight operations worldwide.

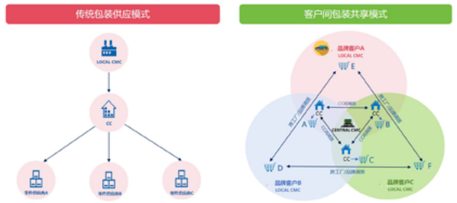
Shared Reusable Packaging for OEMs: Breaking Down Automotive Supply Chain Silos

主机厂循环包装共享模式，破解汽车供应链“包装孤岛”困局

SAIC Anji Logistics Co., Ltd.
上汽安吉物流股份有限公司

Scenario and Challenges

The inbound logistics of thousands of automotive components is a high-frequency, round-trip operation linking suppliers and vehicle assembly plants. For years, suppliers have invested in their own packaging while OEMs managed it independently, creating isolated "packaging silos." Low standardization prevents packaging from circulating across plants and customers; packaging loss and damage rates remain high; idle stock and shortages coexist; and new plants must purchase packaging based on peak demand. These packaging silos are a common challenge across the global automotive supply chain and a key obstacle to zero-carbon transport.



Integrated Solution

SAIC Anji Logistics has developed an innovative "standards + systems + organization" integrated shared packaging model, creating a closed-loop decarbonization pathway that spans unified standards, centralized investment, shared allocation, high-frequency reuse, backhaul loading, and material recycling.

Resource circulation: SAIC Anji Logistics continues to advance the standardization of reusable packaging. As a key drafter, the company helped develop and revise China's national standard GB/T 31150 to enable closer alignment between its own standards and national standards. Taking automotive OEMs as an entry point, the company has established a shared packaging model covering 15 plants and 2.4 million reusable packaging units, reducing single-use packaging and lowering costs.

Smart management: The company independently developed a container management system (CMS) to manage receipts and dispatches, inventory, and plans across all stages, while providing real-time alerts for packaging shortages. The system connects to the Transportation Management System (TMS) to generate backhaul plans, prioritizing empty packaging for available return-trip capacity.

Cross-entity sharing: The company has expanded from sharing packaging among multiple plants of the same customer (Sharing 1.0) to sharing across customers of different brands (Sharing 2.0), achieving the first commercial deployment of cross-brand reusable packaging sharing among automotive OEMs.

Collaborative mechanism: A two-tier "center + base" Container Management Center (CMC) structure balances packaging supply and demand across plants on a monthly basis. The company has also signed tripartite agreements with OEMs and suppliers that define management responsibilities at each supply chain stage and establish rules for loss liability and compensation claims, ensuring orderly sharing and controlled losses.

Outcomes and Value

Environmental value: In 2026, the model is expected to use about 2.4 million reusable containers for roughly 20 million rotations, replacing some 20 million disposable cardboard boxes. This is estimated to avoid the felling of over 260,000 trees and cut packaging waste by about 3 million tons. Annual net emissions reductions are expected to reach about 7,000 tCO2e, with per-rotation emissions down by roughly 63%.

Economic value: The model can cut packaging costs for automakers by more than 20%. The shared packaging pool has grown from 270,000 units in 2017 to over 2.4 million in 2026, with suppliers served rising from 260 to more than 1,200—clear evidence of its transferability at scale.

Social and institutional value: The packaging standardization rate has risen from under 50% to over 80%, and packaging loss rates have dropped significantly. The project has won the Logistics Packaging Excellence Award from China Federation of Logistics & Purchasing multiple times. In addition, it was featured in the China Automotive Logistics Development Report, and was named a 2026 GoldenKey · Breakthrough Solution.

Replication and Transferability

Prerequisites: The model requires: 1) a unified packaging size standard; 2) a sufficiently large packaging pool and adequate supplier density (with demand for the same container type matched locally within a 50-kilometer radius in densely concentrated areas); and 3) a neutral third-party coordinator and digital capabilities to track and measure each container's circulation. In addition, the model must retain unified standards, a digital platform, centralized ownership, and cross-entity allocation mechanisms. Container materials, cleaning frequency, and allocation radius can be tailored to local conditions, and SMEs can access the shared pool through leasing.

Transferability: The model can be extended to multi-supplier manufacturing sectors such as home appliances, electronics, and construction machinery. It offers a replicable Chinese solution for reducing packaging, promoting resource circularity, and enabling low-carbon, green logistics across global supply chains.





Prefabricated Substations, Industrialized Future: A New Model for Green Substation Construction

“预”见绿色，“装”配未来——变电站工业化建造新模式

State Grid Linfen Electric Power Supply Company
Linfen Fenneng Electricity Technology Test Co., Ltd.
国网山西省电力有限公司临汾供电分公司、临汾汾能电力科技试验有限公司

Scenario and Challenges

Substations are critical hubs for power transmission and distribution and among the key civil works in grid construction. Conventional on-site concrete casting, however, presents three major challenges. First, environmental impact: construction generates heavy dust and noise, and wastewater is often discharged directly, with two to three months of construction causing sustained disturbance to nearby communities. Second, resource efficiency: outdoor storage leads to material loss, surplus concrete goes to waste, and reusable formwork and other temporary materials are underused, resulting in high consumption and low efficiency. Third, long-term durability: the humid, corrosive soil of the Linfen Basin accelerates steel corrosion and concrete cracking, shortening structure service life, while repeated repairs and rework add to lifecycle carbon emissions.

Integrated Solution

Design-led construction rethinking. Aligned with State Grid's standardization system, the company has modularized and optimized prefabricable components, such as cable trenches and covers, busbar bridge and terminal box foundations, and concrete aprons, guided by four requirements: manufacturability, transportability, ease of assembly, and low-carbon performance. The result is a standardized prefabricated product family with uniform dimensions and interchangeable interfaces, turning construction components into industrial products at the design stage.

An in-house prefabrication plant to reshape production. In 2025, the company built a standardized production workshop equipped with precision steel molds, automated batching and mixing, and temperature- and humidity-controlled curing. Components are produced indoors, with wastewater recycled and dust centrally treated. This controlled environment enables year-round, weather-independent production. Raw materials are precisely measured and stored indoors, eliminating outdoor storage losses. Built to standardized specifications, components offer precise dimensions, consistent finishes, and reliable waterproofing, raising dimensional accuracy from centimeters to millimeters.

On-site dry assembly to streamline construction. Once cured and inspected, components are shipped to site and quickly assembled by a small crew with a compact crane. This eliminates heavy equipment and the slurry, noise, and dust of conventional on-site construction. Cable trench installation, for example, now takes days instead of weeks. At the 110 kV Qinglangping Substation, the civil works period fell from two to three months to one month—a cut of over 70%. The company has also piloted basalt fiber-reinforced concrete (BFRC), replacing part of the steel reinforcement with natural fibers and cutting component weight by 50%. A prototype "Xuanren" prefabricated cable trench has been developed, laying the groundwork for longer structural life and lower lifecycle carbon emissions.



Outcomes and Value

Environmental value: The solution cuts construction pollution at the source. At Qinglangping Substation, dry assembly has brought on-site dust and wastewater to near zero, cut construction waste by over 90%, and reduced transport and equipment operating time by 80%, significantly lowering construction carbon emissions. Basalt fiber-reinforced components resist corrosion and last far longer, cutting carbon emissions by 16% compared with conventional wet construction.

Economic value: The solution delivers cost savings, efficiency gains, and new value. At Qinglangping Substation, the construction period shrank by 70%, saving about USD 43,000 in direct construction costs. Earlier commissioning added USD 18,000 in revenue, while annual O&M costs are expected to fall by about USD 71,000. The standardized product portfolio also lets the company scale its solutions, shifting it from a construction contractor to a technology solution provider and opening up new value-added opportunities.

Social value: More than 100 frontline workers have shifted from heavy outdoor labor to skilled factory-based technical roles, significantly improving their working conditions and professional dignity. The project has drawn virtually no complaints from nearby residents about construction disturbance.

Replication and Transferability

Prerequisites: A mature grid standardization system, established design standards for prefabrication, and project teams capable of modular design and new material development. Organizations also need the financial and technical capacity to build in-house prefabrication facilities and run factory-based production.

Transferability: Aligned with State Grid standards, the prefabricated components can be rapidly replicated across projects at the same voltage level, with low marginal costs. The solution can also extend to other new infrastructure—distribution substations, EV charging stations, and solar PV mounting structures—with considerable room for broader application.

Carbon Footprint Accounting: Driving Green Transformation in Power Transmission Projects

给变电站装个“碳算盘”，碳足迹核算助力输变电工程绿色转型

State Grid Zhejiang Electric Power Co., Ltd. Construction Company
State Grid Yuhuan Power Supply Company
国网浙江省电力有限公司建设分公司、国网浙江省电力有限公司玉环市供电公司



Scenario and Challenges

The power sector contributes over 40% of society-wide carbon emissions. With more than 10,000 substations in operation, these facilities form the core of transmission and transformation infrastructure—yet each can generate a lifecycle carbon footprint of up to 10,000 tons. Breakthroughs in reducing this footprint will be pivotal. They will not only accelerate the green transition of power infrastructure but also provide critical support for the power sector’s broader journey toward carbon peaking and neutrality.



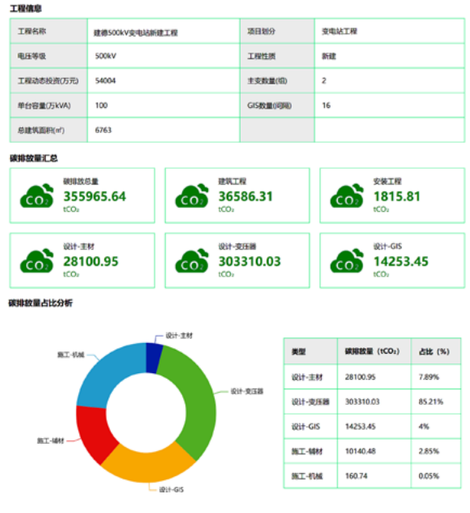
Integrated Solution

To address the challenges of inaccurate, inconsistent, and uncontrolled carbon accounting in substation construction, the project introduced three pioneering practices:

A carbon footprint accounting model for substations. This model covers the full design and construction process, as well as the lifecycle of key equipment. It defines the quantification boundaries and emission sources, establishes carbon footprint inventories for both projects and equipment, and specifies calculation metrics and emission factors, providing a unified, standardized methodology.

A quantitative carbon emissions indicator system. The system covers the entire lifecycle of major electrical equipment and the full construction process. It enables systematic, quantitative lifecycle assessment for the first time, supporting three key functions: low-carbon project evaluation, low-carbon equipment selection, and environmental assessment. This shifts evaluation from qualitative judgments to a fully quantitative, lifecycle-based approach.

An intelligent carbon footprint assessment platform. At the planning and design stage, the platform extracts data from cost estimates and equipment lists to calculate material usage, machinery inputs, and equipment lifecycle emissions. It then estimates total emissions, generates standardized reports, and proposes smart low-carbon solutions, enabling proactive emission control from the source. The platform can also be scaled to monitor construction, optimize operations, and plan for equipment recycling at decommissioning.





Outcomes and Value

Environmental value: By combining carbon accounting with targeted carbon reduction measures, power transmission and transformation projects can significantly cut emissions. A newly built 500 kV substation is projected to reduce CO2 emissions by up to 104,000 tons. Following technical upgrades to core substation equipment, overall energy efficiency ratings have improved from Level 2 to Level 1, reducing carbon emissions by approximately 10%.

Economic value: By adopting optimization solutions from the carbon footprint platform, the project has saved about USD 14.3 million in construction and investment costs to date.

Social and institutional value: Since 2022, the project has driven the green transition of 1,469 material suppliers. Among them, 88.76% have obtained environmental management system certification, and 53.02% hold green patents.

Replication and Transferability

The project has validated the applicability and practicality of its carbon footprint accounting model, quantitative indicator system, and digital-intelligent platform in transmission and transformation projects, setting a unified standard for carbon footprint accounting in the sector.

Prerequisites: A clear construction or operating entity is required, with the capacity to localize and dynamically update regional grid, material, and transportation emission factors.

Transferability: The solution is applicable to main grid substations at 500 kV, 220 kV, and other voltage levels. It can also be extended to 110 kV and below, including indoor, outdoor, prefabricated-cabin, and modular substations. Parameters can be adjusted to suit diverse climatic conditions, such as extreme cold, high altitude, severe sandstorms, and hot, humid environments, as well as industrial contexts with varying levels of supply chain data.



COOC: Net-Zero Leadership in Full-Lifecycle Green Commercial Buildings

COOC 中海商务：零碳领航——商办楼宇全生命周期绿色变革

China Overseas Commercial Development (Shenzhen) Co., Ltd.
中海商业发展（深圳）有限公司

Scenario and Challenges

As energy-intensive public buildings, commercial office buildings face three major challenges in their transition. For new developments, technologies often operate in silos. Energy efficiency measures and renewable energy systems are typically deployed as standalone solutions, with no integrated net-zero model. Existing buildings face hardware constraints and unclear retrofit pathways, often trapped in a cycle of aging equipment and inefficient operations. At the operational level, building owners' decarbonization goals are disconnected from tenant behavior. The lack of practical tools and incentive mechanisms leaves emissions reduction largely at compliance level. Bridging the full chain, from new-build benchmarks and the renewal of existing buildings to tenant engagement, is a pressing challenge for deep decarbonization in commercial buildings.

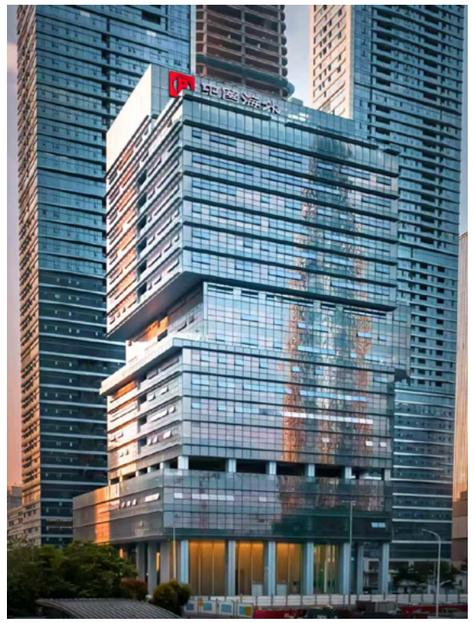
Integrated Solution

China Overseas Office Capital (COOC) is the commercial property asset operation and management platform under China Overseas Commercial. It adopts a full-lifecycle decarbonization approach driven by two complementary levers, technical solutions and behavioral enablement, creating a closed loop from technology integration to collaborative operations.

Developing zero-carbon benchmarks for different climate zones. China Overseas Building in Shenzhen, located in South China's hot and humid climate, integrates 11 technologies to enable extended natural ventilation. These are complemented by a high-efficiency chiller plant, active chilled-beam air conditioning and AI-enabled smart IoT controls. China Overseas Financial Center in Beijing, situated in the temperate climate of northern China, integrates 19 key technologies and deploys a large-scale "PV-storage-DC-flexible" system for commercial buildings. The project combines passive natural ventilation, high-efficiency air conditioning, ground-source heat pumps and high-prefabrication low-carbon construction. Together, the two projects establish two complete zero-carbon technology pathways tailored to southern and northern China.

Gradually upgrading existing buildings with site-specific solutions. For operating buildings such as China Overseas Plaza and China Overseas Business Center in Beijing, distributed rooftop solar PV systems make use of available roof space. A smart integration platform connects more than ten subsystems, including air conditioning and lighting. This approach unlocks decarbonization potential without large-scale demolition or reconstruction.

Empowering tenants to participate in decarbonization. COOC pioneered the industry's Zero-Carbon Tenant Handbook, which breaks down dozens of tenant decarbonization measures into quantifiable actions. It has also introduced a low-carbon points system that turns green office practices by companies and employees into redeemable benefits, encouraging tenants to shift from passive compliance to proactive emissions reduction. In addition, COOC has developed a comprehensive dual-carbon service catalogue, enabling it to offer the wider industry systematic services in consulting, operations and maintenance, and retrofitting.



Outcomes and Value

Environmental value: China Overseas Building in Shenzhen achieved an overall energy-saving rate of 61.6% and a carbon reduction rate of 54.3%. Office Building No. 1 at China Overseas Financial Center in Beijing achieved an overall energy-saving rate of 81% and a renewable energy utilization rate of 68%. It saves 2.25 GWh of electricity annually, directly cutting carbon emissions by 1,406 tons. Existing buildings continue to deliver stable emissions reductions through solar PV and smart O&M.

Economic value: Zero-carbon projects enhance asset value and earn recognition from capital markets. In 2025, China Overseas Land & Investment, the parent company of China Overseas Commercial, received an ESG score of 89 on the London Stock Exchange, placing it among the top tier of global real estate companies. The projects also help lower long-term building operating energy costs.

Social and industry value: China Overseas Commercial contributed to the development of national standards, including the Technical Standard for Zero-Carbon Buildings. It serves more than 350 Fortune Global 500 companies, helping drive low-carbon transformation among tenants and across the industrial chain. Its pioneering tenant-engagement tools fill a gap in decarbonization mechanisms for commercial building operations. The projects have obtained national-level carbon verification and have been selected as part of China's first batch of zero-carbon building demonstration projects.

Replication and Transferability

Prerequisites: Buildings should have clearly defined management boundaries and a professional operating entity capable of coordinating hardware and software upgrades and energy metering. New developments can reserve space for solar PV and energy storage systems. For existing buildings, retrofits should prioritize available rooftops and existing electromechanical systems.

Transferability: The model has already been implemented and validated across multiple commercial projects under China Overseas. Its core components include a technology package for new zero-carbon buildings tailored to different climate zones, a lightweight retrofit toolkit for existing buildings, and standardized tools for low-carbon tenant operations. Beyond Grade A office buildings, this framework can also be applied to commercial complexes, industrial parks and other large public buildings. It offers a practical Chinese example for the full-lifecycle net-zero transition of commercial buildings in cities worldwide.

90% 的绿色拼图：东部国家级零碳园区破局之道

国网江苏省电力有限公司溧阳市供电分公司

场景画像与挑战

溧阳高新区是首批国家级零碳园区试点，清洁能源消费占比须不低于 90%。园区 2025 年能源消费中，电力占 81.3%（年用电量 10 亿千瓦时）、天然气占 11.59%、热力占 7.1%、柴油占 0.01%。园区内动力电池龙头企业 24 小时连续生产，日间光伏富余、夜间无绿电；仅靠自建光伏无法达标，单纯绿电替代电力也无法解决天然气、热力等化石能源消耗短板。土地紧张、本地风光有限、绿电时序错配、碳核算颗粒度粗，是东部地区制造业园区零碳转型的典型痛点。

系统解决方案

国网溧阳市供电公司牵头构建“电源侧绿电拓荒、电网侧数智增绿、用户侧能碳共治”三块拼图协同方案。

电源侧绿电拓荒：在园区厂房屋顶、河道边坡、车棚等空间全域开发分布式光伏，建成省内规模领先的园区微电网集群，年发电量 4.4 亿度，满足园区 44% 用电；打造全国首批绿电直连工程，打通外部渔光互补电站与园区龙头企业点对点直供通道，年供绿电 5 亿度，叠加内部光伏形成 94% 绿电供给基本盘。

电网侧数智增绿：落地分时分区电碳因子技术，建成国内首个获 SGS 国际认证的小时级电碳因子平台，搭载 AI 智能体实现逐时电碳核算、负荷预测与自动优化调度。通过富余光伏前置引导企业错峰生产、储能择时存绿电、不同生产节奏企业互济消纳三大策略，最大化绿电就地消纳，压低外购电碳含量。

用户侧能碳共治：将园区 18 台天然气导热油锅炉改造为生物质热源，实现热源近零排放；联动钢铁企业回收工业余热供给园区热力管网，热电厂同步掺烧生物质与工业固废，减少化石能源消耗；同步推进节能改造项目，持续提升综合能效。

零碳成效与价值

环境价值：2026 年 8 月园区清洁能源消费占比突破 90%，提前完成国家级试点指标，预计 2027 年末稳定至 94.93%；实现绿电可溯源、碳足迹可认证，满足欧盟电池法案绿电要求，助力企业破除绿色贸易壁垒。

经济价值：2025 年，微电网前期建设收益超千万，园区度电成本降低 0.21 元。

社会与传播价值：园区具备优良的削峰填谷调节能力，可作为分布式灵活资源支撑区域大电网安全稳定运行；建设成效先后被央视《经济半小时》、CGTN 等专题报道；园区生产的全国首批“碳中和”认证变压器顺利出口欧洲。

复制条件与场景迁移

该方案面向东部土地紧缺、制造业负荷密集的零碳园区场景，模块化、标准化程度高，可复制性强。

前置条件：园区有连片制造业负荷，具备屋顶、边角空间开发分布式光伏，具备条件对接外部绿电资源，有电网主体统筹源网荷协同调度。

场景迁移：这套模式适配长三角等东部工业集中区，可推广至化工、装备制造等各类产业园区，为土地紧张、绿电稀缺区域的零碳园区建设提供可借鉴的东部方案。

“能效主理人”驱动医药园区绿色转型

国网杭州市钱塘区供电公司

场景画像与挑战

医药园区内企业普遍自建供能站，具有用能需求高、生产环境要求高、碳排基数高等特征。在“3060”双碳目标和能耗双控要求下，医药园区绿色转型迫在眉睫。但园区企业相互独立，传统“各自节能降碳”模式转型成本高、绿能引入难、降碳手段少，单点改造难以破解，亟需园区级系统解法。以杭州医药港园区为例，企业单独改造自建供能站和引入绿电动辄数百万元，还需占用地块，医药车间对温湿度、洁净度极为敏感，新能源波动可能造成整批药品报废，损失以千万元计，同时医药生产连续性强，需常年维持生产环境。

系统解决方案

项目以电网为枢纽，组建“能效主理人”团队，推动政府、园区、企业、电网多方协同，将企业局部优化转变为园区整体优化：

一是集中建设供能站。与园区共同谋划，走访百余家企业凝聚共识，牵头召开四方会议，推动选址快速审批和园区补贴支持，促成 4 座集中供能站落地，减少土地占用，新进驻企业“能源拎包即用”。

二是算力联动源网荷储。依托杭州“算力之城”优势，搭建智算能源调度平台，将 10 兆瓦光伏、20 兆瓦时储能和 72 兆瓦供能站用算法协同，实现园区“源网荷储”微电网毫秒级联动，以精准调控保障温湿度恒定，让绿电稳定可用。

三是新型材料与能效提升。升级光伏建设，选用碲化镉材料，使 5 万平方米屋顶、幕墙均可发电；以溴化锂供能站替代传统燃气热力站，年回收 1.2 万吨废热废汽；对 16 幢办公楼宇实施智能低碳改造，自动调整办公负荷。由此形成“集中供能—绿电消纳—智慧调控—能效提升”的降碳闭环。

零碳成效与价值

环境价值：医药港园区绿电占比提升 32%、年减碳 1.5 万吨，从容应对国际碳壁垒，为“3060”双碳目标扎实落地贡献力量。

经济价值：医药产业总产值提升 7.1 倍，医药港园区入驻企业增长 6.7 倍、售电量增长 4.2 倍，相较同规模园区，投资节省超千万元，企业用电成本下降 23%、建设成本降低 51%、占地成本节约 30%。

社会价值：项目入选能源绿色低碳转型典型案例，获主流媒体深度报道，杭州临空生物科技谷、生命健康产业园已学习借鉴并实现绿色转型，体现出规模化验证与可复制性。

复制条件与场景迁移

该模式适用于用能需求高、环境敏感、企业独立自建供能站的医药园区，也可延伸至同类零碳园区、生命健康产业园等场景。

前置条件：园区边界清晰、计量体系完善，具备明确运营主体，政府、园区、企业、电网形成协同机制，并具备专业能源服务和智慧调度能力。

场景迁移：“能效主理人”多方协同机制、集中供能站、源网荷储智算调度平台和能效提升核心模块可借鉴采用；光伏形式、储能规模、楼宇改造范围等可因地制宜选择。若中国七百多个医药园区引入该模式，可撬动百亿级成本节省，为行业绿色转型提供可复制标杆。

“绿色皮肤”生长记——“电热耦合”重塑园区降碳新路径

日出东方控股股份有限公司 × 国网连云港供电公司

场景画像与挑战

产业园区是工业领域降碳的核心载体，热负荷占园区总能耗比重达 50% 以上。长期以来，行业降碳普遍存在“重电轻热”误区，资源集中投向光伏、储能等电侧项目，热侧降碳潜力被严重忽视，成为园区低碳转型的共性短板。

园区降碳面临三大行业痛点：**一是热能“看不见”**，电力有精准计量，热负荷缺乏量化手段，余热分布、余量及时段特征底数不清；**二是联动“配不上”**，电、热系统独立运行，无法精准协同；**三是调度“算不清”**，不同业态热负荷差异大、时空错配突出，缺乏精细化调度。

系统解决方案

项目跳出“重电轻热”的传统路径，**以“电热耦合、精算细配”为核心思路**，提出三大举措：

智慧能碳管理平台：研发基于 AI 的跨层级、全场景智慧能碳管理平台，实时接入电价、负荷预测、热量预测、新能源发电四大动态信号，结合设备运行、储能调度、生产工艺三大约束条件，搭建日前、日内、分钟级三级调度体系，实现多能协同的精细化管控。

模块化标准落地：创新推出积木式六大功能模块，不同园区可根据自身用能特点自由组合、按需选配；固化五步标准化落地流程，保障改造科学高效。

多元商业协同：推出能源管理、能源托管、设备租赁、合资共建等多种合作模式，厘清资金投入、日常运营、收益分配等核心机制，大幅降低园区降碳改造的资金门槛。

零碳成效与价值

环境价值：标杆园区零碳实验楼年减排二氧化碳 1200 吨，全园年减排超 5100 吨；园区光伏年发电量超 970 万度，绿电自给率达 80%，外网购电量缩减至改造前的三分之一。

经济价值：园区年节支增收超 500 万元，项目普遍 4~5 年即可实现回本，企业对外技术合作产值超 2 亿元。

社会价值：该模式在极端气候区具备适用性，荣获国家科学技术进步二等奖。打造了行业首座零碳实验楼、江苏省首批零碳工厂，荣获清华大学建筑节能研究中心优秀工程实践案例，相关成果登上联合国气候大会讲台。

复制条件与场景迁移

该方案具备极强的可复制性与适配性，具备在全国园区低碳改造场景推广的条件。

前置条件：需具备清晰的用能物理边界，拥有基础的电力计量体系与明确的运营管理主体。

场景迁移适配：创新推出积木式六大功能模块，不同园区可根据自身用能特点自由组合、按需选配，已落地连云港总部基地、北京大兴机场、华为软件园、特斯拉超级工厂等多个标杆场景。该方案为全球产业园区破解“重电轻热”误区、长出专属低碳“绿色皮肤”提供了可落地、可推广的中国方案。

鲜起来！绿起来！——从一杯牛奶到全域制造的能源转型

国网浙江省电力有限公司平阳县供电公司、浙江一鸣食品股份有限公司

场景画像与挑战

浙江一鸣食品股份有限公司是集奶牛养殖、乳品生产、物流配送、连锁经营于一体的国家级农业龙头企业。为保障产品新鲜，企业需实现鲜奶 24 小时内从牧场直达全国近 2000 家终端门店。

然而，鲜奶生产高度集中于白天电价尖峰时段，能源成本与碳排放强度居高不下。企业原有能源管理方式粗放，无法精准溯源，能效浪费问题难以定位整改。面对投资门槛与日趋严格的绿色准入要求，企业陷入“不敢转、转不起、转不好”的困境。如何兼顾产品新鲜度与破解高能耗瓶颈，成为制约企业高质量发展的核心难题。

系统解决方案

国网平阳县供电公司联合一鸣食品，引入国网温州综合能源公司，以“企业零投入、全托管运营、长期收益分享”模式，系统推进三大工程。

硬件降碳：全额投资建设屋顶分布式光伏，年发电量 230 万千瓦时；配套用户侧储能系统，采用“谷充尖放”策略压减尖峰外购电量；生产端推进高耗低效设备淘汰与余热回收。

能效管控：部署全要素能源智慧管理平台，统一接入电、光、储及水气数据，实现光伏优先消纳与储能智能调度；实时监测温度、压力、水位等参数并异常预警，能耗核算细化至每道工序。

全链溯源：搭建碳计量平台，每 15 分钟动态核算碳排放因子，精准计量单瓶牛奶碳排放；贯通上下游数据，核算全生命周期碳足迹，满足绿色工厂复评要求，并助力企业获得“绿色碳标签”认证。

零碳成效与价值

环境价值：园区万元产值能耗降低近 15%，全周期减碳 2.6 万吨。澳瑞鲜牛奶获得“绿色碳标签”认证，温室气体排放较行业平均水平低 14%，企业通过国家级绿色工厂复评。

经济价值：企业无需承担初始建设成本，通过绿电替代、储能峰谷调节及精细化能效管理实现降本。2025 年企业归母净利润同比增长 77%。

示范价值：“一鸣模式”在平阳已由食品行业延伸至宠物用品、汽摩配等领域，累计助力企业降本 9929 万元、减碳近 29 万吨；支撑平阳县培育国家级绿色工厂 6 家、省级 7 家、市级 48 家，实现从单一乳品企业向全域制造业辐射。

复制条件与场景迁移

前置条件：需具备可利用屋顶资源建设光伏，配电房具备智能化改造条件；企业需配合智慧平台部署与数据接入；碳足迹追溯要求上下游具备一定数据采集基础。

场景迁移：该方案不依赖特定行业工艺，具备跨行业适用性：光伏与储能容量可因地制宜调整，能效平台采集点可按产线灵活配置。该方案为全球食品加工及中小制造企业实现轻量化零碳转型提供了可复制、可推广样板。

武汉京东方：AI 驱动的绿色循环智慧能源管理实践

京东方科技集团股份有限公司

场景画像与挑战

武汉京东方位于武汉临空港经济技术开发区，占地 1132 亩，是 10.5 代液晶显示面板超级工厂。过去，工厂的能源管理主要靠人工经验，存在监测盲区多、响应滞后、资源浪费等痛点。如何在保障生产的前提下大幅降低能耗和碳排放，是这座工厂面临的核心挑战。

系统解决方案

京东方坚守“成为地球上最受人尊敬的伟大企业”愿景，构建“战略—组织—品牌”三位一体可持续发展体系。以“屏之物联”为牵引，确立开放创新、环境永续等六大支柱；发布显示行业首个可持续品牌“ONE”，推动从“科技创新引领者”向“可持续生态构建者”迈进；设定“双碳”战略及六大行动路径，已拥有 21 家“国家级绿色工厂”、2 家“零碳工厂”，武汉京东方的绿色实践正是战略在一线的落地。项目构建了“能效星云”——一套以“全域感知、AI 决策、循环再生、产用协同”为核心的绿色智慧能源管理体系。

全域感知。部署覆盖全环节的能流监测网络，从总进线到每台重点设备安装高精度传感器，让每一度电的流向都清晰可见。全域数字能源平台实现了从购入、转换到使用全环节的毫秒级能流监测，消除高压侧至工艺设备侧的监测盲区。

AI 决策。依托 AI 算法，让系统学会自主优化。制冷系统根据天气和生产负荷自动调节；空压机集群根据实际需求智能调度，调节机组负荷，减少放空浪费；洁净间的风机根据空气质量自动调速，避免“过度通风”浪费能源。

循环再生。对水资源和废弃资源进行闭环改造：生产废水分级回收利用，构建“生产—废水—再生—生产”的小循环；安装空压机余热回收系统，将空压机冷却水的热量置换出来用于预热空调热水，替代原有燃气锅炉；在 22.75 万平方米的屋顶建设 38MW 分布式光伏电站，把阳光转化为绿色电力。

产用协同。打通能源系统与生产系统的数据壁垒，让能源调度与生产计划实时联动，实现单耗精准核算与异常提前预警。

值得一提的是，武汉京东方还实现了另一项行业突破——通过工艺革新，在刻蚀环节成功减少乃至消除氯气使用，成为京东方首家“无氯工厂”。通过工艺革新，降低对高环境负荷物质的依赖，推动生产过程更加清洁、安全和可持续。这意味着，一块屏幕从诞生之初，就减少了对环境的潜在影响。

成效与价值

环境价值。仅制冷站 AI 控制一项每年可减少 5126 吨二氧化碳排放。配合光伏绿电、水资源循环等措施，单位产值能耗和碳排放显著下降。

经济价值。空压机智能调度年节电 2100 万千瓦时、AI 制冷优化年节电约 1260 万千瓦时；天然气消耗下降 31.3%；超纯水（UPW）系统通过多级回收管网改造，再生水利用率达 70%，年减少新水取用 560 万吨；分布式光伏电站年发电 4200 万千瓦时。

社会及制度价值。能效异常排查时间从平均 6 小时缩短至 30 分钟以内，人工巡检工作量下降 70%，运维模式从“人治”转向“数治”，设备运行效率实现 100% 数字化在线监控。项目形成的“UPW 五级回收模型”及“AI 制冷站数字孪生控制逻辑”已在合肥京东方显示技术有限公司等兄弟工厂复制推广，合肥工厂年节水率提升 40%。该项目不仅树立了高科技制造业与城市生态和谐共生的典范，也通过品牌化传播将绿色实践转化为企业长期竞争力。

复制条件与场景迁移

前置条件。具备基本的能源计量基础；有明确的运营管理主体；生产与能源数据可实现数字化对接。

场景迁移。该方案适用于各类高能耗制造工厂。在不同气候或产业环境下，AI 算法模型和循环改造的具体参数可因地制宜调整，但“全域感知 +AI 决策 + 循环再生 + 产用协同”的核心框架具有通用性。其核心价值在于证明：制造业的绿色转型不一定只能靠大规模更换设备，也可以通过数智化改造、工艺创新和能源结构优化，实现降本、提质、减碳的多重收益。

高精“碳算盘”，赋能新能源汽车产业链协同降碳

国网安徽省电力有限公司合肥供电公司

场景画像与挑战

全球绿色转型加速，欧盟通过 CBAM（碳边境调节机制）等法规，正在将“碳成本”从隐性转为显性，并已传导至汽车行业。合肥是中国新能源汽车产量第一城，2025 年产量 137.1 万辆、占全国 8.3%。经考察，该地区新能源汽车产业链降碳面临三大症结：国际通用电力碳足迹因子对中国电力默认值偏高，产品未出口先背“高碳包袱”；制造端链条长、碳数据壁垒突出，缺少统一核算口径与协同降碳机制；新能源汽车用户充电碳排放计入车企范围三，披露压力随保有量攀升。

系统解决方案

以“合电领跑”电力服务品牌引领电力数据、认证服务和低碳激励嵌入产业链协同，形成“数据—制造—使用”三端贯通降碳闭环。

数据端：联合安徽电科院，基于发电端碳排实测与电网实时运行数据，建成国内首个分时分区分压电碳因子数据库，把电力碳核算从“一年一算”升级为 15 分钟级动态计量；获第三方审阅声明，符合 GHG Protocol、ISO 14067 等国际标准。

制造端：构建“链主牵头、电力支撑、第三方认证”协作机制，对 15 家供应商 14 类零部件核算碳足迹，按企业信息化水平选用关口加权平均法或产品批次追溯法；再依分时碳因子输出错峰排产指导，把高耗能工序移至午间光伏大发时段，实现物理减排。

使用端：叠加链主企业 8760 小时充电数据与分时碳因子，识别午间“低碳窗口”，通过“皖美充电”、V2G（车辆到电网）放电激励和碳积分，引导居民和商业充电向低碳时段转移。

零碳成效与价值

碳排核查精细化：应用本地化电碳因子后首批 5 类零部件生产环节碳足迹下降 18% ～ 22%，预计降低整车生产用电碳排放约 8%，15 家链上企业均获产品碳足迹核查 Bureau Veritas 必维认证证书，帮助车企压降 CBAM 碳关税成本。

生产方案低碳化：某企业结构支撑板仅调整排产时序即实现减碳 13%。

用户充电绿色化：新能源汽车充电碳排放平均降 5%、最高达 80%，缓解车企范围三披露压力。项目累计促进新能源消纳超 870 万千瓦时。

复制条件与场景迁移

本方案以本土实测数据重塑产品碳足迹并取得国际互认，具备在更多地区与行业推广的条件。

前置条件：较完善的电力数据基础，明确的运营主体，第三方认证资源。

核心模块：分时电碳因子库、统一核算方法、“链主—电网—第三方认证”机制应保留。激励方式、活动形式可因地制宜调整。

场景迁移：经验可延伸至装备制造、家电、五金等制造业，及零碳园区、数据中心等以电力为共同投入的场景。

“生态塑料”产业化方案，驱动塑料全产业链减污降碳

金发科技股份有限公司

场景画像与挑战

塑料生产、使用与废弃，已成全球环境与气候治理痛点：每年产塑料超数亿吨，仅不到一成被回收，约两千万吨泄漏入环境。把混杂、污染的废塑料转化为环保高性能再生料，以低碳制造压减排放、满足国际再生含量与碳足迹合规，是产业链减碳的关键难点。金发科技以“生态塑料”产业化方案回应，将难题化作可计量、可复制的系统解决方案。

系统解决方案

金发科技以“生态塑料”统领高性能改性、循环再生、生物塑料三条路径，依托“绿色设计 + 低碳制造 + 再生利用 + 认证支持”四位一体模式，形成“回收—分选—再生—改性—应用—溯源”全链条降碳闭环。

绿色研发设计：构建“13551”研发体系；依托全生命周期评价统筹材料性能、寿命、成本与环境影响；以“以塑代钢 / 代木 / 代 X”轻量化方案助力下游减重增航。低碳制造：推进“绿色工厂”建设，2025 年环保投入 2.27 亿元；光伏自发自用 8334 万千瓦时、采购绿电 7015 万千瓦时；国内改性塑料单位产品碳强度（范围 1+2）降至 0.1305 tCO_2e/t，较 2022 年下降 29.32%。

再生利用：贯通“分—选—洗—生—用”，AI 智能分选可识别 100 余种材质、纯度达 99.5% 以上；保险杠物理脱漆率 98% 以上，再生料纯度达原生料 98% 以上，满足车规级要求。2025 年环保高性能再生塑料生产量 37.90 万吨、销量 25.63 万吨；全球产能 51.9 万吨，并在国内多地及海外布局 PCR 闭环回收产业链。

生物基与生物降解塑料：贯通“生物基单体—聚合—改性”全产业链，生物基丁二酸（Bio-SA）5 万吨 / 年、生物基丁二醇（Bio-BDO）1 万吨 / 年稳定生产；具备 PBAT/PBS 18 万吨 / 年、PLA 3 万吨 / 年产能，2025 年生物降解塑料销量 22.63 万吨。

认证与可持续供应链：成为国内首家、全球行业第二家通过 ISCC PLUS 认证的特种工程塑料供应商；核心供应商现场审核覆盖率超 90%；开发 500 余家优质再生塑料供应商、60 余个回收网点。

零碳成效与价值

环境价值：2025 年 37.90 万吨再生塑料相当于年减排约 95 万吨 CO_2e；自 2004 年以来累计提供约 255 万吨环保高性能再生塑料，相当于减少石油使用 1400 余万吨、碳排放 320 万吨。

经济价值：2025 年生产绿色塑料 30.94 万吨、回收废旧塑料 27.20 万吨、生产再生塑料 37.90 万吨，分别完成 2030 年目标的 30.9%、27.2%、37.9%；海外基地销量 29.75 万吨、营业收入 42.34 亿元，同比增长 27.41%、35.20%。

社会价值：“塑料废弃物低碳高质回收再制造关键技术及应用”获国家科技进步二等奖；ESG 评级获标普 CSA 全球化工行业前 20%；在 COP30 上 UN 新闻厅发表绿色低碳新材料主题报告。

复制条件与场景迁移

前置条件：具备清晰物理边界（工厂 / 园区）、完善的能源与碳排放计量体系、稳定的废塑料收运网络与端到端管理的运营主体。

适用场景：面临废塑料治理压力、且对再生塑料使用有强制或激励要求的物理空间与产业集群，如汽车、包装、消费电子等制造园区，以及须满足国际法规的出海企业与海外基地。核心模块——回收再生闭环、低碳制造、认证与碳足迹支持须保留，生物基 / 降解产能、光伏氢能等可因地制宜，其全球生产网络已验证跨国复制能力，可为同类场景提供可推广经验。

从零碳海岛到气候行动现场——绿电赋能大陈岛绿色消费新生态

国网浙江省电力有限公司台州市椒江区供电公司

场景画像与挑战

大陈岛位于台州湾外，是国家 4A 级旅游景区，2025 年上岛游客 23 万人次。岛上零碳转型覆盖整座岛域的发输用电与游客消费全环节，具体痛点有三：一是能源与用能脱节，绿电价值停留在发电量上；二是体验与认知脱节，绿电以工程形态存在，游客看得见风机却读不懂零碳；三是行为与激励脱节，低碳行为没有被计量和回报，减排止步于供给侧。这类困境在绿电基础较好、旅游流量稳定的海岛中具有典型性。

系统解决方案

案例从能源供给、终端用能和消费行为重构场景，把降碳延伸到行为侧。

绿电替代：建成 34 台风机、海岛绿氢工程、世界首个 35kV 柔性低频输电工程，年减碳近 5 万吨。

全电改造：31 家民宿全电改造，能源成本降低近两成；黄鱼养殖全电化，年增产 300 吨、减排 50 吨；25 辆电动客车、300 辆共享电动车，住吃行全绿电。

碳积分机制：一本《走读大陈观察日志》串起垦荒纪念碑、双碳馆等 6 个点位，游客步行、骑行、乘公交、住全电民宿，扫码得积分，兑换民宿、餐饮、黄鱼等消费权益。行为变积分、积分变消费，商户再增绿色供给，形成闭环。

上述举措由多方协同落地：政府出政策，供电公司建绿电底座与计量入口，文旅商户和村集体承接运营。

零碳成效与价值

环境价值：绿电工程年减碳近 5 万吨，其中 34 台风机 4.5 万吨，柔性低频输电 4,480 吨，氢能 9.77 吨；游客入住一晚全电民宿，可节能标准煤 0.87 千克，减碳 7.09 千克。

经济价值：2025 年游客 23 万人次，旅游收入超 2.02 亿元；黄鱼全产业链产值 11.1 亿元，带动渔农人均年收入 8.4 万元。

社会与品牌价值：大陈岛获批全国唯一碳排放类标准化试点海岛，省级低（零）碳试点 A 等级镇。

复制条件与场景迁移

该模式已在离岛场景验证可行，具备向同类海岛和景区推广的条件。

前置条件：具备绿电供给能力；具备稳定的文旅流量与可兑换的本地消费场景；具备统一的计量核销入口和政策支撑。

场景迁移：适用于边界清晰、人流稳定、有本地消费承接的岛屿、景区与社区；绿电底座、碳积分规则、本地产业兑换入口需保留，点位与激励强度可因地制宜裁剪；对承受海平面上升代价的小岛屿国家尤具参考价值。

让绿水青山有“价”——绘就泰宁“零碳生态旅游”新底色

国网福建省电力有限公司泰宁县供电公司

场景画像与挑战

三明泰宁大金湖作为“中国丹霞”世界自然遗产核心区，申遗十年累计接待游客 3483.2 万人次。旅游复苏使用电负荷较往年激增约 60%，但景区光伏、储能、充电设施分属不同主体、分散运行，缺乏统一调控；保障电网可靠性急需线路增容，而遗产地线路走向与施工须最小化对植被、生境和景观的扰动。此外，燃油游船排放的氮氧化物、硫氧化物还可能加速含铁红层风化。保供电与护生态如何两全，成为生态景区供电的难点与痛点。

系统解决方案

公司把经济账和生态账并行比较，以“规—建—驭—算”闭环重构景区能源基础设施：

规划前置、两账比选：在景区设施谋划时便提前介入，做生态约束识别和负荷预测，确保建设承载力；综合投资收益与生态效益，确保项目可行性。坚持先用足存量资源、再精准增容，低耗场景由分布式光伏供给“变零碳”，高耗场景光储协同“变低碳”。

全绿电微网、多站融合：锦江酒店建成全省首个“全绿电”微电网，南会集散中心建成“光储充放”一体化站，游船油改电，实现绿电自用、储能削峰、集中补能协同。

平台调度、低扰动建设：“零碳金湖”平台统一协调调配光伏、储能、充电设施与负荷；110 千伏文昌站配套线路全长 5.6 公里、29 座铁塔塔材全由 3 台大型绿电无人机吊运，零开山、零伐木。

电碳计量、价值转化：依托电—碳计算模型和高精度碳监测，碳减排与生态减损分账核算；衔接绿电绿证、碳减排权益与三明林业碳票。

零碳成效与价值

环境价值：景区电气化率由 24% 升至 31%，年温室气体减排 52.8 万吨，清洁能源额外减排 1913 吨；减少林木砍伐 400 余立方米，避免近 1 万平方米植被破坏。

经济价值：相较传统方案投资 1110 万元，新电方案仅 330 万元，节省投资约 780 万元；酒店微能源网、集散中心项目年收益分别达 59 万元、95 万元；设备总体利用率升至 28.9%，需求侧负荷率 63%。

社会及制度价值：形成“政府主导、电网主动、用户主体”协同机制，泰宁县出台推进新型电力系统建设措施；新华社等二十余家媒体报道，暑期“零碳”旅游热兴起。

复制条件与场景迁移

模式已在世界自然遗产地、5A 级景区大金湖进行验证，适用于生态敏感型旅游区的能源基础设施运营。

前置条件：场景边界与运营主体清晰，具备光伏、储能、充电建设空间；可获取负荷、电量与碳数据。

场景迁移：核心模块为经济账和生态账的两账比选、微网与停车充电站融合、平台调度、电碳计量；绿电无人机吊运等生态低扰动工艺在生态敏感区优先保留。

港途电行——构筑港区电动重卡柔性调度样板

国网天津市电力公司经济技术研究院、天津港电力有限公司

场景画像与挑战

港口是全球货物集疏运的关键枢纽，港区短倒重卡场景面临三大结构性症结：充电桩缺乏数据支撑盲目建设，形成“一边排队、一边闲置”的资源错配；单台重卡充电功率超 300 千瓦，高峰集中快充迫使大规模硬件扩容，改造成本居高不下；风光出力与充电时段错配，绿电闲置，充电仍依赖火电兜底。电动化仅转移了尾气排放，未实现用能端真正脱碳。这也是全球港口重卡电动化转型的共性痛点。

系统解决方案

项目摒弃“单纯增建充电桩、大规模升级电网硬件”的传统思路，从港网荷协同底层重构，创新集成四条路径：

充电网络智慧布局：运用多源时空大数据规划充电站点，搭建全域桩态实时监控导航模块，引导重卡分流补能，盘活存量充电设施。

配网柔性功率调控：打通港区配网实时数据接口，构建自适应充电功率调节机制，联动储能平抑用电尖峰，以数字化柔性调控替代传统电网硬件扩容改造。

分时引导绿电消纳：对接港区风光出力监测系统，推出分时绿电优惠激励错峰充电，依托绿电统计模块精准匹配充电负荷与清洁能源，最大化就地消纳风光电力。

车 - 桩 - 站 - 网协同调度平台：打通港口、电网、车队、新能源系统数据壁垒，集成充电调度、负荷管控、绿电匹配、碳核算功能，实现全链路智能调度与闭环复盘。

项目攻克了港口大功率重卡动态负荷与配网、风光资源的协同匹配难题，自研场站规划、功率调控、绿电供需匹配三大核心算法，完成完整的车网协同示范闭环。

零碳成效与价值

环境价值：港区新能源就地消纳率提升至 80% 以上，每年二氧化碳减排 25 万吨、削减氮氧化物及颗粒物污染物 3 万吨，消除燃油重卡尾气直排。

经济价值：单座充电场站节约基建投入 100 万元，单片区减少电网改造投入超 2000 万元，物流企业依托分时绿电降低用能成本。

社会及制度价值：落地天津港零碳码头示范场景，形成标准化运营流程与技术规范，拥有超 20 项自主发明专利，立项零碳港口相关标准 2 项，相关成果获第 51 届日内瓦发明展银奖，构建起港 - 网 - 物流多方共建的协同运营闭环。

复制条件与场景迁移

该方案已在天津港完成完整示范验证，可为全球封闭型货运枢纽电动化转型提供参考。

前置条件：具备边界清晰的封闭或半封闭作业场景，重卡线路相对固定；可打通车辆、充电桩、配网、新能源的计量数据接口；拥有能源运营与货运主体，能够落地协同调度与电价激励机制。

场景迁移：除沿海、内河港口外，还可迁移至矿山、钢铁厂区、大型货运园区等场内重卡短倒场景。本地风光不足地区可替换为外部绿电采购，储能、电价策略可按需本地化裁剪。该方案兼顾物流效率、电网安全与气候效益，为全球同类货运场景零碳转型输出可复制推广的中国实践。

主机厂循环包装共享模式，破解汽车供应链“包装孤岛”困局

上汽安吉物流股份有限公司

场景画像与挑战

数千种汽车零部件入厂物流是连接供应商与整车工厂的高频往返场景。长期以来，供应商自投包装、主机厂各自管理，形成“包装孤岛”：标准化率低，无法跨厂、跨客户流通；包装丢失、损耗率居高不下；闲置与短缺并存，新工厂须按峰值重新采购。“包装孤岛”是全球汽车供应链的共性难题，也是实现零碳交通的关键挑战。

系统解决方案

安吉物流创新构建“标准 + 系统 + 组织”三位一体的标准包装共享模式，形成“标准统一—集中投入—共享调配—高频复用—返程搭载—回料再生”的降碳闭环。

资源循环：持续推进循环包装标准化，安吉物流作为核心起草单位深度参与国家标准 GB/T 31150 的编制修订，推动自有标准体系与国标深度融合并以汽车行业主机厂为切入点，搭建覆盖 15 个工厂、240 万循环包装量的共享模式，减少一次性包装投入，降低成本。

智慧管控：自主开发包装管理系统（CMS），实现全节点收发、库存与计划管理及缺箱实时预警；对接 TMS 编制返空计划，空箱优先搭载既有回程运力。

跨主体共享：从同一客户多工厂调配（共享 1.0）拓展至跨品牌客户间调配（共享 2.0），实现汽车行业跨品牌主机厂客户循环包装共享的首次商业落地。

协同机制：“中心 + 基地”包装管理中心（CMC）两级组织按月平衡各工厂供需，与主机厂、供应商签署三方协议，明确供应链各环节管理责任和损耗定责索赔原则，确保共享有序、损耗受控。

零碳成效与价值

环境价值：2026 年预计约使用 240 万只周转箱完成约 2000 万箱次周转，替代一次性纸箱约 2000 万个，间接减少树木砍伐 26 万余棵，减少包装废弃物约 300 万吨。年净减排约 7000 吨 CO_2e，单次周转减排约 63%。

经济价值：可为主机厂节约包装成本 20% 以上；包装池由 2017 年 27 万只增至 2026 年 240 余万只，服务供应商由 260 家增至 1200 余家，规模化验证充分。

社会及制度价值：包装标准化率由不足 50% 提升至 80% 以上；包装丢失率大幅降低；项目多次获中国物流与采购联合会“物流包装优秀案例奖”，入选《中国汽车物流发展报告》，获评 2026“金钥匙·突破型解决方案”。

复制条件与场景迁移

前置条件：统一的包装尺寸标准；足够的包装池规模与供应商密度（密集区 50 公里内可就近匹配同箱型需求）；中立的第三方统筹主体及逐箱流转的数字化计量能力；统一标准、数字平台、集中产权与跨主体调配机制须保留；箱体材质、清洗频次、调配半径可因地制宜裁剪，中小企业可通过租赁接入共享池。

场景迁移：该模式可迁移至家电、电子、工程机械等多供应商制造场景。为全球供应链包装减量、资源循环利用及实现低碳绿色物流提供了可复制的中国方案。

“预”见绿色，“装”配未来——变电站工业化建造新模式

国网山西省电力有限公司临汾供电分公司、临汾汾能电力科技试验有限公司

场景画像与挑战

变电站是电网电能输送枢纽与土建施工核心。传统变电站现场浇筑模式存在三大突出矛盾：一是生态环保矛盾，扬尘噪声大、废水直排，工期长达 2—3 个月，持续污染扰民；二是投入效率矛盾，物料露天损耗、混凝土余料浪费、周转材料利用率低，高耗低效；三是长期韧性矛盾，临汾盆地潮湿腐蚀性土壤易致钢筋锈蚀、混凝土开裂，构筑物寿命缩短、反复返修增加碳排放。

系统解决方案

设计前置引领，重构建造逻辑。对标国网输变电工程标准化体系，对电缆沟本体、沟盖板、母线桥支架基础、端子箱基础、散水等可预制构件全面模块化拆分与二次优化。统筹“生产可行、运输可控、装配便捷、低碳导向”四维要求，形成规格统一、接口通用的预制构件产品族谱，从设计源头将工程部件转为工业产品。

自建“预制构件工厂”，重构生产模式。2025 年建成标准化生产车间，配备精密钢模、自动配料搅拌及恒温恒湿养护设备，构件封闭生产、废水循环、粉尘集中处理。生产不受天气季节影响，可全天候连续作业；原材料室内精准计量、集中存放，杜绝露天损耗。车间按“产品族谱”标准化生产，构件尺寸精准、外观规整、防水可靠，精度从“厘米级”提升至“毫米级”。

现场干法拼装，重构施工流程。构件养护质检合格后运抵现场，仅需少量人员与小型吊车快速拼装，现场无大型设备、无泥浆噪音、无扬尘污染。以电缆沟为例，施工周期由数周压缩至数天；110 千伏青朗坪变电站土建工期由 2—3 个月缩短至 1 个月，降幅超 70%。同时试点应用玄武岩纤维增强混凝土（BFRC）技术，以天然纤维替代部分钢筋，构件减重 50%，成功研制“玄韧电缆沟”样品，为延长结构寿命、减少全生命周期碳排放储备核心技术。

零碳成效与价值

环境效益。从源头切断施工污染链。青朗坪站采用干法装配，现场扬尘、污水近零排放，建筑垃圾减少 90% 以上，运输与机械台班减少 80%，施工碳排放显著下降。玄武岩纤维构件耐腐蚀、寿命大幅延长，较传统湿作业变电站降低 16% 碳排放。

经济效益。实现降本增效与价值升级。青朗坪站工期压缩 70%，直接节约施工成本约 30 万元，提前投运增收 12.5 万元，后期运维成本年均降低约 50 万元。同时依托 “产品族谱” 实现标准化输出，推动企业从施工建设向技术方案输出转型，打开增值空间。

社会效益。百余位一线工人从户外重体力作业转为工厂化技术作业，劳动条件与职业尊严显著提升。现场近零扰民投诉。

复制条件与场景迁移

前置条件：电网标准化体系成熟，预制构件设计有据可依，且项目团队具备模块化设计与新材料研发能力，具备实力自建预制构件车间，实现工厂化生产。

场景迁移：构件对标国网标准，可在同电压等级工程模块化快速推广，边际成本低。技术方案可延伸至配电站房、充电站、光伏支架等新型基建领域，应用边界持续拓展。

给变电站装个“碳算盘”，碳足迹核算助力输变电工程绿色转型

国网浙江省电力有限公司建设分公司、国网浙江省电力有限公司玉环市供电公司

场景画像与挑战

电力行业占全社会碳排放超 40%。存量超万座的变电站作为输变电工程的核心载体，其全生命周期碳排最高可达万吨级。变电站全生命周期的碳减排突破，将极大推动输变电工程的绿色转型，为整个电力行业的“双碳”进程提供强大支撑。

系统解决方案

针对变电站建设“算不了碳、算不准碳、控不住碳”痛点，项目开展三项首创实践：

首创变电站工程碳足迹核算模型：该模型精准识别工程设计、施工建设全流程和关键设备全生命周期为典型场景，明确变电站工程碳足迹量化的边界范围和碳排放源，建立变电站工程和关键设备的碳足迹清单，同时明确计算指标和排放因子，提供统一的标准化计算方法。

首创变电站工程碳排放定量指标体系：该方法建立了一套覆盖电气主设备全生命周期、工程建设全流程的碳排放指标体系及环境评价指标体系，首次实现了变电站全生命周期的系统化定量测算，支撑起低碳工程评价、设备低碳选型和环境评价三大功能，推动评价方式从“定性”向“全生命周期定量”的根本转变。

首创变电站工程碳足迹评估数智化平台：该平台可在策划设计阶段，通过工程造价、材料设备清册等资料，提取解析材料用量、机械台班及设备全链条碳排放信息，完成全流程及主设备碳排放量预估，生成规范化数据报表和智慧低碳方案，从源头实现碳排放前置管控。平台还可进一步拓展功能，如施工阶段对工程进行低碳监控与改进，运营阶段总结最优减碳方案，退役阶段提前制定设备回收方案等。

零碳成效与价值

环境价值：输变电工程经核算后叠加针对性减碳降碳举措，可大幅降低工程碳排放，预计一个新建 500 千伏变电站最高可实现二氧化碳减排 10.4 万吨。变电站核心设备技术升级后，能效等级整体由 2 级提升至 1 级，碳排放量降低 10% 左右。

经济价值：项目通过采纳碳足迹平台提供的优化方案，累计降低工程建设成本及投资成本超亿元。

社会及制度价值：2022 年至今，项目已推动 1469 家材料供应商实现绿色转型，其中 88.76% 供应商取得环境管理体系认证，53.02% 取得绿色专利。

复制条件与场景迁移

项目验证了碳足迹核算模型、定量指标体系和数智化平台在输变电工程中的适用性与可操作性，为输变电工程的碳足迹核算提供了统一规范。

前置条件：需明确建设或运营主体，能够对区域电网因子、材料因子和运输因子进行本地化替换与动态更新。

场景迁移：可适用于 500 千伏、220 千伏等主网变电站，还可延伸应用于 110 千伏及以下变电站、户内式、户外式、预制舱式和模块化变电站。在严寒、高海拔、强风沙、湿热等不同气候条件下，或供应链数据基础不同的产业条件下，可对相应参数进行因地制宜的调整。

COOC 中海商务：零碳领航——商办楼宇全生命周期绿色变革

中海商业发展（深圳）有限公司

场景画像与挑战

商办写字楼作为高能耗公共建筑，转型面临三大痛点：增量项目 “技术孤岛”，被动节能与可再生能源多为单点应用，缺少系统性零碳集成范式；存量楼宇受硬件约束，改造路径模糊，易陷入硬件老旧、运营低效的循环；运营端业主降碳诉求与租户行为脱节，缺少落地工具与激励机制，减碳停留在合规层面。如何打通“新建标杆—存量更新—租户协同”全链条，是商办楼宇深度减碳的现实难题。

系统解决方案

COOC 中海商务为中海商业旗下商办资产运营管理平台，采用“双轮驱动 + 软性赋能”全生命周期路径，构建从技术集成到运营共创的降碳闭环。

增量创新打造南北气候适配的零碳标杆。深圳中国海外大厦（华南高温高湿）集成 11 项技术，实现长时间自然通风，搭配高效制冷机房、主动式冷梁空调与智慧物联 AI 调控；北京中海金融中心（北方温带）集成 19 项关键技术，落地大型商办“光储直柔”系统，融合被动式自然通风、高效空调、地源热泵、高装配率低碳建造，形成南北方两套完整零碳技术路线库。

存量项目因地制宜渐进式硬件升级。对北京中海广场、北京中海商务中心等已运营楼宇，利用屋面资源建设分布式光伏，打通空调、照明等十余个子系统智慧集成平台，在不大规模拆改前提下挖掘降碳潜力。

软性赋能构建租户参与生态。行业首创《零碳租户手册》，量化拆解数十项租户减碳举措；推出低碳积分体系，将企业、员工绿色办公行为转化为可兑换权益，推动租户由被动遵守转向主动减碳；沉淀形成双碳服务清单，面向全行业输出咨询、运维、改造体系化服务能力。

零碳成效与价值

环境价值：深圳中国海外大厦综合节能率 61.6%，降碳率 54.3%；北京中海金融中心 1 号办公楼综合节能率 81%，可再生能源利用率 68%，年节电 225 万 kWh，直接减碳 1406 吨。存量项目通过光伏与智慧运维持续实现稳定减排。

经济价值：零碳项目带来资产增值与资本市场认可，2025 年，中海商业的母公司中海地产在伦敦证券交易所 ESG 评分 89 分，位列全球房地产企业第一梯队，持续降低楼宇长期运营能耗成本。

社会与行业价值：中海商业参与编制《零碳建筑技术标准》等国家标准；服务 350 余家世界 500 强企业，带动租户及产业链共同低碳转型；首创租户参与式运营工具，填补商办楼宇运营端减碳机制空白，获得国家级碳核证，项目入选全国首批零碳建筑示范工程。

复制条件与场景迁移

前置条件：具备清晰的楼宇管理边界，拥有专业运营主体统筹软硬件改造与能源计量；新建项目可预留光伏、储能布设空间，存量项目优先依托屋面、现有机电系统开展适配改造。

场景迁移：该模式已在中海旗下多个商办项目落地验证。核心模块包括：分气候区的新建零碳建筑技术包、存量楼宇轻量化改造工具包、租户低碳运营标准化工具。技术框架除甲级写字楼外，还可迁移至商业综合体、产业园区等大型公共建筑，为全球城市商办建筑的全生命周期零碳转型提供可借鉴的中国实践样本。

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