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Penetrating Insights

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High-quality Development of Modern Productive Service Industry for Food and Agricultural Product Processing in Chongqing

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ABSTRACT

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Abstract

This article puts forward an opinion of high-quality development of modern productive service industry for food and agricultural product processing in Chongqing regarding the policy guidance on the food and agricultural product processing pillar industries, the prominent leading role on digitalization of integrated reform in the "fusion of two industries" and modernization, together with the important historical milestone of the 10th anniversary of the China-Singapore (Chongqing) Interconnection Demonstration Project, according to the Action Plan for Accelerating the High-quality Development of Modern Productive Service Industries (2024-2027) proposed by the Chongqing Municipal Government, and in combination with "33618" modern manufacturing cluster system.

By leading the industry to extend towards the high-end of the value chain, we aim to achieve high-quality development and focusing on the four leading industries for food and agricultural product processing. Their approaches include: giving full play to the influence and driving role of China-Singapore (Chongqing) Interconnection Demonstration Project, expand the opening of the service industry to the outside world, and create the "big integration" of service brand, the total integration of the whole industry chain and the "small integration" of intelligent greenization, Improve the level of quality, internationalization, integration, digitalization and greenization, lead the way in external recruitment and internal cultivation, utilize existing platform to optimize and integrate the industry chain, and create a high-level productive service industry cluster demonstration zone with strong industry influence and competitiveness.

Chapter 1 Overview of Background and Approach

I. Action Plan for Accelerating the High-quality Development of Modern Productive Service Industry

In recent years, the productive service industry, which provides intellectual supports for production, manufacturing and business activities, has become an important industry for measuring the comprehensive competitiveness and modernization level in a country or a region. In 2023, the added value of the main productive service industries in Chongqing was nearly RMB 700 billion Yuan, accounting for 23% of the GDP in the city and 42% of the added value of service industries in the city.[1] The development of the modern productive service industries is an important measure for establishing a national advanced manufacturing center, cultivating new quality productivity, and promoting economic transformation and growth in Chongqing.

In the notice on the Action Plan for Accelerating the High-quality Development of Modern Productive Service Industries in Chongqing (2024-2027) issued by the municipal government:

[1] The Development of Moder Productive Service Industries in Chongqing by Grasping the "Urgency" and "Opportunity" was issued in Chongqing Daily on August 1, 2024

1. In the overall requirements, it is proposed to promote the extension of productive service industries to specialization and high-end value chain, and improve the level of quality, digitalization, integration, greenization, and internationalization. It is recommended to ensure quality through specialization, promote digital transformation of enterprises through advanced intelligent manufacturing, promote integration through “penetration of two industries”, promote green development with a “double carbon” as a mark, and promote the level of the internationalization through expanding opening up to the outside world.

2. Among the three major initiatives, it focuses on accelerating the optimization and integration of the industrial chain and digital transformation, leading the industry to extend to the high-end value chain. It is suggested to focus on the development of total integrated service industry[2].

3. Among the eight key projects, the digital empowerment enhancement project is consistent with the above connotation of “digital transformation leading”; The development of business entities and the expansion of open cooperation, such as the agglomeration of productive service industries and the cooperation between Chongqing and Singapore, can play the roles of internal cultivation and incubation, as well as external investment attraction through Singapore as a transit point for mergers and acquisitions; The platform carrier support project is responsible for creating a “Chongqing Service Brand” with regional characteristics; The deep industrial integration project focuses on the innovative development of agricultural productive service industry, and coordinates with the development of western Chongqing represented by Jiangjin District and Bishan District.

[2] In the notice (YFF (2024) No. 18) on the Action Plan for Accelerating the High-quality Development of Modern Productive Service Industries in Chongqing (2024-2027) issued by the Chongqing Municipal People's Government

II. Pillar Industry of Food and Agricultural Product Processing in the "33618" Modern Manufacturing Custer

According to the data of the Ministry of Agriculture and Rural Affairs, the ratio of agricultural processing production value and total production value in agriculturally advanced countries is 4:1, and 2.5:1 in China. In the agricultural product chain, processing, as a core element of modern productive service industries, is an important link that can maximize the value of agricultural products.

The Action Plan for Further Promotion of the High-Quality Development of the New Era, New Journey, and New Chongqing Manufacturing Industries (2023-2027) proposes the "33618" modern manufacturing industry cluster system. The second "3" element is to create three 500 billion -level pillar industry clusters, one of which is food and agricultural processing industry. It is consistent with the basic concept of "big rural" pattern in 38 districts and counties of Chongqing and the development of the urban economy through manufacturing industry. In 2023, the production value of food and agricultural product processing industries in Chongqing has reached RMB 258.14 billion yuan, with a year-on-year increase of 3.4%.

Subsequently, the Chongqing Municipal People's Government successively issued *the Opinions on the Great Promotion of the High-quality Development of the Food and Agricultural Product Processing Industries and the Ten Policies on Supporting the High-quality Development of the Food and Agricultural Product Processing Industries by Chongqing Municipal People's Government*. Among them, the "Golden Ten Measures" focus on enabling enterprises in the field of grain and oil, prepared dishes, snack food, meat, eggs and milk, Chinese medicinal materials, fruits and vegetables, hot pot ingredients to undergo digital and intelligent transformation, industrial integration, and attract leading enterprises to settle in, and create "excellent products" on grain and oil, prepared vegetables, snack food. The preferred price shall not exceed 30% of the investment in publicity and brand building, with a maximum reward of 2 million yuan[3].

In order to achieve high-quality development in the above-mentioned "agriculture + food" industry fields, it cannot be separated from the "support" and even "development guidance" of modern productive service industries.

III. Formation of Internal Driving Force by the Digital Construction in Chongqing to Support the Modernization Development of the Service Industry

In 2023, Yuan Jiajun, the Secretary of the Municipal Party Committee, proposed to "further promote comprehensive and deepening reforms led by digital transformation", placing digitalization

[3] In the notice (YFBF (2023) No. 49) on *Ten Policies on Supporting the High-quality Development of the Food and Agricultural Product Processing Industries by Chongqing Municipal People's Government issued* by the General Office of Chongqing Municipal People's Government

in a prominent position in the overall construction of a modern new Chongqing. The essential attribute of digital transformation is integrated reform and institutional reshaping to promote efficient collaboration among various entities[4]. Zhejiang Province is at the forefront of the country in this regard, and it is urgent for megacities like Chongqing to shoulder the leading responsibility of promoting modernization through digitalization.

In the past year, the "Digital Chongqing Construction" conference has fully achieved its expected goals and built a modern internal driving force for the productive service industry. Currently, we are exploring the "1+1+N" industrial brain. The first "1" refers to integrating knowledge, components, models and algorithm elements to build a comprehensive integration of industrial generation, production and ecological services, and form the core competence of the industrial brain. The second "1" refers to the industrial data warehouse. "N" refers to the industrial brain in multiple segmented industries, such as the food and agricultural product processing industry. In response to the dispersed spatial layout of the industry, it supports the construction led by "chain owner" enterprises with strong industrial chain connectivity and resource concentration. For industries with strong common demands in the industrial chain, a third-party platform will lead the construction of a shared industry brain[5].

IV. Deepening and Implementing the China-Singapore (Chongqing) Interconnection Demonstration Project, and Promoting the Expansion of the Service Industry's Opening up to the Outside World

In April 2024, General Secretary Xi Jinping visited Chongqing for inspection and gave it a new positioning as an "inland comprehensive hub for opening up to the outside world", and expressed the central government's expectation for Chongqing to "leading and driving economic development" in expanding its opening-up to the outside world[6]. We will accelerate the high-quality development of modern productive service industries by expanding comprehensive pilot programs for opening up to the outside world, deepening Chongqing-Singapore cooperation, and cooperating with RCEP member states.

The Strategic China-Singapore (Chongqing) Interconnection Demonstration Project is the third largest national-level cooperation project between China and Singapore, and it will usher in a milestone 10th anniversary celebration event in 2025. As of 2023, the China-Singapore (Chongqing) Interconnection Demonstration Project has signed a contract with a total amount of 25.6 billion US dollars in multiple fields, and there are already 151 Singaporean capital enterprises in Chongqing. In response to Singapore becoming the largest source of foreign investment in Chongqing, the China-

[4] "*Introduction to Digitization Reform*", Yuan Jiajun, Zhejiang People's Publishing House, page 17

[5] *Realizing the Goal of "Forming Key Capabilities within One Year" in the Construction of Digital Chongqing*, Chongqing Daily, April 9, 2024

[6] *Central Government's High Expectations for Chongqing from a New Positioning,* Chongqing Outlook, May 6, 2024

Singapore (Chongqing) Interconnection Demonstration Project Operation Center has established the first comprehensive service center for China-Singapore enterprises in Raffles City, which is responsible for providing one-stop services such as policy consultation, business agency, and cluster registration and so on. In *the Action Plan for High Quality Implementation of RCEP in Chongqing*, the impact and driving role of the China-Singapore (Chongqing) Interconnection Demonstration Project are regarded as important measures to enhance Chongqing's ability to participate in global resource allocation and level of opening-up to the outside world[7].

The China-Singapore (Chongqing) Interconnection Demonstration Project has expanded to the field of "agriculture + food" industry. In August 2024, the Municipal Commerce Commission (CCI Administration Bureau), together with the Municipal Agriculture and Rural Commission and the Singapore Food Science and Technology Association, jointly held a **round-table conference on China-Singapore (Chongqing) Agriculture Cooperation,** and had in-depth exchanges on expanding the "foreign trade" of agricultural products in Chongqing, investment and development of emerging enterprises in Chongqing, new product development, and brand management in the service industry[8]. The China-Singapore (Chongqing) Agriculture Cooperation Project has promoted the direct supply of agricultural products from Sichuan and Chongqing to supermarkets in Singapore, with a trade volume of RMB 79 million yuan.[9]

As a wholly-owned subsidiary of Singapore-based grain and oil giant Wilmar in China, which ranks 198th in the world's top 500, Yihai Kerry will continue to enhance the "bring in" and "going out" levels of the Sino-Singapore project cooperation platform, and strengthen the expansion of the opening-up of modern productive service industries for food and agricultural processing in Chongqing.

Chapter 2 Promoting the Extension of the "Agriculture + Food" Productive Service Industry to the High-end Value Chain

I. Overall Integration of the Whole Service Chain of the Leading Industries in Food and Agricultural Product Processing

In order to achieve the goal of high-quality development of modern productive service industries for food and agricultural products processing in Chongqing, the key and efficient way is to extend the service for the lead industry of "agriculture + food" and form system solutions through

[7] Notice from the General Office of the Chongqing Municipal People's Government on Issuing *the Action Plan for High Quality Implementation of the Regional Comprehensive Economic Partnership (RCEP) in Chongqing*

[8] *The round-table conference on China-Singapore (Chongqing) Agriculture Cooperation has been held! Chongqing and Singapore join hands to promote agricultural cooperation*, China-Singapore (Chongqing) Interconnection Demonstration Project, August 13, 2024

[9] *We Achieve Common Development through the Accumulation of Various Forces, and China-Singapore (Chongqing) Interconnection Demonstration Project Creates New highlights of High-level Opening-up to the Outside World*, Phoenix Network Chongqing, June 27, 2024

integrated innovation. This is also the ability of leading productive service industries, which can be cultivated in conjunction with the “Head Sheep Plan” of the “Agriculture + Food” industry.

According to the “Opinions” [10]on “strengthening and optimizing leading industries", in combination with the basic needs of people's livelihood and development trends, it is recommended to promote leapfrog development through the overall integrated industry services in the four major sub-fields such as grain and oil, prepackaged vegetables, leisure food, and meat, egg, and milk.

Regarding the whole chain integration of food and agricultural product processing industry services, on the one hand, from the top-level design of field to table integration services and definition of the core links, such as: planting - production - processing - storage - distribution - delivery, the leading enterprises and strategic partners are responsible for jointly building the “Agriculture + Food” service industry alliance and consortium, such as: rice and noodles design empowerment center improves the benefit and connection mechanism, and drives the coordinated development of all related subjects on the industry chain; On the other hand, we introduce service providers with strong innovation ability and have integrated some resources to achieve system integration, and carry out services of the high-end value chain.

To achieve the overall integration of the entire industry chain of the lead industry of food and agricultural products processing modern productive service industries, digital integration reform should be carried out to support the integration of the two industries and promote efficient collaborative integration.

II. Integration of Intelligent Manufacturing Systems, Technological Innovation, and Green and Low-carbon Development

The development of intelligent manufacturing system integration is a key element to enhance the scenario support of total integration service capabilities and extend to the high-end value chain.

Case: Yihai Kerry’s Production Intelligence Manufacturing Demonstration Factory[11]

Yihai Kerry has achieved full process intelligence based on the integration and application of new generation information technology, and is a municipal level digital workshop, municipal level intelligent factory, and national level green factory in Chongqing. In terms of products, production, and supply chain, it integrates 12 intelligent manufacturing processes, such as quality control, marketing management, factory construction, warehousing and logistics. 20 typical application scenarios have been formed together, for example, intelligent online detection and precise tracing

[10] *Notice on Chongqing Municipal People's Government on Vigorously Promoting the High-quality Development of the Food and Agricultural Products Processing Industries (YFBF (2023) No. 15)*

[11] *Application for Intelligent Manufacturing Pilot Demonstration Project of Yihai Kerry (Chongqing) Grain and Oil Co., Ltd., August 28, 2023*

under quality control, sales driven business optimization under marketing management, and digital infrastructure integration under factory construction. With standard technical support, it achieves seamless integration and application of information systems between the above scenarios.

In this process, we continue to iterate and update technologies, strengthen research on key technologies, upgrade or introduce intelligent manufacturing equipment, promote the large-scale application of new technologies and products, and provide more demonstration scenarios.

The *Action Plan* proposes to explore innovative green and low-carbon service models. In the Opinion, it is required to accelerate the intelligent and green low-carbon transformation of enterprises, promote the application of emission reduction technologies, and energy-saving equipment.

Case: Yihai Kerry's Green and Low Carbon Action

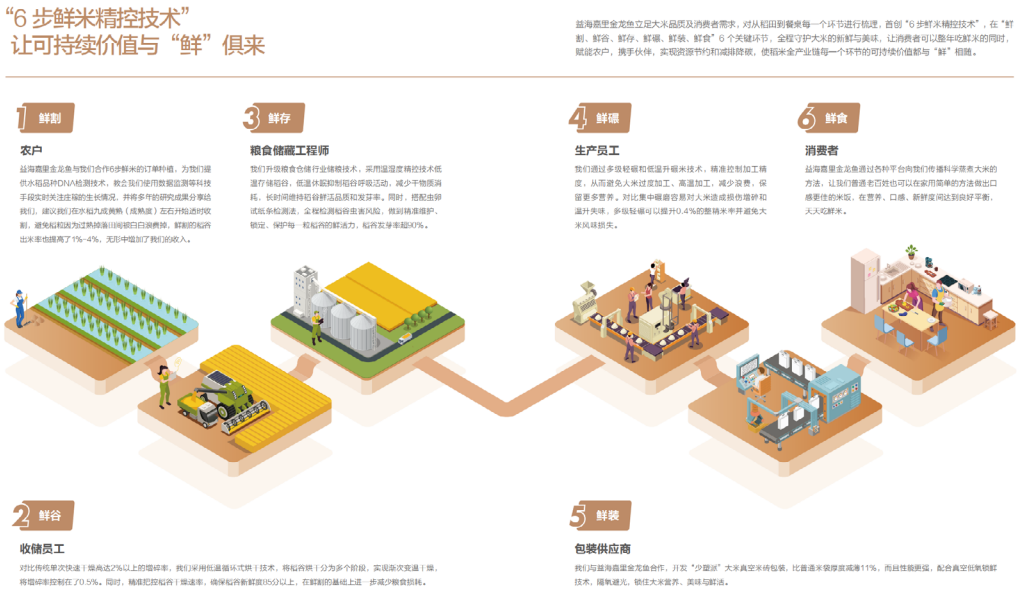
Yihai Kerry has made an active respond to the national “double carbon” policy, set up zero carbon goals, built a low-carbon whole chain system, and achieved remarkable results in green manufacturing, circular economy, six-step fresh rice precision control and other aspects. As of 2023, the Group has won 81 green factory honors[12]. After more than 10 years of research, Yihai Kerry has developed the “circular economy of paddy rice” model in which the extensive planting and primary processing are upgraded to intensive processing and production, and transformed from resource consumption to efficient utilization, for example: Extraction of plant sterol and other byproducts from rice bran, development of plant sterol ester solid-drinks, soy milk and jelly as well as other

[12] *2023 Sustainable Development Report of Yihai Yihai Kerry Arawana Holdings Co., Ltd.*, Page 16

scientific and technological innovation health products, with high premium to feed cooperative farmers, so that agriculture positioning is more accurate, and has higher added value, longer industrial chain.

In order to further promote green and low-carbon development, Yihai Kerry plans to invest RMB 220 million yuan to launch an 800 tons/day rice processing project with a production value of about RMB 1 billion yuan in Chongqing.

Yihai Kerry has also explored the “Six-step Fresh Rice Precision Control Technology” system of “Fresh Cutting, Fresh Graining, Fresh Storage, Fresh Grinding, Fresh Packaging, and Fresh Eating”. In addition, the “timely harvesting” technology has achieved a 5% increase in rice yield, a 1% to 4% increase in milled rice rate and an increase of 2 to 5 food taste values, thus contributing to the reduction of food consumption, so that consumers can eat fresh and nutritious rice all year round.



III. Deepening Cooperation between Chongqing and Singapore, Deep Integrating of the Two Industries, and Join Creation of Service Brands

China-Singapore (Chongqing) Interconnection Demonstration Project was launched in November 2021, which aims to share new opportunities in regional agriculture through the China Singapore Agricultural "Double Hundred" Cooperation Plan. Blood oranges from Rongchang and crispy plums from Mt. Wu are regularly exported to the Singapore market. In the first half of 2024, the export of agricultural products in Chongqing reached RMB 750 million yuan, with a year-on-year increase of more than 50% over the same period in the past five years.[13] Local enterprises can take the advantages of the China-Singapore (Chongqing) Interconnection Demonstration Project to match high-quality suppliers from ASEAN or RCEP member countries. Singapore private equity firm, CAP 1 FINANCIAL PTE.LTD (CAP), plans to establish a $140 million special industry fund in Rongchang District to introduce fruit deep processing service enterprises, set up a processing base in Rongchang, and sell blood oranges and other locally distinctive agricultural products in China and Southeast Asia after deep processing. The company plans to transform the project into a China-Singapore (Chongqing) agricultural benchmark demonstration project. The cooperation between Chongqing and Singapore will shift from deepening agricultural product trade to assigning agricultural brands and extending towards the high-end value chain. The key factor is the deep integration of modern productive service industries.

After Singapore was selected as the global “City of Design” in 2015, Chongqing will become the fifth city in Chinese Mainland to win this title in October 2023. The Action Plan also proposes to promote the construction of a global “City of Design”. The concept of “China-Singapore Design Co-Creation” is based on this background. The “Co-Creation Base” is unveiled at the 2024 "West China International Fair" and plans to implement the “Design Empowering Brand Export Action”.[14] On the occasion of the 10th anniversary of the China-Singapore (Chongqing) Interconnection Demonstration Project, by empowering design as the core sector of modern productive service industry, both parties will work together to create an “agriculture + food” joint souvenir or create a collective brand with both Singapore and Bayu cultural elements. According to the relevant regulations on “high-quality products” in the “Ten Golden Rules”, it is suggested to develop healthy functional food in terms of grain and oil, prepared vegetables and leisure food, such as MLCT (medium and long chain fatty acid edible oil) that “people do not get fat after eating oil”, scientifically proportioned whole grain cereals Congee, highland barley and tartary buckwheat noodles which are suitable for diabetics and which have passed low GI certification, and it is also the strategic direction of Yihai Kerry in the future. Regarding the collection of brands, it is

[13] *Empowerment Approach from the Import and Export of “Chrome Ore” and "lemon" to the New Land Sea Corridor in the Western Region*, Chongqing Customs, August 16, 2024

[14] *Chongqing New Design*, Volume 7 [Approval Number: (Yu) 2021821], Director of Chongqing Municipal Commission of Economy and Information Technology

recommended to create industry collection brands with high market awareness and strong premium ability, such as "a barrel of healthy oil, a package of condiments, and a basket of selenium-rich vegetables"[15] and carry out the concentrated publicity and promotion of brands with policy subsidies.

On the basis of China-Singapore design, we aim to jointly create "high-quality products" or collective brands in the "agriculture + food" industry, achieve the extension towards the high-end value chain, and accelerate the transformation of design results. In addition, the quality and internationalization of endorsement design service agencies will greatly assist in building the "Chongqing Service Brand" and promote the high-quality development of CQ food and agricultural products processing modern productive service industry.

Chapter 3 Building a Leading Platform Carrier for "Agriculture + Food" Productive Service Industry in Chongqing

I. Optimization, Upgrading, Integration and Sharing of the Food and Agricultural Product Processing Industry Chain

In order to achieve the goal of high-quality development of modern productive service industries for food and agricultural products processing in Chongqing, another key and efficient approach is to integrate the existing spatial layout and supporting facilities of the served industries to create an "agriculture + food" modern productive service industry cluster area (platform carrier).

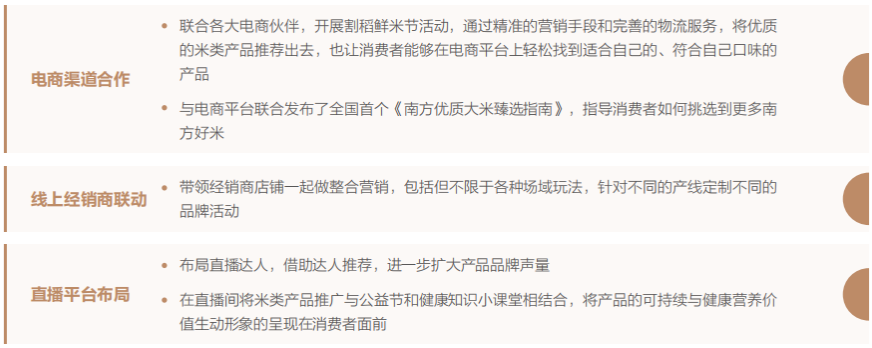
[15] *Action Plan for Building a Demonstration Area of High-quality Development of Consumer Goods Industry in Jiangjin District (2020-2022)*

In the process of optimizing and upgrading the industry chain, a new system of integrated and shared service industry and a professional service sector that connects upstream and downstream resources should be constructed.

The optimization and upgrading of the industry chain include:

Integrated supply chain management services from fields to dining tables, supply chain visualization monitoring (For example, the first visual inspection system based on whole line technology in the grain and oil industry developed by Yihai Kerry covered all production lines in Chongqing in 2016), integrating development industry and e-commerce services.

Case: Online Marketing and Promotion of Rice Products of Yihai Kerry[16]



稻米产品线上推广方式

The integration and sharing of the industry chain include:

Creation of an agricultural industry consortium[17]: Can promote production and sales models, such as “production base + central kitchen + catering store”, “production base + processing enterprise + supermarket sales”. Expand the reverse manufacturing process by means of commissioned manufacturing, brand authorization or joint creation, and intellectual property cross-licensing.

Case: Ecological Park for Yihai Kerry’s Central Kitchen

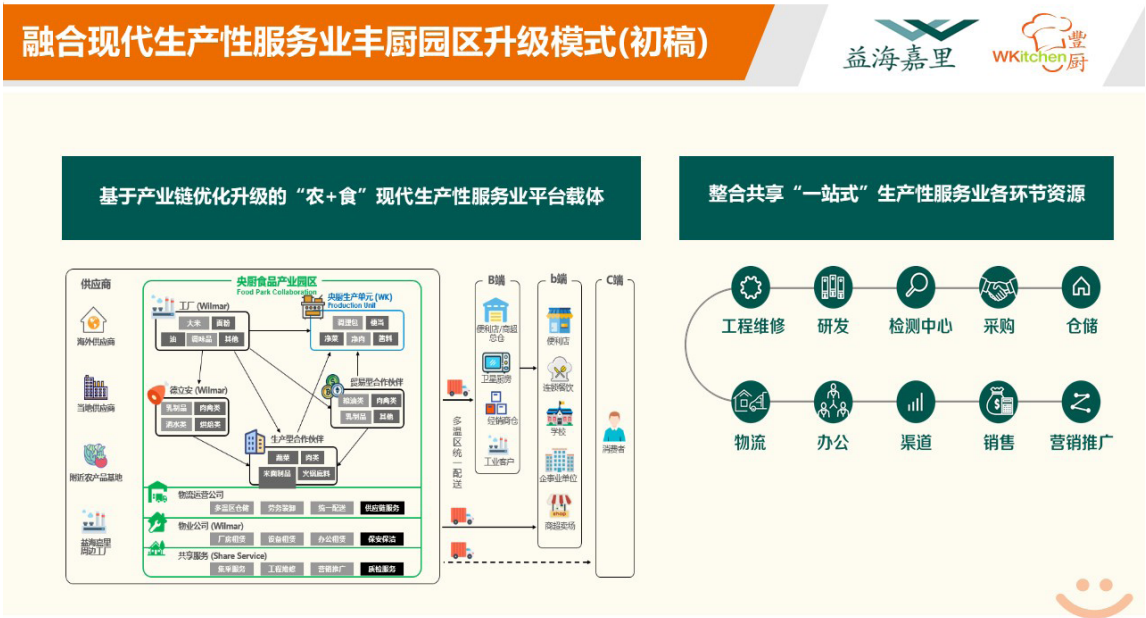
Singapore Wilmar International conducted the exploration of the industrial model of “central kitchen park” in Jiangjin, Chongqing. It is hoped to build an ecological chain of Chinese food industrialization and an open platform for sharing, integration and mutual-development with the staple food industry as the core. In addition to introducing upstream raw material suppliers,

[16] *2023 Sustainable Development Report of Yihai Yihai Kerry Arawana Holdings Co., Ltd.*, **Page 23**

[17] *Implementation Opinions of the General Office of the Chongqing Municipal People's Government on Promoting the Development of Agricultural Product Processing Industry*

midstream prepackaged food and baking product manufacturers, we also introduce modern productive service enterprises in the field of the downstream warehousing, logistics, retail, so as to open up the whole industrial chain of agricultural production, food processing, and terminal sales, and realize a whole-process visual monitoring and whole-chain data management.

The essence of this model is a modern productive service industry cluster for food and agricultural product processing, which integrates and shares all resources from the industry chain, integrates and innovates solution systems, and manages the entire digital chain. The pilot program also is helpful to accelerate the construction of a leading platform carrier for the service industry with a guiding and demonstrating role.



II. External and Internal Cultivation of High-quality Services in the Food and Agricultural Product Processing Industry

In order to build a leading platform carrier for modern productive service industry in food and agricultural product processing in Chongqing, it cannot be separated from the joint efforts of the main operators in high-quality service industry so that a common prosperity of industrial ecology can be built. For brand, export-oriented and value-added benchmarking service enterprises, the main work should be carried out in parallel from two aspects: external attraction of foreign investment and acquisition, as well as internal cultivation and incubation.

1. External attraction of foreign investment and acquisition

By utilizing various models such as ecological chain investment, fund investment, “enclave” investment, and cloud investment, in combination with merger and acquisition strategies, we aim

to attract a group of high-quality service industry entities both domestically and internationally to ensure that benchmark enterprises establish regional headquarters in Chongqing, for example: The Singapore Chamber of Commerce and Industry (DBCS) will establish its Chinese operation headquarters in Chongqing in 2024. Based on the implementation of the China-Singapore (Chongqing) Interconnection Demonstration Project, attracting talents from foreign markets can give priority to building Singapore, and has achieved remarkable achievements in the headquarters economy. Singapore has attracted about 30,000 international companies. It is the city with the most regional headquarters of multinational companies. By using the network resources of Singapore's Wilmar International, the parent company of Yihai Kerry, it will greatly assist high-quality service enterprises in attracting cross-border customers.

2. Internal cultivation and incubation

By using the benchmark incubation role of leading enterprises or implementing the “Chongqing Service Brand” leading plan, we aim to attract various operators in the “agriculture + food” industry service chain to carry out various incubation and cultivation activities, such as shareholding incubation (intellectual property can be valued and paid in), "aerial incubation" and mobile incubation. The most important thing is that leading enterprises can provide demand orders for service chain enterprises, accelerate the incubation of productive service industry projects with the “big and small” model, and then use project results to feed back to service providers for optimization.

Chapter 4 Suggestions

I. Adjustment and Improvement of Policy Measures to Ensure the Healthy Development of the Grain and Oil Processing Industry

Provide more top-level attention and policy supports for the four major sub-fields such as the food and agricultural product processing industry in the “33618” modern manufacturing cluster, especially in the modern productive service industry for grain and oil processing. Suggestions: Ensure the implementation of special policies; The trial method for determining and deducting input VAT on agricultural products will be implemented on a nationwide scale to avoid the impact of tax troubles on the development of the grain and oil processing industry. The flexible implementation of the current grain import and export management measures, the granting of some quotas to eligible enterprises for exporting high-quality rice, can not only meet the demands in the Hong Kong, Macao, and Southeast Asian markets, but also help the domestic processing industry increase profits and promote the healthy development of the grain and oil processing industry.

II. Integrated Innovation of the System to Enhance the Overall Integrated Service Capability of the "Agriculture + Food" Industry

The government should actively guide and encourage the implementation and promotion of the overall integrated service model. Supports should be provided for the application of comprehensive solutions in various core links of modern productive service industries such as research and development, production, processing, procurement, testing, warehousing, and marketing industries, the enhancement of intelligent manufacturing system integration capabilities, and the development of the overall integration services of the "hardware + software + platform + service". It is necessary to promote the innovative integration of service-oriented manufacturing and agricultural productive service industries, and expand the typical application scenarios of "data element X food and agricultural product processing" to enhance integrated service capabilities.

III. Multi-function Integration to Accelerate the Transformation of Health Functional Food Service Achievements

It is necessary to support leading enterprises to integrate "one-stop" services across the entire industry chain, and integrate multi-functions according to industrial logic and supporting service sections. It is necessary to encourage the introduction of modern production service benchmark enterprises for professional empowerment, in order to meet consumers' diverse, cost-effective, healthy, and personalized needs for food, while accelerating the market sales conversion of service achievements.

Due to the inability of current policies and regulations to accurately identify products with multiple functions of "medicine and food", it fails to meet specific health needs, resulting in the difficult sale of healthy functional food in enterprises, and it is recommended to implement a standardized licensing system and allow appropriate labeling and promotion of such products after strict review and filing, in order to help consumers with different physical conditions purchase such products in a timely manner.

IV. Upgrading of the Ecological Park of the Central Kitchen to Play a Role of the Leading Training in Leading Enterprises

Based on the existing industrial layout of the "Central Kitchen Ecological Park", it is necessary to update the carrier and create a benchmark platform for the modern productive service industry in high-energy food and agricultural product processing. It is necessary to play a role of China-Singapore (Chongqing) Interconnection Demonstration Project, attract high-quality service enterprises to invest and develop in Chongqing, establish regional headquarters, and cultivate and incubate local service enterprises. It is suggested to leverage the leading brand, technology, and resource advantages in the industry, and encourage upstream and downstream enterprises to build a "Chongqing Service Brand" platform with distinctive characteristics, high quality, scale effects, and

strong industry competitiveness around the “agriculture + food” industry service chain. By using the nationwide channels of Yihai Kerry and the network resources of Singapore's Wilmar International, we plan to expand its influence in both domestic and overseas markets.

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Advancing Chongqing's Green Manufacturing Towards a Net Zero Economy

Sabrina Soussan
Chairman and CEO of SUEZ

Executive Summary

This white paper provides a strategic roadmap to advance Chongqing's transition towards green manufacturing, reinforcing its role as a leader in China's broader efforts for sustainable development. As a key city in the Yangtze River Economic Belt, Chongqing has a unique responsibility to demonstrate green initiatives that align with China's climate ambitions. The objective of this paper is to outline actionable recommendations for Chongqing to enhance its green manufacturing sector, leveraging its existing industrial base and geographical advantages to contribute significantly to national and global climate targets.

Chongqing's transformation from a traditional industrial hub to a leader in green manufacturing is essential not only for regional sustainability but also for its economic growth and competitiveness. SUEZ, a global leader in circular solutions for water and waste and a long-term partner of Chongqing, has been contributing to the city's ecological transformation for over 20 years. Leveraging our global experience in the environmental industry for over 160 years, we believe the city can adopt a multifaceted approach for advancing its green manufacturing and low-carbon evolution, positioning it as a global city:

1.Defining a Strategic Roadmap Towards a Net Zero Economy

As one of the key industrial bases, Chongqing should take a forward-looking approach to define a more comprehensive roadmap for addressing new environmental challenges associated with emerging industries and embracing renewable energy use. This involves a multidimensional approach from transregional and multi-industry standpoints, supporting Chongqing moving towards the development of a net zero economy.

2.Promoting Green Innovation Alongside Digital Manufacturing

Supporting the new green industries must be accompanied by a transition from a traditional manufacturing hub to a leader in the innovation economy. Recent developments in AI, Big Data, and IoT in manufacturing will boost efficiency and reduce waste.

3.Strengthening Policy Support and Financial Incentives

Policy support and financial incentives are crucial for attracting both local and foreign investment into Chongqing's green initiatives. Set clear criteria for green initiatives and ESG standards that guide and motivate manufacturers to transition to responsible operations.

4.Expanding International Collaboration

Moving towards green development means thinking globally. Partnering with international leaders means sharing knowledge, innovation and will bring Chongqing's green solutions to the world. These collaborations boost sustainability and expand its reach, making Chongqing a talent attraction hub.By focusing on these strategic areas, Chongqing can advance significant progress in its green development goals, contributing to China's overall environmental targets and setting a benchmark for other cities to follow.

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I. Global and National Climate Context

Global climate change presents a significant challenge, with impacts ranging from environmental degradation to economic disruption. China has recognized the urgency of these challenges and committed to ambitious climate goals: peaking greenhouse gas (GHG) emissions by 2030 and achieving carbon neutrality by 2060. In August 2024, the Chinese government, through the CPC Central Committee and the State Council, introduced guidelines to advance the green transition across all sectors of the economy. These guidelines aim for a substantial reduction in carbon emissions and enhanced resource efficiency, setting the stage for a green, low-carbon, circular economy by 2035.

These guidelines emphasize optimizing land use, promoting green industrial and energy transitions, and advancing sustainable practices in transportation and urban development. By 2030, China aims to have the energy conservation and environmental protection industry reach a scale of 15 trillion yuan (approximately $2.1 trillion). Additionally, non-fossil energy should make up 25% of total energy consumption, with a significant increase in renewable energy infrastructure, such as hydropower with pumped storage, waste-to-energy, and biomass power generation.

II. Chongqing's Green Development Landscape

Chongqing is strategically positioned as a gateway to China's west, a key connection in the Yangtze River Economic Belt, and a strategic base for China's Belt and Road Initiative. Geographically, Chongqing is built on mountains and surrounded by rivers, and is known as a "city of mountains and rivers". As one of China's largest cities, Chongqing is also a key industrial base in

Western China. Driven by its distinct mountainous topography and a large share of heavy industries, Chongqing is considered as an energy and carbon intensive city.

Despite these challenges, Chongqing has made an extraordinary transformation over the past 20 years, moving from a traditional heavy industrial base towards a more sustainable economy. At SUEZ, we are honored to have contributed to this transformation, providing first-class water and wastewater infrastructure to the city.

By 2025, Chongqing aims to decrease energy consumption intensity by 14% compared to 2020 levels and increase the proportion of non-fossil fuel consumption to 25%, with a target of rising to 28% by 2030. Furthermore, Chongqing's initiatives in treating wastewater have achieved a rate of 92%, and solid waste management has reached 100%.

Chongqing has also collaborated with leading enterprises from around the world in various environmental industry fields, including the upgrade of electric vehicle batteries, medical waste, intelligent manufacturing, and renewable energy. The successful implementation of these cooperative projects has not only revitalized the green transformation of Chongqing's manufacturing industry but has also established a new benchmark for China's open cooperation in the field of sustainable and low-carbon development.

III. Green Evolution – A Turning Point for Chongqing’s Sustainable Growth

In a global context that is becoming increasingly complex, the economic and environmental issues are multiplying: tackling the climate challenge by reducing GHG emissions and adapting to the consequences of climate change; preserving biodiversity; ensuring energy sovereignty; securing access to resources; meeting the growing expectations of citizens... These are major issues that every country, every city, and every company is facing. The profound and rapid transformation of our model is essential. This transformation isn't just an environmental imperative. It is the right choice to promote high-quality growth and competitiveness in a global society that is increasingly aware of environmental issues. Green manufacturing evolution, like any change, presents challenges, but also provides tremendous opportunities.

In the last two decades, we have witnessed together how Chongqing has become one of the major cities in China, and in the coming years, we will witness a bigger and more profound transformation. A transformation that will position Chongqing as one of the global cities, embracing a sustainable and low-carbon growth model, becoming a high-end technology industry hub.

By prioritizing green industries and sustainable solutions, Chongqing can diversify its business base and attract additional investments in high-growth industries, including renewable energy infrastructure, electric vehicle production, and advanced material manufacturing, as mere examples. These industries are contributing to achieving a net zero economy, boosting economic growth, and

promoting a society of shared prosperity for Chongqing's citizens.

This path to sustainability is being taken by many cities and countries around the world. In France for example, the transformation to a low emission economy is already underway. The net benefit of the transition for the country could reach +3.5% of national GDP in 2070. In the UK it is estimated that the net zero economy grew by 9% in 2023[1], creating 765,000 new jobs.

Working towards a net zero economy is also essential for creating sustainable urban environments. It reduces dependence on fossil fuels through energy efficiency and renewable energy sources, while minimizing the environmental footprint. Additionally, circularity fosters collaboration between industries and public-private entities, enabling resource sharing and innovative solutions. By embracing these principles, Chongqing can build resilient systems that respect planetary boundaries and support a sustainable future.

Additionally, prioritizing green manufacturing also aligns Chongqing with China's national goals of peaking GHG emissions by 2030 and achieving carbon neutrality by 2060. By meeting these targets, Chongqing contributes to China's broader climate commitments and enhances its role as a model city for sustainable urbanization.

IV. Strategic Recommendations for Chongqing's Green Manufacturing

So, how can Chongqing leverage its existing industrial base and geographical advantages to bring Chongqing to the next level of green transformation and leadership?

SUEZ, as a global player dedicated to the environmental services for over 160 years, has a long history in China. It was one of the first foreign environmental companies to enter China, contributing to China's infrastructure development for nearly half a century. With over 6,500 employees across 30 cities, SUEZ has built more than 400 water and wastewater treatment plants in the region. Together with its local partners, the Group provides water and waste management services to more than 25 million people, and 20 industrial parks across the country. It is also the only foreign company ranked among the Top 10 Most Influential Companies in China's Water Industry for the past 21 consecutive years.

In Chongqing, SUEZ has been a partner to the municipality since 2002, unveiling a path of long-term collaboration to assist the city to achieve its ambitious environmental goals. Over the last two decades, the scope of its services has expanded from water supply to wastewater treatment and industrial park environmental services. SUEZ is also a strategic shareholder of Chongqing Water Group and Sanfeng Environment, with a total investment of over 4 billion RMB. Today, SUEZ's partnership with Chongqing has become a successful model of win-win cooperation between China and foreign enterprises in Chinese water market.

[1] https://www.theguardian.com/environment/2024/feb/27/uk-net-zero-economy-grew-in-2023-report-finds

SUEZ has always set carbon reduction as a priority in its sustainable development strategy and supports its clients in decarbonizing their production value chain. Over the last five decades, SUEZ has been fully supporting China's dual carbon goals and is committed to playing an active role in the country's efforts towards a greener future. Its robust industrial cooperation models with Chinese partners have allowed it to make significant progress towards energy efficiency and decarbonization. For example:

- **In Chongqing,** it captures and uses biogas from wastewater treatment processes for energy and electricity generation. It is recognized as the excellent example of low-carbon sewage treatment.
- **In Shanghai Chemical Industry Park,** it produces and supplies energy to its partners while operating one of Asia's largest hazardous waste treatment facilities.
- **In Suzhou,** it dries sludge from wastewater treatment and uses it as alternative fuel to generate electricity. This is recognized as an excellent reference case of upstream-downstream industrial collaboration and the circular economy.
- **In Dalian,** it uses waste from the refining process of its upstream chemical clients to treat wastewater, reducing both types of waste while contributing to its low-carbon commitments.

Leveraging on its solid global and local experience in the environmental sector, SUEZ would like to share its top 4 recommendations to Chongqing:

● Firstly: Defining a Strategic Roadmap towards a Net Zero Economy

Leveraging its industrial base, Chongqing successfully upgraded its manufacturing sector to focus on IT and automobiles. In the next round of transformation, Chongqing can continue to build on its strengths in the real economy and aim to develop advanced manufacturing and technological capabilities. To cope with its development, it should also take a forward-looking approach to define a more comprehensive roadmap for **addressing new environmental challenges associated with emerging industries and embracing renewable energy use** to boost the green manufacturing processes across its entire value chain. This involves a multidimensional approach from trans-regional and multi-industry standpoints, supporting Chongqing moving towards the development of a net zero economy.

- **Increasing the share of alternative energy:** Chongqing's high emissions are driven by its distinct mountainous topography and a large share of heavy industries. Chongqing's ambition is to increase the proportion of non-fossil fuel consumption to 28% by 2030. Decoupling economic growth from high carbon emissions by transitioning to renewable

energy sources such as solar, wind, and hydropower is crucial for its long-term growth. This shift will not only provide an economic boost but also reduce energy costs for businesses by decreasing Chongqing's reliance on volatile fossil fuels, making it a more resilient and productive economy while also aligning with China's dual carbon goals.

Waste is also a resource to decarbonize the industries and provide a new source of local and sustainable energy: using residual waste as fuel to generate electricity for domestic or industrial use.

- In France, SUEZ is building a Solid Recovered Fuel (SRF) heat generation unit to supply sustainable energy to a sugar refinery-distillery, replacing 40% of its fossil gas needed for steam production. Additionally, SUEZ will produce SRF from waste to help Humens, a mineral-based chemicals producer, eliminate coal use and reduce 60% of its carbon emissions.

- In the UK, SUEZ's energy-from-waste facilities divert 96% of West London's residual waste away from landfill, generating and exporting electricity enough to power 50,000 homes annually.

◦ **Transregionally,** Chongqing should also consider forging a strategic partnership with neighboring areas like Chengdu to optimize the alternative energy development such as hydrogen energy and fuel cell vehicle networks, leveraging its role as the largest automobile manufacturing base in China and its competitive advantage in new energy vehicles.

◦ **From a multi-industry standpoint,** Chongqing can promote synergies between upstream and downstream, encouraging the development of pilot projects like **low-carbon battery parks** and **lithium battery recycling centers**. Reducing waste and improving circular economy in the industries are key steps towards building a zero-waste city.

- For Instance, SUEZ is working in France on an electric vehicle battery recycling plant that will recycle strategic metals in a closed loop, contributing to secure the metal supply needed for Europe's energy transition.

● **Secondly, Promoting Green Innovation alongside Digital Manufacturing**

Supporting the new green industries must be accompanied by a transition from a traditional manufacturing hub to a leader in the innovation economy. Recent developments in AI, Big Data, and IoT in manufacturing will boost efficiency and reduce waste.

Efforts to promote smart and sustainable practices will require the attention of city leaders. Chongqing's market size and strong supply chains provide a unique edge in achieving this vision. For instance,

- **Prioritize innovation in emerging industries** like alternative energy vehicles, advanced materials, and wind power equipment. Addressing new environmental challenges associated with these sectors — such as EV battery recycling, management of retired wind turbines, and the treatment of fluoride wastewater — is crucial.

- **Focus on smart manufacturing and industrial IoT:** Digital transformation, driven by Artificial Intelligence (AI), Big Data, and the Internet of Things (IoT), is essential to improve production efficiency, reduce costs, and enhance the competitiveness and performance of Chongqing's industries.

  At SUEZ, we have seen how digital solutions can enhance efficiency in our water and waste facilities, supporting the achievements of our sustainability goals. For instance,

  - In Macau, SUEZ digital solutions have enabled the city to optimize its water resource productivity and resilience, successfully reducing the water network leakage rate to 7.7%, surpassing the Chinese government's goal a decade ahead of schedule.

- **Collaborate with leading global digital enterprises to create Chongqing's Lighthouse Factories:** Identify key enterprises in the green environmental protection sector as industry benchmarks, strive to have more Chongqing enterprises included in the ranks of the world's typical digital Lighthouse Factories and become leaders and demonstrators in the digital and green transformation of global manufacturing.

● Thirdly, Strengthening Policy Support and Financial Incentives

To advance Chongqing's green manufacturing and sustainability initiatives, policy support and financial incentives are crucial for attracting local and foreign investments into Chongqing's green initiatives. Additionally, diversifying corporate financing channels and encouraging foreign funds to participate in investment structures, construction of low- carbon factories, and specialized industrial zones should be encouraged.

The environmental challenges ahead of us will require the collaboration between public and private players. To help Chongqing attract more green investment and support businesses committed to green manufacturing, Chongqing shall encourage:

- **Stable policies and strong financial incentives:** For foreign and local investors, stability, consistent policies and regulations, reliable tax framework, and clear financial incentives are vital.

  - Private investments will need to be rewarded properly and strong partnerships based on mutual trust will need to be forged. And it is crucial for both foreign and local investors to have **stable regulations and incentives** to ensure continued investment and foster their

confidence in the future.

- Official leaders will need to strike the right balance to promote growth while keeping public finances healthy. New taxes on polluters will offset the new tax benefits for the green transformation drivers.
- The new targeted tax breaks and subsidies will help Chongqing attract more green investment and support businesses committed to sustainability.

◦ **Clear criteria for green initiatives and ESG standards:** Establishing clear evaluation criteria for green practices, incorporating Environmental, Social, and Governance (ESG) standards, will motivate and guide businesses towards responsible operations.

● Finally, Expanding International Collaboration

Moving towards a green development means thinking globally. Partnering with international leaders means sharing knowledge, innovation and will bring Chongqing's green solutions to the world. These collaborations boost sustainability and expand its reach, making Chongqing a talent attraction hub.

◦ **Strengthening foreign investments:** Foreign investments will need to be encouraged to benefit from the global effort to develop low-carbon factories and specialized industrial zones.

◦ **Promoting international collaborations:** The Chongqing government has already been promoting international collaborations. A prime example is SUEZ's expanded partnership with Chongqing Sanfeng Environment, signed during President Xi's state visit to France this May. This agreement aims to combine the strengths of these two industry leaders to help Chongqing export its waste-to-energy technologies globally, boosting Chongqing's presence in the international waste market.

V. Conclusion

Chongqing's commitment to green development is pivotal to its future as a leading city in sustainable urbanization and manufacturing. By advancing green infrastructure, increasing renewable energy consumption, developing circular economy, fostering green innovation through digital and intelligent technologies, strong policies, and global partnerships, Chongqing sets a strong example for other regions in China and beyond.

As Chongqing continues to transition from a traditional industrial base to a hub of green manufacturing and environmental innovation, the participation of stakeholders — from government

bodies to private enterprises and international partners — is essential. As a leading player in environmental services and a long-term partner rooted in Chongqing for more than 20 years, SUEZ is committed to fostering win-win cooperation in environmental protection and low-carbon development, particularly in the context of deepening relations between China and France.

Together, we can contribute to achieving the ambition that Chongqing not only meets its sustainability goals but also becomes a global leader in responsible development, contributing to a more sustainable future for all.

Leveraging Innovation in New Energy Vehicle Development to Drive Chongqing's Next Round of Industrial Upgrading

Bertrand Stoltz
EVP Finance and Asia Public Affairs
STMicroelectronics

Good morning, distinguished Secretary Yuan, Mayor Hu, and esteemed industry colleagues:

I'm Bertrand Stoltz from STMicroelectronics. It is an honor to be invited as a member of the Chongqing Mayor's International Advisory Council and to represent my company today. Our partnership began way back in the Covid pandemic period, and despite the many challenges we faced, the Chongqing Municipal Government, including the Foreign Affairs Office, the Exit-Entry Administration, and the High-Tech Zone, demonstrated remarkable efficiency, professionalism, pragmatism, and commitment throughout the entire process — from negotiations to the establishment of the Sanan-ST manufacturing joint venture. The JV will provide strong and reliable support to our Chinese customers for multiple applications in new energy vehicles and across multiple industrial applications. As a board member of this joint venture, I firmly believe that the establishment of our Chongqing factory will significantly advance ST's strategic positioning and business development and growth in China.

As one of the world's largest semiconductor companies, ST has a wealth of experience and a stable global supply system. We are recognized as a global innovation leader and committed to achieving carbon neutrality by 2027. ST's products and solutions offerings are widely used in NEVs, charging stations, power and energy, cloud-connected autonomous things, supporting the global industry's shift towards greener, more intelligent, and connected development. One of ST's key characteristics is its deep-rooted cooperation approach, with multiple long-term relationships with customers, suppliers, research organizations, some of them decades old today (including in Shenzhen where our manufacturing joint venture was created 30 years ago, in 1994).

As we all know, Chongqing, as the only municipality in the central and western regions of China, has always been a core area of China's strategic hinterland, with policy advantages, a strong industrial foundation, and tremendous significant innovation potential. In the automotive sector, Chongqing is home to many technologically advanced manufacturing enterprises. In the first half of this year, over 1.21 million vehicles were produced in the municipality, accounting for 15% of China's total output, ranking first among all cities nationwide. Of these, over 32% (390,000) were new energy vehicles (NEVs), with the fastest growth rate among the top ten provinces and cities in China. With these advantages, Chongqing is fully capable of integrating its innovative resources

to lead the buildup of a safe and stable supply chain in the NEV sector, becoming a leading hub in China's next round of opening up.

Based on ST's extensive worldwide experience, we humbly suggest that Chongqing could consider piloting and exploring the following areas:

- **Firstly**, introduce a more innovation-friendly policy framework for the NEV industry. Global experience shows that when technological innovation and policy frameworks are not aligned, it can greatly hinder the effective utilization of innovative resources. Chongqing could optimize market access policies in the NEV sector to address the challenge of "the door is open, but the path is narrow" encountered by multinational companies, offering them instead, localized treatment in line with companies that have secure and stable supply chains in China, and thereby unleashing their full potential to participate in China's domestic innovation ecosystem.

- **Secondly**, promote coordinated development between talent cultivation and industry-academia-research innovation in the automotive chip sector. The development of automotive chips requires extensive open innovation and high-end talent, both of which are strongly interlinked. Traditionally, talent cultivation and industrial innovation have been somewhat disconnected, limiting the potential for growth. We suggest that Chongqing, driven by the real, urgent, and strategic needs of automotive enterprises, support chip companies in integrating industry-academia-research resources to establish joint innovation centers. This would then facilitate breakthroughs in key technologies and foster the integration of high-end talent with practical industry needs.

Currently, China's emerging industries are at a critical juncture, fast moving towards the high end of the industrial value chain, making increased international cooperation and coordination more important than ever.

Looking ahead, ST is committed to the vision of "In China, For China", and will continue to strengthen and deepen its involvement in China. For instance, building on the foundation of the Chongqing silicon carbide joint venture, we are accelerating the establishment of a NEV Competence Center in Chongqing as well as increasing our sustainable development cooperation with Pengshui County. Through our solid technology ecosystem, we are confident in steadily advancing the momentum of green, smart, and high-end development of China's industries.

Together, we are not just contributing and driving the future of technology; we are certainly building a more sustainable and innovative world for generations to come.

Thank you.

Taking advantage of the concentration of manufacturing industries to become an innovation city

Kanetsugu Mike
Chairman, Mitsubishi UFJ Financial Group, Inc.

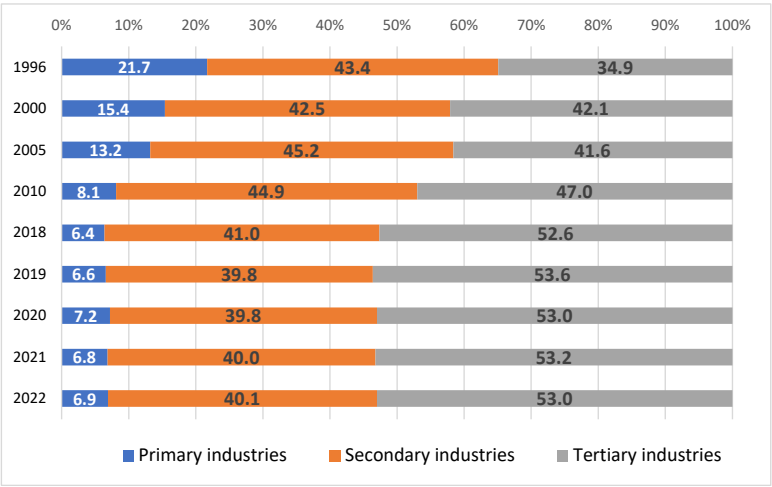
1 Current situation in Chongqing

- Development into one of China's leading industrial cities

Looking at the changes in the industrial structure of Chongqing based on gross regional product (GRP) [*][1], secondary industries, mainly manufacturing, have accounted for around 40% for around 30 years (Figure 1). This is a much higher proportion of the GRP than what is seen in cities such as Beijing and Shanghai (Figure 2). Moreover, the added value of secondary industries in Chongqing has also grown significantly in the last decade.

Chongqing has long been known as an inland industrial city where a variety of manufacturing industries are concentrated. In recent years, the automobile industry, which produces passenger cars and motorcycles, along with electronic components and advanced materials, which are key elements for building the supply chain, have become major industries, increasing added value. In the automotive industry in particular, the city is home to new energy vehicle manufacturers Seres Group (Sokon), Changan Automobile, and Lifan Group, as well as major automotive-related companies such as Changan Ford and Beijing Hyundai. Leading Japanese automobile and motorcycle manufacturers such as Honda, Isuzu, and Yamaha have also expanded into Chongqing, making the city a key global production base for Japan's transportation equipment industry as well.

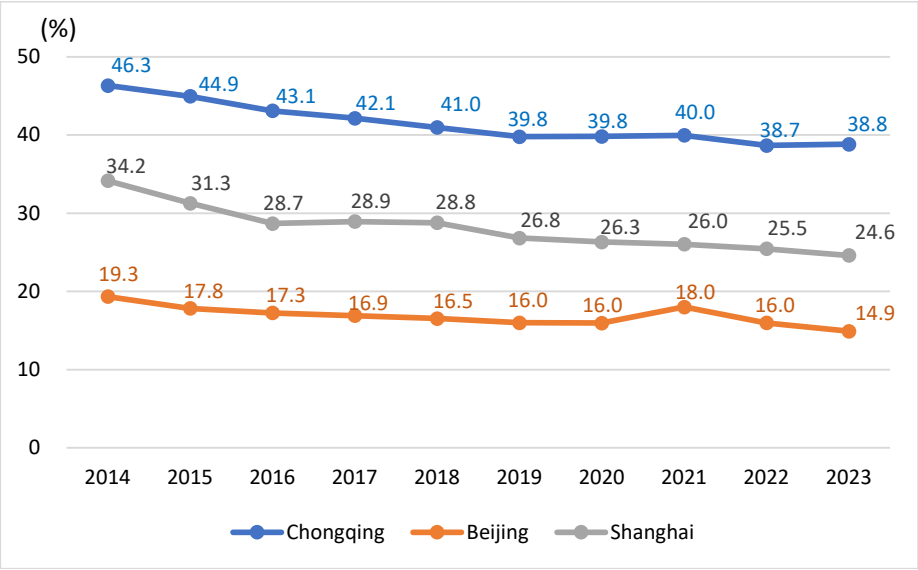
Figure 1: Trends in the share of gross regional product (GRP) by industry



Source: Chongqing Statistical Yearbook 2023

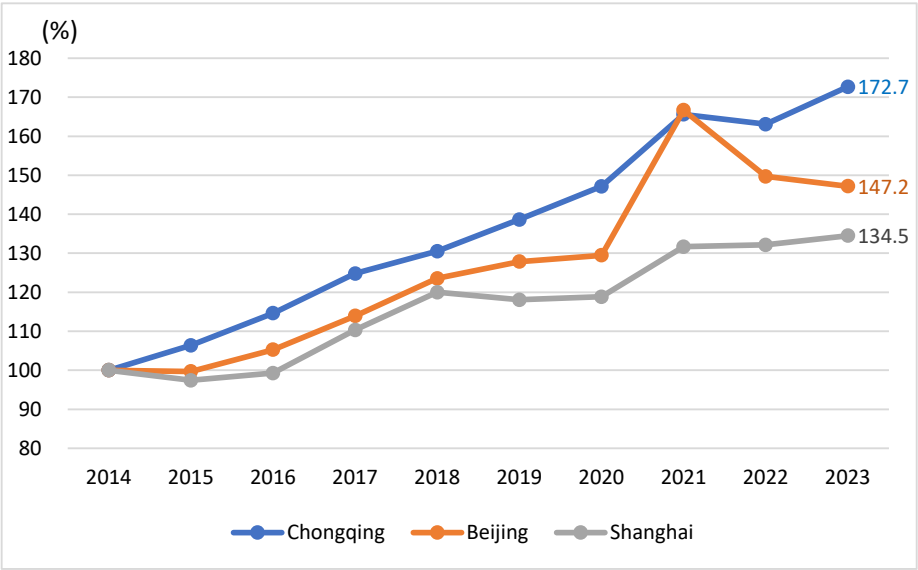
[1] https://tjj.cq.gov.cn/zwgk_233/tjnj/tjnj.html?url=https://tjj.cq.gov.cn/zwgk_233/tjnj/2023/2023cqtjnj.pdf Time series data on p. 37

Figure 2: Trends in the share of secondary industries in gross regional product (GRP) by city



Source: China Statistical Yearbook 2023

Figure 3: Trends in added value of secondary industries by city (2014 =100)



Source: China Statistical Yearbook 2023

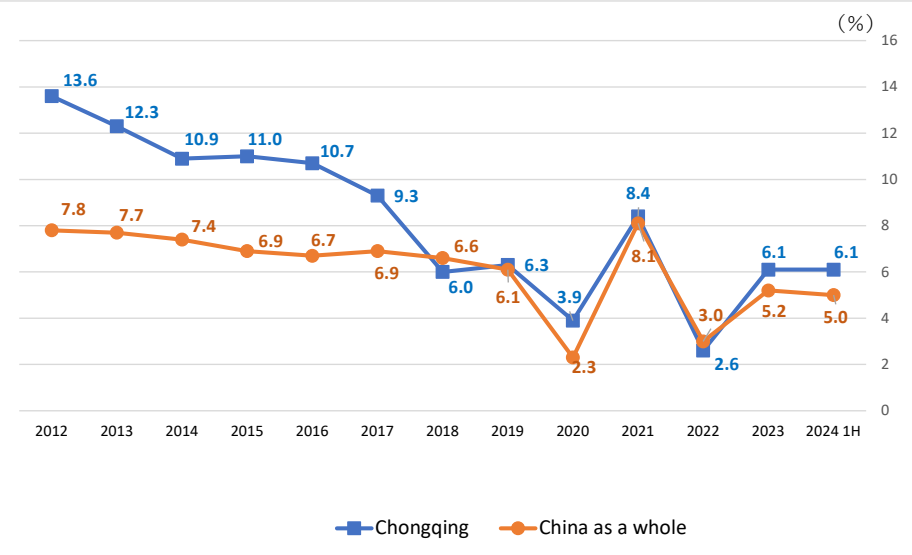
**As Beijing's 2021 figure stands out, we confirmed the data just to be sure.*

- New energy vehicles (NEVs) drive the local economy

Chongqing's economic growth in 2023 and the first half of 2024 outstripped the growth rate of China as a whole (Figure 4). By region, the 6.1% growth rate in the first half of 2024 was second only to the 6.2% recorded by the Inner Mongolia Autonomous Region. The strong sales of NEVs

by Seres Group and Changan Automobile were major contributors to these results. In particular, the Aito Wenjie, which was jointly developed by Seres and Huawei Technologies, sold briskly. In the first half of 2024, sales of NEVs under the Aito brand dramatically increased by 4.5 times (200,949 vehicles) over the same period of the previous year, supporting the growth of related parts manufacturers in the region. In July 2024, Seres acquired the trademark rights for Aito from Huawei and strengthened its intellectual property strategy. As its cooperative relationship with Huawei will continue, there are expectations that the advancement of Chongqing's automotive industry, including the development of NEVs and connected cars, will accelerate.

Figure 4: Trends in economic growth rates (China as a whole and Chongqing)



Original source: China Statistical Yearbook (for each year), Chongqing Statistical Yearbook (for each year)
Source: Compiled based on the JETRO Chongqing overview (June 2024) and business news updates (February 2 and July 29, 2024)

In fact, Chongqing is launching a series of policies aimed at upgrading the manufacturing industry. In March 2024, the Chongqing Municipal Government issued the Action Plan for Convenient Supercharging of New Energy Vehicles (2024-2025)[*][2], stating that by the end of 2025, NEVs and supercharging networks will be interconnected, connected to the electric power grid, and a convenient supercharging ecosystem equipped with advanced technologies will be constructed. The plan calls for more than 2,000 supercharging stations and more than 4,000 supercharging piles to be installed in the city. Through this action plan, Chongqing aims to help build a connected auto industry cluster in the city and promote the green transformation of the economy and society.

[2] https://wap.cq.gov.cn/zwgk/zfxxgkml/szfwj/qtgw/202404/t20240403_13104551.html

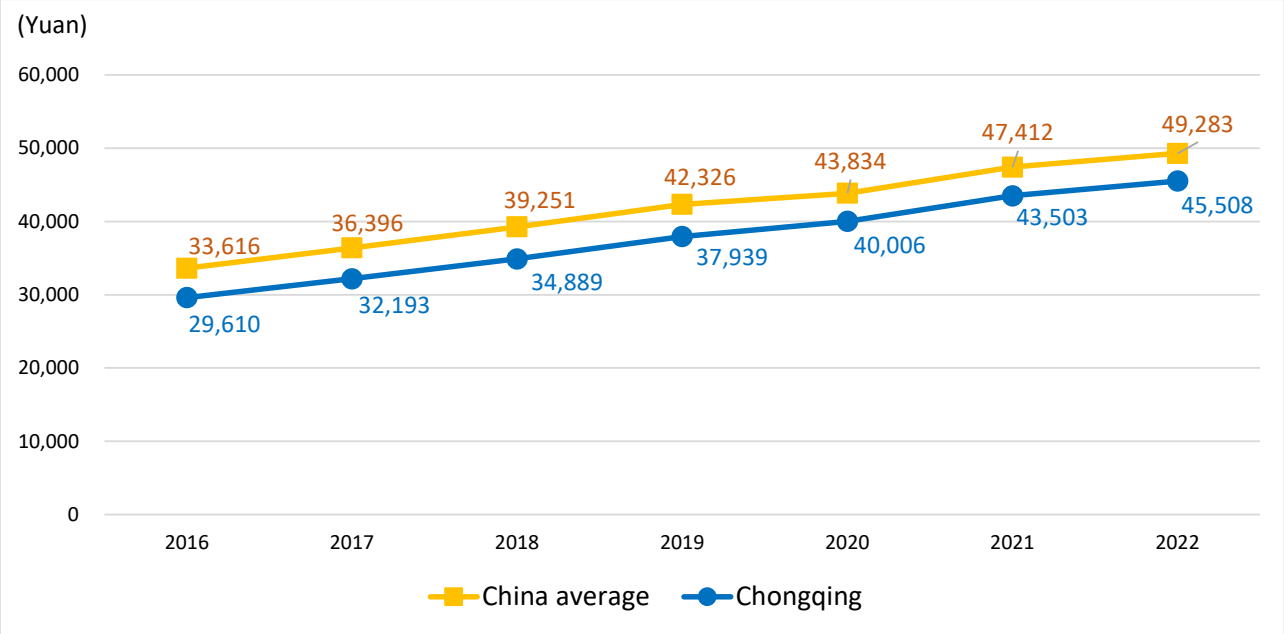
Meanwhile, in response to the March State Council announcement of an action plan to promote the renewal of large-scale production facilities and the replacement and trade-in of consumer goods, in April, Chongqing announced its own municipal-level action plan for the same. Along with support for upgrading of production facilities, consumers who trade in vehicles that meet certain conditions will receive subsidies of up to 3,000 yuan. There are expectations that these policies will spur economic growth through digitalization and greening, which the Chinese government aims to achieve.

2 The challenge of transformation from an industrial city to an innovation hub

Over the years, Chongqing has developed consistently to become one of China's leading industrial cities, and is now attracting attention as China's fastest-growing economic city, on par with Beijing and Shanghai.

On the other hand, because manufacturing still accounts for a large proportion of Chongqing's economy, it is easy to surmise that the transformation of the industrial structure, including the upgrading of the manufacturing industry, will be the key to Chongqing's future economic development. In terms of disposable income per urban household, Chongqing has unfortunately been below the Chinese average, and further upgrading of manufacturing, its key industry, will be a major challenge in the future to raise the local income level.

Figure 5: Trends in per capita disposable income of urban households (China as a whole and Chongqing)



Source: China Statistical Yearbook 2023

IT enterprises and startups will also be playing a greater role in fulfilling the upgrading of industry. In 2017, the Chinese government announced its Next-Generation Artificial Intelligence

Development Plan, which sets out the strengthening of AI as a key strategy for enhancing international competitiveness. The plan aims to raise China's AI technology to the most advanced level in the world by 2030, designating China's leading IT companies as core companies responsible for AI open innovation platforms in each of four key areas, including autonomous driving (Baidu), smart cities (Alibaba), medical imaging (Tencent), and voice recognition (iFlytek). The Chinese government has used this platform to support the digitization of state-owned enterprises and SMEs and investment in various startups, thereby accelerating innovation and the social implementation of AI in China. While Chongqing has produced many unicorn companies in recent years, more than 50% of China's unicorns are concentrated in Beijing, Shanghai, Shenzhen and Guangzhou. Chongqing is one of China's leading industrial cities, but it has yet to establish an image as one of China's leading cities for innovation.

As a manufacturing nation, Japan has long implemented various policies aimed at upgrading the manufacturing industry. In the past, this goal was achieved by focusing on support for advanced technology. However, with the rapid progress of IoT and AI in recent years, the barriers between industries are disappearing, and the competitive environment has drastically changed, with players from different industries entering existing markets and the creation of added value through products that have a “plus alpha” factor being required. In addition, any advanced technology must take environmental concerns into consideration, and taking measures to address carbon neutrality is now essential. It is becoming difficult for a single company to cope with such environmental changes and social issues, and various efforts are being made to overcome these problems.

In this paper, I would like to introduce two main patterns of initiatives in Japan that can be used as a reference for Chongqing to build an advanced manufacturing cluster.

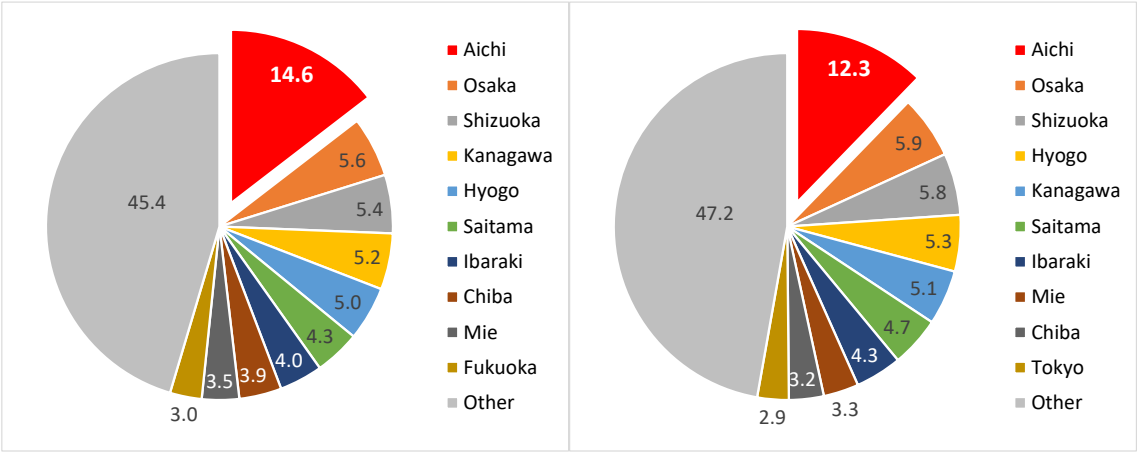
3 Case 1: Passing on legacy manufacturing clusters to next-generation industrial clusters

First, I will describe cases in which a region that was built up around and for the manufacturing industry is transforming itself into a next-generation industrial cluster in cooperation with leading local companies.

(1) Aichi Prefecture's Aichi-Startup Strategy

Aichi Prefecture, where Toyota is based, is known worldwide as the largest industrial area in Japan, and has been ranked number one in the nation in terms of value of manufactured goods shipped for 44 consecutive years since 1977. It also provides overwhelmingly higher added value than other prefectures, and the manufacturing industry plays an important role as the key industry in the region (Figure 6).

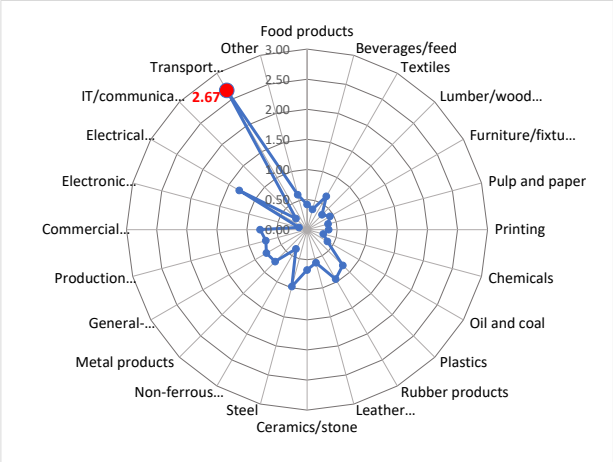
Figure 6: Distribution of value of manufactured goods shipped (left) and added value (right) by region (2020)



Source: Ministry of Internal Affairs and Communications and Ministry of Economy, Trade and Industry, 2021 Economic Census
(Note) Results for business establishments with four or more employees

However, despite the region having maintained robust economic power, the Prefectural Government of Aichi, home of Toyota, and the Chubu Bureau of Economy, Trade and Industry have been concerned about an industrial structure that relies on the manufacturing industry. In addition to the accumulation of a broad-based supply chain linked to the automobile industry, in Aichi Prefecture there is also an accumulation of companies in the electronic parts and aircraft industries, along with materials industries such as ceramics and steel. A comparison of the specialization coefficient with that of the national industry shows that Aichi's transport machinery industry has a remarkably high coefficient of 2.67 (Figure 7), indicating that Aichi Prefecture has a single-legged industrial structure extremely dependent on the automobile industry.

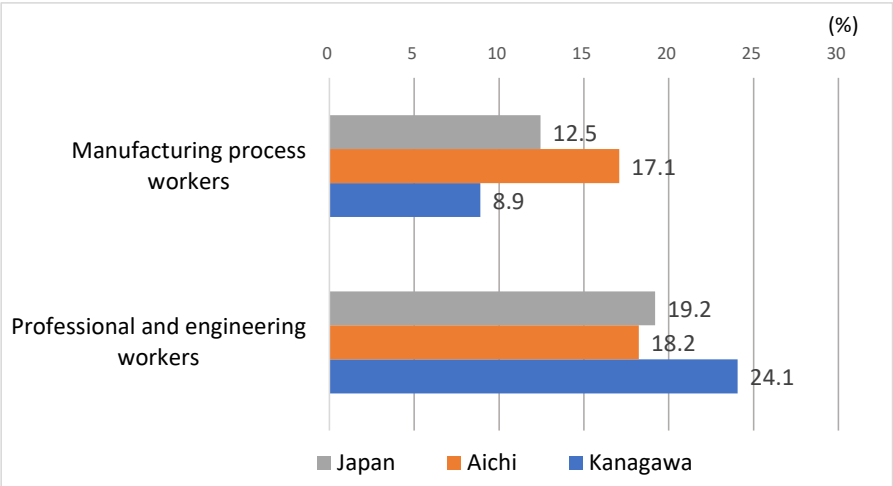
Figure 7: Coefficient of specialization by industrial classification for value of manufactured goods shipped in Aichi Prefecture (nationwide =100)



Source: Ministry of Internal Affairs and Communications and Ministry of Economy, Trade and Industry, 2021 Economic Census

In terms of employment structure, since manufacturing is the core industry in Aichi Prefecture, the ratio of "manufacturing process workers" is 17.1%, higher than the national average (12.5%), while the ratio of "professional and engineering workers"[*][3] is 18.2%, lower than the national average (19.2%). On the other hand, Kanagawa Prefecture, which ranks fourth in value of manufactured goods shipped and fifth in added value, has an extremely high ratio of 24.1% for "professional and engineering workers" and 8.9% for "manufacturing process workers," far below the national average. Kanagawa Prefecture has a high value-added industrial structure, with many corporate research and development centers (Figure 8).

Figure 8 Comparison of employment structures (2022)



Source: Compiled from Ministry of Internal Affairs and Communications, 2022 Employment Status Survey

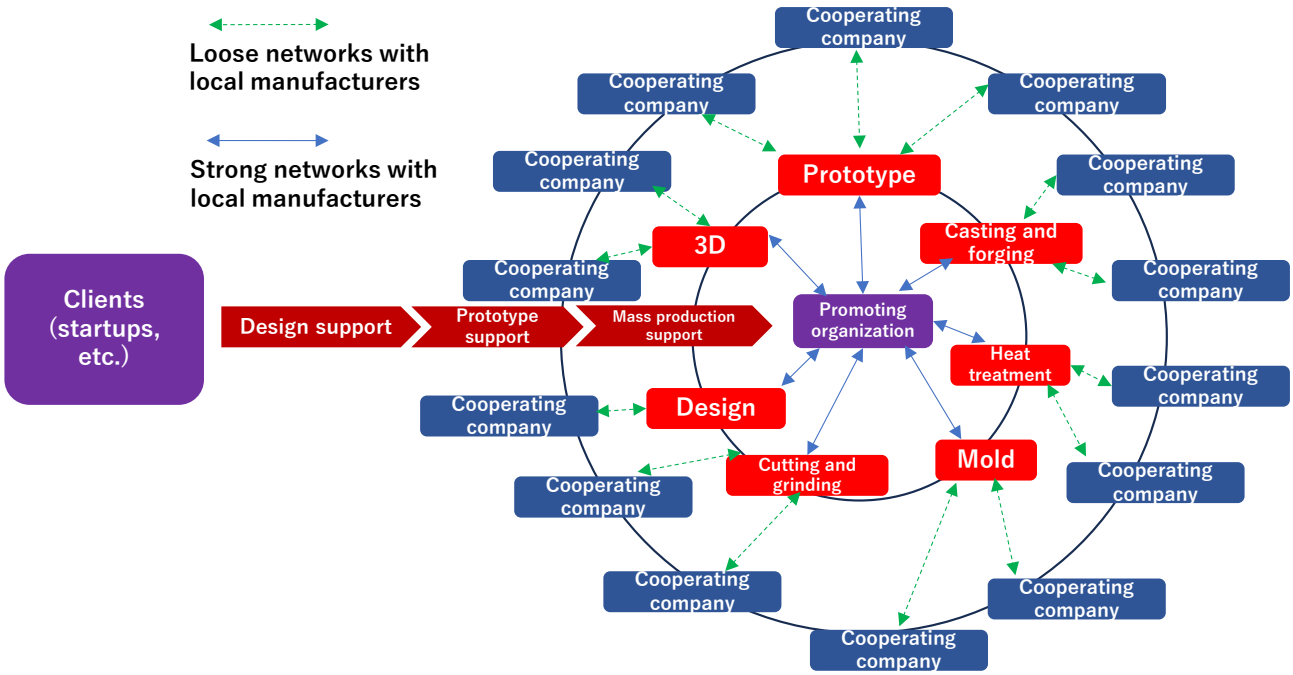
Collaboration with universities and other research institutes is essential for the advancement of industry. However, due to factors including the excessive strength of local manufacturing companies and the solid supply chain, Aichi Prefecture has had little industry-academia collaboration to date, and has lacked the basic elements needed to create startups. However, the rapid development and diffusion of digital technologies such as AI, IoT, and big data, which has become apparent in recent years, has led to a heightened sense of crisis not only in local governments but also in local industries. In the last four to five years, Aichi Prefecture has seen rapid changes, as industry-academia collaboration has gone into full swing and a number of high-profile startups have emerged.

This transformation is based on the 2018 "Aichi-Startup Strategy: Creating the Aichi Startup Ecosystem." The strategy was formulated with the idea that in order for the automobile industry, Aichi Prefecture's main industry, to overcome a period of major change that is said to occur only once a century, it will be essential to spark innovation by introducing best-in-class innovative

[3] [In the Basic Survey on Employment Structure, professional and engineering workers are defined as "a person who is engaged in technical work applying scientific knowledge, or in work of a medical, legal, educational, artistic or other professional nature at a high professional level. In order to perform this work, it is usual to require advanced scientific training and other specialized training at universities and research institutes, or equivalent practical experience or artistic creativity."]

business models and cutting-edge technologies, and to accumulate and expand knowledge and know-how for growth, and moreover, that the formation of a startup ecosystem in Aichi Prefecture is the most important tool for this purpose. The strategy aims to create innovative services and new markets by fusing the cutting-edge technologies of manufacturing companies with the new ideas and business models of startups through the formation of the Aichi Startup Ecosystem (Figure 9).

Figure 9 Aichi Monozukuri Network Project (an example of the Aichi-Startup strategy)



Source: Compiled based on Aichi Prefecture/Aichi-Startup Promotion Network Conference, Aichi-Startup Strategy

Scheduled to open in Nagoya in October 2024, STATION Ai will be Japan's largest incubation facility (Figure 10). This is not a project led by the national government, but is being promoted as a project under the direct control of Governor Hideaki Omura of Aichi Prefecture. The project is run as a private finance initiative (PFI) to maximize utilization of the managerial and technical capabilities of the private sector. Various support services will be provided through cooperation with startup support institutions and universities in Japan and overseas, and leading local companies such as Toyota are also scheduled to move in. There are great expectations for the sophistication and diversification of industry in Aichi Prefecture, which has been called Japan's "car kingdom," and the Chubu region.

Figure 10 External view of the STATION Ai building

Source: Aichi Prefectural Government website: https://www.pref.aichi.jp/press-release/stationai-open.html

(2) Hitachi's green transformation (GX) initiatives using a digital twin

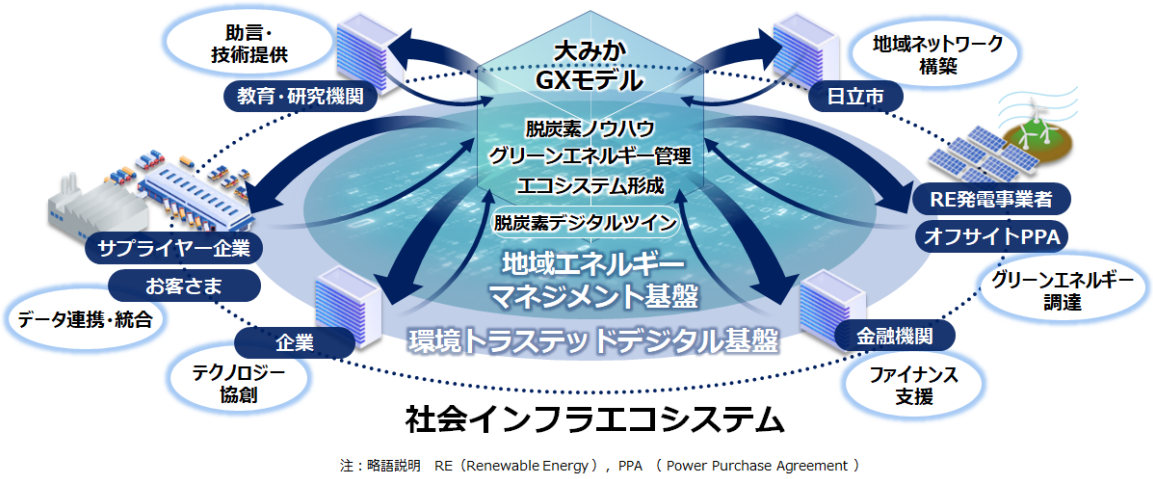
Ibaraki Prefecture, which prospered as an area that developed around Hitachi, ranks seventh in Japan in terms of the value of manufactured goods shipped, and manufacturing is still a key industry in the region. Hitachi's Omika Works, a factory which has been operating in Hitachi City, Ibaraki Prefecture, since 1969, is a comprehensive system factory that provides information control systems that support social infrastructure such as electric power, railways, steel, and water supply. Hitachi has long been working to provide digital solutions using IoT. Approximately 80,000 RFID tags, 450 RFID readers, and video cameras have been installed at Omika Works, creating a progress and operation monitoring system that provides a real-time, bird's-eye view of the dynamics of people and goods at the entire production site. In January 2020, Omika Works was the first factory in Japan to be selected by the World Economic Forum (WEF) as a Lighthouse, an initiative that designates the world’s most advanced factories.

Hitachi is using a digital twin of this factory to visualize electricity usage using power sensors installed at 900 locations in the factory, and is conducting various simulations based on a CO2 emissions model for the entire factory in a virtual space to demonstrate its efforts to achieve net-zero CO2 emissions. However, considering that it will be difficult for a single company or corporate group to achieve Japan’s target of carbon neutrality by 2050, Hitachi launched the Omika Green Network concept (Figure 11) in June 2022, and has been focusing on activities to provide

decarbonization solutions by conducting various decarbonization demonstrations with its Omika Works as the hub, in cooperation with partner companies and local communities. In addition, by combining the Omika GX model with the regional energy management infrastructure, Hitachi aims to build a system that enables procurement and optimal utilization of green energy throughout the region. In order for local SMEs to also decarbonize, Hitachi is also emphasizing cooperation with local governments and regional financial institutions that have support schemes for local SMEs.

Digital twin simulation is an indispensable tool for smart manufacturing, and by utilizing the technology for decarbonization and collaborating with various stakeholders in the region, Hitachi aims to build a social infrastructure ecosystem that can enable GX for the entire region.

Figure 11 Social Infrastructure Ecosystem Aimed for by the Omika Green Network



(Original source) Hitachi, Ltd.

Source: White Paper on Manufacturing 2023

4 Case 2: Supporting the industrial advancement of SMEs

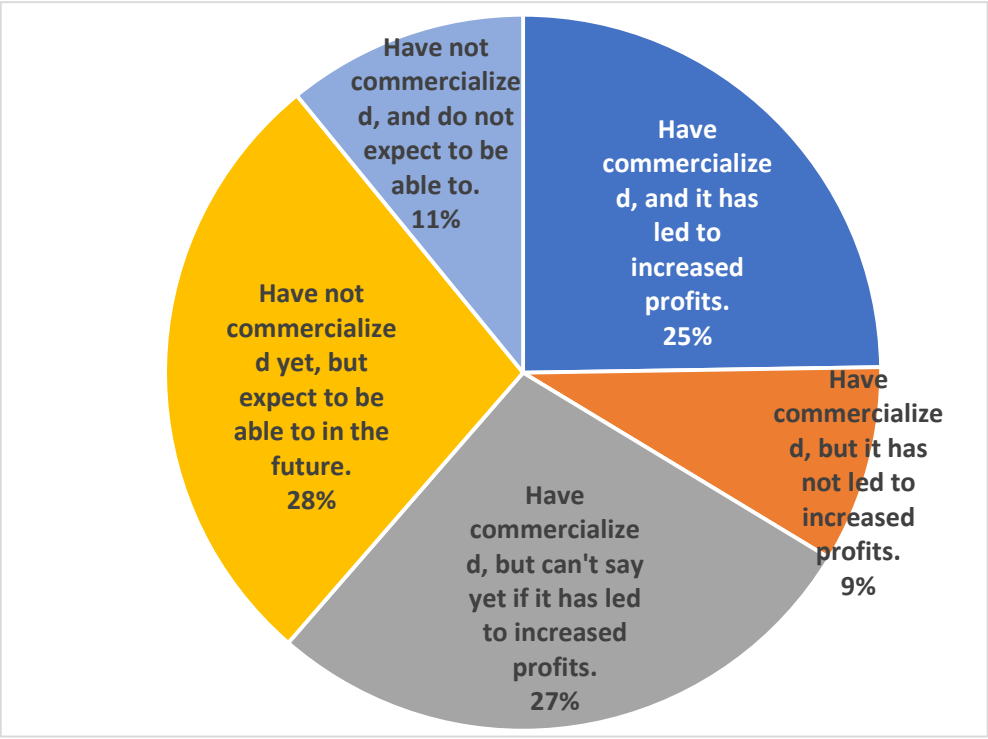
In Japan, small and medium-sized enterprises (companies with 300 or fewer employees or capital of 300 million yen or less) account for more than 99% of the total manufacturing industry, and approximately 65% of the total workforce (as of 2021). These SMEs have accumulated knowledge and know-how in production technology, and quite a few of them possess highly advanced technologies that are not available at large corporations. Supporting innovation by local small and medium-sized manufacturing companies is extremely important for upgrading local industries and forming clusters that lead to next-generation industries, and various support organizations have been established throughout Japan to support SMEs. This section introduces the latest initiatives for SMEs, which emphasize support for marketing, and examples of conventional initiatives that emphasize support for technological development.

(1) Support from innovation producers.

Since FY2023, Japan's Small and Medium Enterprise Agency (SMEA) has been publicly recruiting "innovation producers" to support SMEs in generating innovation and creating new products and services. Support for SMEs to date has focused primarily on supplementing the resources (people, goods, money, and information) that they are lacking. However, in light of the current situation in which many SMEs that have engaged in innovative activities have not been able to turn their achievements into profits (Figure 12), this project is a major step forward from past support for SMEs.

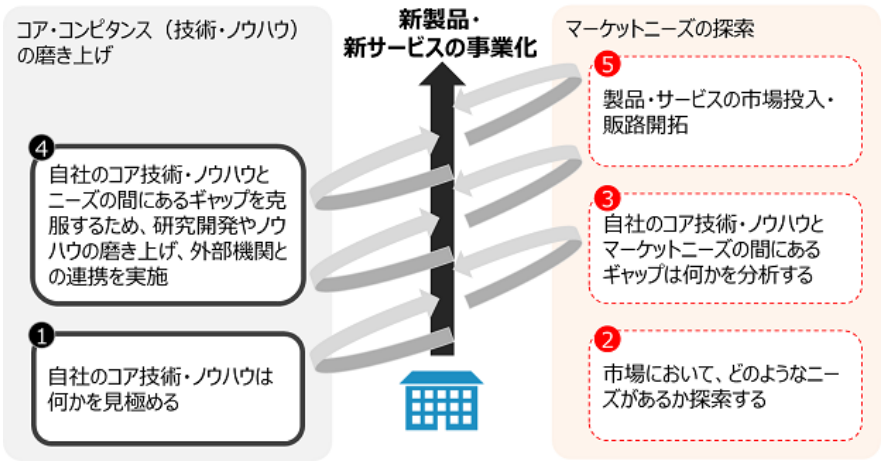
The aim is to create an innovation ecosystem for SMEs that will enable them to independently achieve growth through innovation during the transitional period of the industrial structure, such as the progress of digitalization, without having to settle for a subcontracting structure, while having innovation producers support SMEs in (1) analyzing their own strengths and describing them in words (many SMEs do not properly recognize their strengths and fail to appeal to the public), (2) strengthening their marketing capabilities to identify market needs, and (3) positioning their commercialization strategies and supporting their differentiation strategies (Figure 13).

Figure 12: Have you been able to commercialize new products and services as a result of your innovation activities?



Source: Survey on the State of Innovation at SMEs, commissioned by the SME Agency (2023 - Mitsubishi UFJ Research & Consulting Co., Ltd.)

Figure 13: Commercialization of new products and services through reciprocation between core technologies and market needs

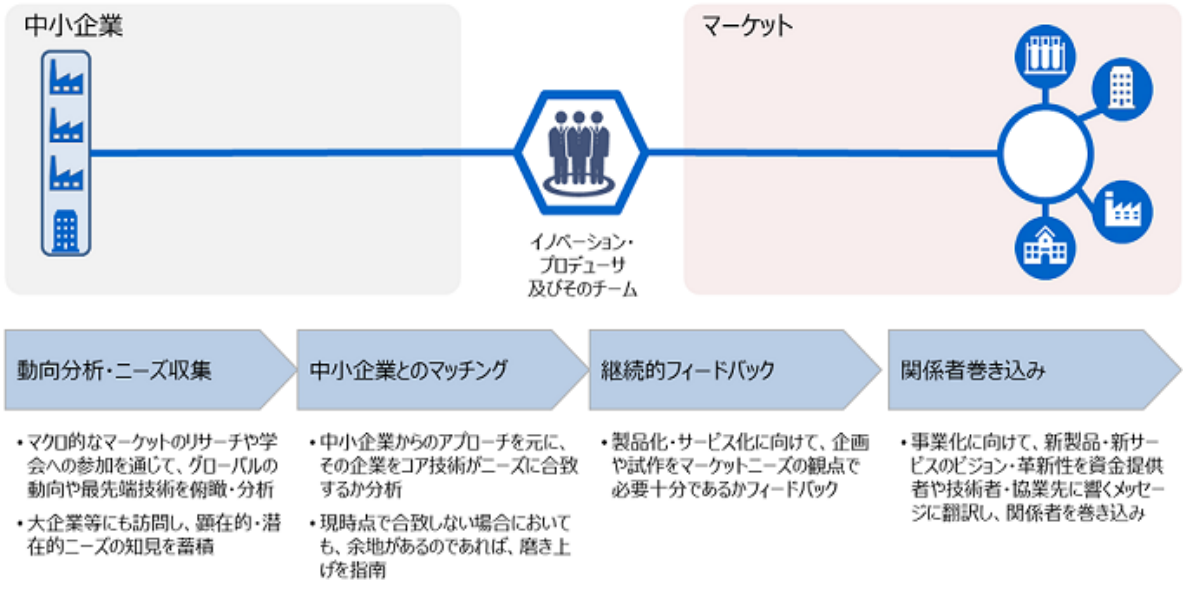


Source: SME Agency, Interim Report of the Expert Committee on Innovation by SMEs

**If you use this sketch, you can create a picture with the same concept.*

It should be noted that this measure was not created from the top down, but focused on carefully scrutinizing successful cases that led SMEs to expand their sales and develop new businesses nationwide, identifying that human resources functioning as enablers ("producers") were commonly involved in these efforts, and clarifying the capabilities required of "innovation producers." Efforts to link the innovation activities of SMEs to results are gaining momentum by dispatching professionals with the appropriate capabilities (Figure 14).

Figure 14 Competencies required for innovation producers



Source: SME Agency, Interim Report of the Expert Committee on Innovation by SMEs

**If you use this sketch, you can create a picture with the same concept.*

(2) Support by public research institutes.

In every prefecture in Japan, there are facilities that support research and development activities established by the national and local governments. In particular, public research institutes established by each prefecture play an important role in supporting the technological development of SMEs. The National Institute of Advanced Industrial Science and Technology (AIST), established by the Ministry of Economy, Trade and Industry, has the Council for the Promotion of Industrial and Technological Cooperation, which plays a role in coordinating all public research institutes in the 47 prefectures, providing a one-stop service to connect to AIST on difficult technical issues that cannot be solved at the nearest public research institute.

Support through public research institutes is a traditional form of support for SMEs to compensate for insufficient technological resources, and it also has the advantages of a good understanding of the local industrial structure and the ability to provide long-term, face-to-face support. For example, Gunma Prefecture, where Subaru has a base plant, ranks 13th in Japan in terms of the value of manufactured goods shipped, and has a large concentration of manufacturing industries such as automobiles, electronics, electricity, machinery, and food. The Gunma Industrial Technology Center, in cooperation with the coordinator of the Gunma Prefectural Industry Support Organization, is actively supporting the use of IoT and AI in local manufacturing industries, and has produced many successful examples.

A plastic injection molding manufacturer that was founded in the early 1970s has used digital technology to automatically obtain traceability (manufacturing information) for all its products, and has aggressively introduced AI and robots into its production lines. This has resulted in significant growth, with the company's 2022 sales 4.2 times higher, added value 2.3 times higher, and the number of employees 1.9 times higher than in 2006. The company has been reborn as a company capable of efficient manufacturing 24 hours a day, 365 days a year, even with a small number of employees. By making use of surplus resources created through its improved efficiency, the company has shifted to the production of high-value-added products, and has been commended by the Ministry of Economy, Trade and Industry as a model case of DX for SMEs. The Gunma Industrial Technology Center has long supported these small and medium-sized manufacturers, and has greatly contributed to the advancement of the manufacturing industry in Gunma Prefecture.

5 Building a modern manufacturing cluster system in Chongqing

(1) Support for matching with various stakeholders that form the regional ecosystem

As the pace of technological innovation accelerates, the business environment changes rapidly, and consideration for sustainability becomes essential, it is difficult even for leading companies to realize and sustain innovation alone. In order to advance the manufacturing industry in Chongqing,

it is desirable to support the formation of clusters through "co-creation" rather than "competition." Local governments are expected to play an increasingly important role in providing opportunities for matching with diverse stakeholders, dispatching coordinators to act as intermediaries, and providing one-stop services for receiving various types of consultation and support.

However, in forming a manufacturing cluster through co-creation, it is essential to clearly delineate the purpose of such co-creation, as seen in the case of the Omika Green Network, and to ensure the relevant parties have a clear and shared image for social implementation. If the region as a whole is to achieve zero CO2 emissions, as aimed for in the Omika concept, SMEs cannot be left behind. The idea is to involve governments and financial institutions, which have networks with SMEs. Clarifying the target end state will make it apparent which stakeholders to form partnerships with.

(2) Creating a place to incorporate startups' ideas and agility

Just as many companies cite new ideas and concepts as the purpose of collaborating with startups, the appeal of startups lies in innovative ideas and business models that lead to disruptive innovation. On the other hand, the weaknesses of hardware startups in particular are their procurement capabilities for mass production, along with production technology, quality control, and market development. Aichi Prefecture aims to attract entrepreneurs with innovative ideas from Japan and overseas and create new businesses and markets by matching them with local manufacturers with superior quality control and mass-production technology trained by the Toyota Production System.

China has three major startup ecosystems — Beijing, Shanghai, and Shenzhen — each having evolved their own unique ecosystem. France has also launched "Station F," said to be one of the largest startup campuses in the world. Its French Tech branding has been successful in drawing French entrepreneurs back from Silicon Valley, and with generous support, it is now attracting entrepreneurs from around the world. Aichi's STATION Ai is modeled after France's Station F, and Aichi Prefecture is collaborating with France on its opening.

As startups are expected to play an increasingly important role in the advancement of the manufacturing industry, Chongqing should also create its own place where entrepreneurs from all over the world can gather, and expand support to accelerate innovation through synergies with local manufacturing industries.

(3) Extensive support for SMEs in manufacturing

Economic growth dependent on a particular industry or firm entails risks in much the same way as one-legged management. In Japan, diverse local small and medium-sized manufacturers with

proven track records and a passion for the place where they began play a role in diversifying risks. They also provide behind-the-scenes support for manufacturing by major companies and startups that are leading the transformation of the industrial structure. In order to put the spotlight on these SMEs as well, Japan conducts various awards for SMEs.

In Chongqing, too, the role of SMEs is extremely important in promoting the diversification and advancement of industry. Therefore, it is desirable to take measures to provide SMEs with both technological and marketing support. In addition, efforts to boost motivation should be made to shine a spotlight on small and medium-sized manufacturers with potential. Support for SMEs may not be a quick fix for regional economic growth, but it can be expected to help cultivate a manufacturing network that will support Chongqing's manufacturing clusters 10 or 20 years from now.

To Drive the High-End, Intelligent and Green Development of the Auto Industry

Sam Wu

Vice President, Ford Motor Company,President and CEO, Ford China

Introduction

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Chapter 4: Driving the Green Development of the Auto Industry

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Introduction

Manufacturing is the lifeline of a country's economy, the foundation for building a powerful country, and the key to a country's global competitiveness. Given this, China has put forward a major strategic decision to build itself into a manufacturing power and unswervingly promote the high-quality development of the manufacturing industry. Chongqing, as a well-deserved important manufacturing city in China, has also determined to "focus on local manufacturing" and become "a manufacturing powerhouse city".

In 2023, Chongqing held a high-level conference to promote the high-quality development of the manufacturing industry in the whole city, formulated and implemented the *Action Plan for Deepening the High-Quality Development of the Manufacturing Industry in the New Era and the New Journey of Chongqing (2023-2027)*, to deploy and build a "33618" modern manufacturing cluster system, and kept consolidating the high-quality development trend of the local manufacturing industry.

As a "bright pearl" on the crown of the modern industry, the auto industry is recognized as one of the important symbols that can best reflect the national manufacturing strength. Therefore, the high-quality development of the auto industry is crucial to leading the high-quality development of the manufacturing industry. Chongqing is one of the major auto production bases in China. The data shows that in the first half of 2024, Chongqing's auto production reached 1.214 million units, ranking first among all cities in China. After several years of development, Chongqing's auto industry once again ushered in the highlight moment, returning to the position of "No.1 Auto City" nationwide. Therefore, Chongqing should actively learn from the experience and paths of high-quality development of the global auto industry and strive to drive the development of Chongqing's auto industry to a higher level.

From a global perspective, the auto industry is an ever-changing sector to meet consumer needs, make progress in technologies, and achieve innovations, comfort, and luxury. In the long journey of the auto industry, high-end models have always been the benchmark for leading innovations and luxury. Along with the economy development and improved consumers' taste, the high-end auto market will still maintain strong vitality. In addition, with the continuous progress and upgrading of technologies, the auto industry is experiencing an intelligent innovation, which not only involves automated and digital auto manufacturing processes, but also includes the optimization and upgrading of the entire industrial chain. Finally, green development has become a global consensus on tackling climate change, and ecofriendly autos have become an irreversible trend facing the future. Therefore, to keep pace with technological and societal trends, it is crucial to drive the high-end, intelligent, and green development of the auto industry, thereby achieving high-quality development of Chongqing's automotive industry.

As one of the largest auto companies worldwide, the Ford Motor Company (Ford) has a history of over 100 years and has accumulated vast experience in making cars and operations around the world, especially in technological R&D, manufacturing, marketing, and brand management. Having a deep understanding of the local industrial environment after years of operation in Chongqing, Ford is well-positioned to provide valuable advice and support for the high-end, intelligent, and green development of Chongqing's automotive industry, leveraging its international experience.

Upon Ford's international experience, this report will deeply analyze the high-end, intelligent and green development strategy and measures of the auto industry. The provides Ford's expertise and insights to the high-quality development of Chongqing's manufacturing industry and the construction of the "33618" modern manufacturing cluster system.

Chapter 1: Driving the High-Quality Development of the Auto Industry Is the Only Path for Chongqing to Achieve Its High-Quality Development

The auto industry is a top priority in the local economy and one of the important pillar industries in Chongqing.

The auto manufacturing history in Chongqing can be traced back to the 1950s. From the first automobile produced by Changan Machinery Factory to the exploration of military to civilian vehicle manufacturing, to the waves of the "motorcycle manufacturing cluster" and "motorcycle to automobile transition", and finally to today's "fuel to battery transformation", Chongqing's auto manufacturing industry has always played a pivotal role in the country. In the first half of 2024, Chongqing's auto production reached 1.214 million units, ranking first among all cities in China, and becoming a well-deserved "No.1 Auto City in China".

Chongqing's auto industry has a solid foundation for development and a perfect industrial chain. It has formed a relatively complete auto industry system. Auto industry plays an important role in contributing to GDP, employment, and taxation. According to the data released by Chongqing Statistics Bureau, in the first half of 2024, the growth rate of industrial added value in the city was 8.6%, while the growth rate of the auto manufacturing industry was up to 30.3%.

With the increasingly fierce competition in the Chinese auto market, the growth rate of the internal combustion engine (ICE) market has slowed down, and the emerging fields such as new energy vehicles (NEVs) and intelligent connected vehicles (ICVs) have developed rapidly. In order to cope with these new development trends and challenges, and realize sustainable development, Chongqing must drive the high-quality development of the auto industry and realize the transformation from scale expansion to quality improvement. Therefore, driving the high-quality development of the auto industry is the only path for Chongqing to build a modern manufacturing cluster system, which is also an inevitable choice for high-quality development. The high-quality

development of the auto industry is the only path for Chongqing to achieve its high-quality development.

Over the years, the Chongqing government has introduced many policies to stimulate and support the development of the auto industry, and set the following goals that by 2025, the annual production and sales volume of intelligent connected NEVs will exceed 1.5 million units, accounting for more than 10% in China, forming the prototype of a world-class intelligent connected NEVs' industrial cluster; by 2027, the annual production and sales volume of intelligent connected NEVs will exceed 2 million units, forming a 1-trillion-yuan industrial cluster. To achieve these goals, Chongqing's auto industry should focus on driving the high-end, intelligent, and green development of the auto industry.

Chapter 2: Driving the High-End Development of the Auto Industry

The high-end development of the manufacturing industry is an inevitable trend of the era. It is also an important path for different regions and enterprises to get rid of the fierce price competition at the low end of the manufacturing industry, enhance their competitiveness and achieve sustainable development. High-end manufacturing can better realize profits, improve the technical content of products, and enhance the value of the industrial chain.

This is especially true for the auto industry. In recent years, the rat-race degree of China's auto market is second to none across the globe, and the intensity of price war is unprecedented. To deal with vicious competition caused by the rat race, some enterprises even cut corners, make and sell fakes, which results in bad money driving out good money to some extent, and is not conducive to the long-term development of the auto industry.

Under this backdrop, it's even more necessary for auto companies to establish differentiated competition and gain market recognition and competitive advantage with higher technical barriers and brand advantages. As a multinational brand, Ford has also been exploring how to find a way suitable for its own development, so as to comprehensively launch a brand-new business strategy for Ford China according to the future development and competition trend of China's auto industry, including the following three core sectors:

- Focusing on core competencies, fully leverage the advantages of Ford's iconic products, sharpen the images of Ford and Lincoln to form differentiated advantages, and provide better products and experiences for customers.
- Deepening local collaborations for electrification by pooling resources and leveraging mutual strengths with partners to develop new energy products tailored for the local market, hastening the shift towards electrification.

- Accelerating vehicle exports by leveraging Ford China's strengths in product development, manufacturing efficiencies, and cost management along with the global brand's robust image and seasoned distribution network to significantly boost its complete vehicle export operations.

The strategy of focusing on core competencies, encompasses reinforcing the brand's pillars, enhancing product appeal, and enriching customer experiences to establish a more profound connection with Chinese consumers. As for focusing on the business, we should subdivide such three core business sectors the resilience of Ford's utility vehicles, the dynamism of our performance models, and Lincoln's embodiment of luxury. We should make the customers who like Ford love the brand more through the continuous innovation of our product technologies – concentrating on resilience, performance and luxury models is the secret of Ford's to achieve high-end development. In addition, allocating most resources to three core business sectors of resilience of Ford, dynamism performance and Lincoln's embodiment of luxury is also the main direction of Ford's efforts in Chongqing.

2.1 Resilience of Ford

Facing the increasingly diversified and personalized demands of Chinese consumers, Ford China has recently upgraded its all-new brand spirit to "Unleash Fun, Wild at Heart " according to the characteristics of its brand and products, hoping to constantly give consumers the power to move freely and pursue their dreams through a series of products representing the pleasure of driving, from urban commuting, family outdoor adventures to off-road driving, and to awaken the fun deep inside their hearts, that is, their desire for freedom, adventure and pleasure. Ford takes "wild" as the core advantage and soul of the brand, actively speeds up the launch of new products in the Chinese market, and releases a number of new brand models with strong road to off-road driving performance, thus finding its own direction in the fiercely competitive market.

The data shows that from January to July 2024, the sales volume of most mainstream joint ventures showed a decline: Among them, GAC Honda, Beijing Hyundai and GAC Toyota saw a decrease of more than 25% YoY in their sales volumes; FAW-VW saw a decrease of 10% YoY; FAW Toyota, Dongfeng Nissan and SAIC Volkswagen saw a decrease of less than 10% YoY; while the sales volume of Changan Ford increased by 7.8% YoY, making it the only brand with "a positive growth" among the mainstream joint ventures, which is inseparable from Changan Ford's strategy of going wild. Changan Ford has launched a series of models. Ford enhances luxury with the land-yacht Ford Explorer Timberline and the family adventure enabler Ford Edge L, both vehicles infusing exploration with pleasure and encapsulating Ford's 'Unleash Fun, Wild at Heart' brand spirit.

Taking Ford Explorer Timberline as an example, by inheriting the hard-core genes of Ford's SUV family and drawing design inspiration from the natural terrain, Ford builds a high-performance

flagship product Explorer Timberline, which can tackle tough terrains, from the aspects of unique style design, customized interior and stronger off-road performance. In terms of power, Ford Explorer Timberline is equipped with the fourth-generation 2.3T EcoBoost® Engine, which won a spot on the "Wards 10 Best Engines" list, with a maximum power of 276 horsepower, a peak torque of 425 Nm and a 10-speed automated manual transmission (AMT), which not only provide super power for this 5-plus-meter vehicle, but also enable it to have impressive fuel economy, just like Japanese cars. Moreover, Ford Explorer Timberline has further improved its off-road performance. After an upgrade, now it is equipped with a Torsen limited-slip differential on the rear axle, to reasonably distribute the torques of the left and right wheels on the low-friction unpaved road surface on which tires tend to slip, and help the vehicle to get out of trouble more easily.

In a manner of speaking, Ford Explorer Timberline, under the premise of maintaining the leading mechanical quality at the same level, satisfies more users, who want to enjoy smart luxury, strong performance and outstanding personalization, with a rougher style, a customized interior design, more advanced off-road configurations and diverse intelligent technologies.

2.2 Performance of Ford

"Performance" is one of the important characteristics of "high-end" models. On the high-end development path of the global automobile market, Ford has always built its brand image with performance. Ford's products have outstanding performance, which is not only reflected in surgent power output and control performance, but also in all aspects of the auto industry such as technological configurations, brand culture and sports event marketing. Ford has established a unique brand image on the high-end development path by constantly improving the performance and quality of its products. Nowadays when many auto companies are pursuing being amusing, pretty and big screen, Ford always remains true to its original aspiration and uncompromising performance, making it a role model for manufacturing companies to pursue high-end development.

As one of the most famous performance car brands in the world, Ford Mustang is the popularizer of American high-performance sports car culture, and it has sold a total of more than 10 million units all over the world. In China, Mustang is also the dream car of countless car lovers. At the end of 2023, Ford launched the new Mustang Dark Horse and the 2024 Mustang Mach-E in China. The fuel vehicle and the electric vehicle represent the unremitting exploration of Mustang in the direction of fuel engine and the synergistic effect in the direction of modern electrification, which once again raise Mustang's ultimate road driving experience to a new height.

Both the new Mustang® Coupe and Convertible models are equipped with the fourth-generation 2.3T EcoBoost® turbocharged engine, with a maximum power of 220 kW and a peak torque of 453 Nm. They adopt advanced engine technologies such as in-cylinder direct injection, variable cam timing and turbocharging. Moreover, thanks to the unique intake manifold and turbine

housing design, as well as Ford's SelectShift 10-speed AMT, the 0-100 km/h acceleration time of the new Mustang® Coupe model is 5.3 seconds, and that of the new Mustang® Convertible model is 5.6 seconds, awakening the inner passion at a superior speed. The Brembo® high-performance braking system with 6 front pistons and 4 rear pistons further improves the braking performance, distributes the braking force to the front and rear wheels more evenly, shortens the braking distance, and ensures the track-level high-strength performance requirements. Drivers can also customize the driving control mode through MyMustang to have fun with an individual driving mode. Six driving modes, including Normal, Sport, Slippery, Acceleration, Track and Custom, can be switched at will.

With such strong performance, they certainly are high-end cars. At Ford, high-end experience is achieved through performance. Ford firmly believes that the high-end development of the manufacturing industry is based on performance: high performance is the essence of the high-end manufacturing industry.

2.3 Luxury of Lincoln

In addition to the high-end hardware, the high-end auto industry is inseparable from the high-end brand as well. Through the luxury of Lincoln, our continuous efforts in products, marketing, brand and services have gradually improved Lincoln's image and market competitiveness, and its success also provides some experience for the upgrading of Chongqing's auto industry.

First of all, the high-end development should have a clear brand culture and brand positioning: Lincoln is a time-honored luxury brand. Since its inception, the brand has been taking "making top-class cars" as its mission, constantly breaking through innovation, always putting user needs at the center, and knowing well the lifestyle and scenario needs of luxury car users in China. The brand of Lincoln has an American luxury design language that keeps pace with the times. All products of the brand are designed with spacious space, high-quality materials, exquisite interior, strong power and comfortable ride, giving users a first-class ride experience. Lincoln is committed to bringing users a confident and calm luxury car experience and personalized exclusive services with the brand accumulation handed down from generation to generation and a unique luxury taste.

Secondly, the high-end development should have a rich brand connotation. As a time-honored luxury brand, Lincoln has always been in awe of luxury. With an original aspiration, perseverance and ingenuity, Lincoln has created the unique "Five Luxury Philosophy": aspirational yet inclusive, personally crafted, moments of sanctuary & discovery, understated elegance, and safety & credible wellness, aiming to bring users a "luxury, elegant and calm" lifestyle and emotional value!

Aspirational yet inclusive is to hold a bottom line when pursuing luxury, and refuse to build luxury with simple configurations, which is the grand aura brought by the style, durability and large space of all Lincoln cars. Personally crafted is the pursuit of texture and leisurely driving

experience, which is a full sensory pleasure car experience brought by all Lincoln cars through technologies and comfortable configurations, exquisite materials and high-end techniques. Moments of sanctuary & is the pursuit of internal quality, which is the top-class vehicle quietness created by a sound-deadening kit, an active noise cancellation (ANC) system, a new engine sound insolation suite, a double-layer sound insulation firewall of the engine compartment, sound insulation glass, etc., which creates excellent private cockpit experience for users. Understated elegance is not an external show-off, but a worry-free driving experience brought by excellent power reserves such as high horsepower, intelligent driving and an active suspension. Safety & credible wellness is to provide users with a safe and worry-free luxury car experience through internal, external, smart, healthy and valuable protection achieved by comprehensive and thoughtful active and passive security configurations.

Thirdly, the high-end development is not only about the brand and its products, but also about worry-free services. Lincoln has become the industry benchmark since the launch of " Luxury in your own way", providing customers with personalized and distinguished service experience through tailor-made exclusive services. The upgraded Lincoln Way Pro will create a butler-style service that integrates the online and offline channels, and provide a customized, exclusive and distinguished experience for the whole journey of customers.

The last one is the innovation power of a high-end brand. The brand of Lincoln will continue to seek innovations in its products, launch more high-end, intelligent and ecofriendly models, and maintain its brand competitiveness. The brand will create a complete luxury car ecosystem covering products, services, experience, culture, etc., and provide customers with all-around distinguished American luxury experience.

Lincoln's American luxury is defined from the user's perspective and the usage scenarios, which is a respect for users. Lincoln's way to be luxury is based on the "Legendary Luxury, Poised Elegance " brand core, and is committed to building confident, calm and great-taste products and creating experiences for users with excellent products and distinguished services.

In addition, Ford and its partner Changan Auto are actively negotiating and closely communicating on Lincoln's future products and business modes. We also expect to leverage Lincoln's further success to contribute to the high-end development of Chongqing's auto industry.

Chapter 3: Driving the Intelligent Development of the Auto Industry

With the rapid development of artificial intelligence (AI), big data and cloud computing, the auto industry should also accelerate its intelligent development, actively embrace intellectualization, and promote intelligent transformation in manufacturing and car driving.

3.1 Making the automobile manufacturing industry more intelligent

Ford has always been in a leading position in intelligent manufacturing, and constantly explores and applies new technologies to create an efficient, flexible and intelligent production system. For example, Ford has achieved digital transformation in multiple plants around the world, connecting all steps in the production process through digital platforms, to achieve real-time data collection, analysis and application, and improve production efficiency and quality. Ford widely adopts various types of robots, such as the welding, painting and handling robots, to replace workers to complete dangerous, repetitive or high-precision work and enhance production efficiency and safety. Ford applies the automation technology in production lines to realize automated material handling and production, and improve production efficiency and flexibility. Moreover, Ford is the first automaker to use Stratasys Infinite Build 3D printers, leveraging the 3D technology to print large-scale one-piece automobile parts, such as spoilers, for prototype vehicle production and future vehicle manufacturing.

Ford has also achieved a high level of mechanized production of its assembly line in China, by using a great number of advanced manufacturing equipment from home and abroad, such as the DURR monitoring equipment imported from Germany which supports the online monitoring of production, the ATLAS electric tightening tool from Sweden which can record assembly data based on fixed torque tightening operations, the vacuum filling equipment and software & hardware mistake-proofing system from France, thus effectively ensuring product quality.

3.2 Making the automobile products more intelligent

In 2020, Ford launched the world's first level 2 advanced driving assistance system (ADAS) that meets SAE standards—the BlueCruise Autonomous Driving Assistance (ADA) function. This function allows drivers to easily implement ADA on specific sections of expressways and urban highways, which can effectively alleviate the pressure and fatigue caused by long-distance driving and reduce the potential driving risks caused by human errors. BlueCruise integrates data from the ADAS map, cameras, radar sensors and the GPS positioning system. After being activated, the system will automatically determine whether the vehicle can switch to the " autonomous driving" state under the current road conditions, and remind the driver with an obvious sign on the dashboard. This function integrates full-speed self-adaptive cruise control and lane centering assistance, which can control acceleration, deceleration and steering simultaneously, truly realizing the effect of ADA.

For two consecutive years, Ford's BlueCruise won the first place in the evaluation report on the current mainstream ADA systems in the North American market by Consumer Reports, an authoritative magazine under the American Consumers Union. Among the ADA systems of 17 different automobile brands, Ford's BlueCruise ranks first in terms of functions and performance, maintaining driver participation, usability, defining conditions for safe use, and coping with drivers'

unresponsiveness, and has been unanimously recognized by the review experts of Consumer Reports. At present, users around the world have accumulated more than 200 million kilometers of driving distance with Ford's BlueCruise ADA system.

According to the latest statistics, BlueCruise has been adopted by more than 420,000 Ford and Lincoln models around the world. In the United States and Canada alone, Ford and Lincoln car owners have used BlueCruise for a total of more than 3.1 million hours, achieving an automatic driving distance of more than 340 million kilometers.

In the Chinese market, BlueCruise has been adopted by many locally-produced models including Ford's Mondeo, Edge L and Mustang Mach-E models, as well as Lincoln's Corsair, Nautilus, Aviator and Z models, covering more than 400,000 kilometers of expressways and highways in China. On the specific sections covered by the BlueCruise map, the vehicle equipped with BlueCruise can realize autonomous acceleration and deceleration within the speed range of 0-130 km/h, and keep the vehicle in the center of the current lane, without the need to control the accelerator and the steering wheel by the driver, which greatly reduces the fatigue caused by high-speed, long-distance driving and makes travel safer and easier.

Chapter 4: Driving the Green Development of the Auto Industry

Bill Ford, Executive Chairman of Ford, said: "Our industry is experiencing change at a remarkable rate and magnitude, and Ford is seizing this opportunity to lead and help build a better world". Just as he said, Ford always adheres to the sustainable development concept, reduces carbon emissions and waste, actively speeds up the electrification process, builds sustainable operations and industrial chains, and fulfills its corporate social responsibility by using recycled and renewable materials in vehicle design, and upgrading manufacturing processes and standards, in an effort to create an equal, inclusive and sustainable world.

4.1 Electrification

Ford will provide customers worldwide with multiple options, including a series of fuel, hybrid and battery electric vehicles (BEVs) with corresponding software and service, to meet the diversified needs of different customers and establish long-term and lasting customer relationships, thus promoting the company's electrification transformation into a new journey.

Ford devotes itself to expanding the portfolio of electric vehicles (EVs) and establishing a profitable and efficient EV business segment. In 2023, the sales volume of Ford's hybrid vehicles increased by 20%. At present, Ford's iconic BEVs include Mustang Mach-E, F-150 Lightning and E-Transit. In North America, Ford will expand its charging network, eliminate main obstacles to the adoption of EVs, and constantly improve its own fuel vehicle power system to achieve better fuel economy and meet increasingly stringent emission standards.

In China, under the guidance of its new strategy for the Chinese market, Ford is accelerating its electrification transformation by deepening cooperation with local partners. Especially in the R&D of NEVs, its local team will fully leverage all resources to develop NEVs that are more competitive and more in line with the Chinese market around the needs of Chinese consumers. In addition, Ford is also speeding up the launch of hybrid vehicles in the Chinese market. At present, five types of vehicles, including Ford's Mondeo and Edge L models, as well as Lincoln's Z, Corsair, and Nautilus, have launched their respective hybrid models. Ford provides customers worldwide with multiple power options, including a series of fuel, hybrid and battery electric vehicles. In particular, it devotes itself to expanding the portfolio of EVs and establishing a profitable and efficient EV business segment. In addition to serving the Chinese market, Ford China is actively expanding its export business. For example, Mondeo has been exported to multiple overseas markets, enabling more global consumers to experience the products made in Chongqing. In 2023, Changan Ford exported 50,000 vehicles and engines.

4.2 Green innovation

Ford is also making breakthroughs in the research and innovation of sustainable materials, such as the seat fabric made from recycled plastic bottles, sound insulation material made from denim waste, luggage compartment cover plate made from bamboo fiber, underbody cover made from waste tires and wire harness made from rice husk. The development and application of such sustainable materials will help reduce the company's dependence on petrochemical materials and lower its impact on the environment.

The fruits of olive trees are all over the world, which can be eaten as snacks and can be used to produce olive oil and sauce. But every year, olive tree pruning would produce 7 million tons of waste, most of which are burned or directly discarded. To mitigate this problem, Ford's engineers in Cologne initiated an innovative study to explore how to turn the discarded olive branches and leaves into biocomposites, so as to replace plastics to make more sustainable auto parts and support circular economy. Through heating and injection molding of 40% olive fiber and 60% renewable polypropylene plastic, they made the prototype parts of pedals and luggage compartments of vehicles. After performing related tests, the material engineers found that these prototype parts are not only strong and durable, but lighter. Ford is currently evaluating the possibility of implementing this process on a large scale to support the production of a new generation of EVs. The large-scale use of these olive tree wastes to make automobile parts can not only reduce the number of plastic parts in vehicles and the carbon footprint of automobile parts, but also avoid the incineration of these wastes, thus significantly improving local air quality.

Ford has a long history in the research and innovation of sustainable materials, some of which are finally used in its vehicles. For example, material engineers from Ford China, together with experts from related industries, extracted bamboo fibers and added them to the side carpet of Ford

Mondeo's trunk with a special process. Moreover, Ford is also the first automaker in the industry to use soybean-based foam materials for car seats and headrests. These more ecofriendly materials with lower carbon emissions have replaced the previously used petroleum-based polyurethane foam materials. In addition, Ford uses wheat straw as a cellulose reinforcing material, applies it to the storage box and cup holder in vehicles, and adopts the filling material made from rice husk to the motor cover. Recycled materials such as yogurt cups are used in the trunk inserts of Ford Mustang Mach-E, and the harness clips in Ford Bronco® models are made from recycled ocean plastic. These seemingly unimpressive materials can be continuously applied in Ford's models, fully demonstrating the company's pioneering and innovative spirit and sustainable development concept in the field of materials science.

At present, the number of bio-based materials used in Ford's mass production vehicles is increasing worldwide. Ford will continue to work with all partners across the globe to move towards its ambitious sustainable development goals.

4.3 Green production

It is crucial for Ford to follow the harmonious development of manufacturing and environment and improve the well-being of its employees and communities. Ford has established a global sustainability strategy aimed at maximizing its positive impact on society and the environment. Ford has outlined specific strategies and targets for addressing climate change, energy usage, water conservation, waste reduction, and more. For example, Ford is committed to achieving carbon neutrality globally by 2050, and has set a medium- and long-term carbon reduction target according to the Science Based Targets initiative (SBTi), devoting itself to establishing direct, open, transparent and frequent contact and interaction with stakeholders. The company is improving the environment by saving water, reducing industrial waste, and turn to zero-carbon electricity across the whole company.

- Water: Ford globally reduced its water usage by 19.4% between 2019 and 2023. Since 2000, Ford has saved over 750 million metric tons of water.
- Waste: Ford has achieved zero landfill waste at 86 of its global operating sites.
- Energy: In 2023, 70.5% of Ford's global production operations were powered by zero-carbon electricity. Ford plans to achieve 100% zero-carbon electricity for every vehicle produced in Michigan by 2026.

In China, Ford adopts various water-saving technologies in its manufacturing processes, such as the pretreatment electrophoresis process in the paint shop utilizes rotating immersion coating, reverse water washing, and dry spray booths. The plant has installed advanced wastewater treatment and reclaimed water reuse systems, where the reclaimed water is used for paint shop water

replenishment and cooling tower water replenishment. Additionally, the plant collects rainwater for landscaping irrigation, explores the potential for deeper cooling tower efficiency to increase its cycle rate, and implements pipeline leak repair and renovation, all ensuring continuous improvement in water efficiency.

Ford China continuously strives to promote waste reduction, recycling and reuse. Since 2021, all Ford plants in China have achieved zero waste to landfill, and all the waste generated by its plants will not be landfilled anymore, but will be recycled or burned to generate electricity. In September 2021, the Hangzhou Plant of Changan Ford was awarded the title of "Plant Without Waste" by the Hangzhou Municipal People's Government.

In terms of energy conservation and carbon reduction, Ford China has taken proactive measures to advance its carbon neutrality strategy and the use of renewable energy. Ford's plants in China have installed rooftop and parking lot solar panels with a total capacity of 11 MWp, significantly reducing carbon emissions and generating over 80 million kWh of electricity annually.

The Chongqing Plant of Changan Ford is committed to improving the production process and reducing the emission of volatile organic compounds (VOCs). The waste recovered solvent produced during the painting process in the plant is reused in the production line after advanced treatment, realizing circular economy.

Ford's factories in China are dedicated to translating strategy and goals into practical actions, achieving commendable results in sustainability. In March 2023, Changan Ford's Chongqing plant received national-level Green Factory certification.

4.4 Green governance

Ford has established a strict internal control system to ensure the accuracy and transparency of financial reports. To meet this goal, Ford has set up not only an independent board of directors, but also several committees, such as the audit committee and remuneration committee, to supervise the operation and management of the company, so as to protect the interests of shareholders and employees through effective governance mechanisms.

The global supply chain is a vital part of Ford's measures to achieve carbon neutrality in an all-round way, and the cooperation with trusted third parties will help the company to drive continuous improvement on a global scale. On the supply chain side, Ford is committed to establishing and maintaining a mutually beneficial supplier relationship based on trust and transparency, and ensuring that all suppliers can meet its ethical and sustainability standards. As the first automaker to join the Responsible Business Alliance (RBA), Ford follows very strict principles in the management of supply chain. The company establishes terms and requirements with suppliers and sets specific targets for reducing emissions. All the products manufactured and purchased by Ford must not only

comply with local laws, but also meet its commitment to environmental protection. In addition, Ford helps suppliers to create an effective supply chain management system, and especially in environmental protection, assists suppliers to establish a tracking mechanism for energy consumption and greenhouse gas emissions.

4.5 Green social responsibility

When it comes to corporate social responsibility (CSR), Ford has established a foundation in 1949. So far, the foundation has cooperated with non-governmental organization (NGOs) in 43 countries around the world to jointly serve local communities. By 2021, Ford and its foundation had invested a total of USD 74.4 million of public welfare funds in the fields of healthcare, environmental protection, career training, public literacy and STEM. In 2020, the worst period of the COVID-19 pandemic, it donated 11 Ford Transit Negative Pressure Ambulances to Wuhan; and from 2020 to 2022, it customized and produced nearly 8,000 professional ambulances.

"Ford Conservation & Environmental Grants, China (CEGC)" is a global public welfare program initiated by Ford, and it was launched in Britain in 1983. Its purpose is to encourage people from all walks of life to actively protect local environment and natural resources. In the Chinese market, since 2000, Ford has devoted itself to including environmental protection, community volunteer service, support for youth's innovation, and natural disaster prevention & mitigation as important parts into its commitment to building a better world. It has successively launched the CEGC, Ford Volunteer Corps, Ford UCAN and ForDR, and integrated them into Ford's public welfare program to "build a better world". Up to now, the CEGC has funded 500+ outstanding environmental protection institutions or programs, by donating a total of nearly RMB 35 million. In the Ford Volunteer Corps, 20,000+ Ford employees and their family members have participated in various public welfare activities, including those providing support for communities, with a cumulative service time of 120,000+ hours, and have raised RMB 7+ million for public welfare organizations. The Ford UCAN has provided support for 660+ innovation programs by young people from 165 universities around the world, and nearly 4,000 young people have received nearly 10,000 hours of training and coaching.

Chapter 5: Conclusion

As a world-renowned automaker, Ford has accumulated rich experience in driving the high-end, intelligent and green development of the auto industry, and its development path can provide important experience for the high-quality development of Chongqing's auto industry.

As for driving high-end development, Ford has successfully achieved high-end development of its products by focusing on its core competencies and creating three core business sectors: Resilience, Performance and Luxury. Chongqing's auto industry can learn from Ford's experience,

focus on its own advantages, create differentiated competitive advantages, avoid falling into the quagmire of a low-end price war, and achieve high-end development by strengthening brand positioning, building a unique brand image and culture, enhancing brand premium ability, improving product quality, manufacturing competitive products, actively expanding high-end markets, and meeting consumers' demand for high-quality personalized products.

As for driving intelligent development, Ford strives to improve the level of intelligent manufacturing by strengthening digital transformation and adopting robot and automation technologies to enhance production efficiency and product quality, actively improves the level of intelligent driving, and actively develops intelligent driving technology to promote the application of technologies such as autonomous driving and Internet of Vehicles, and improve driving safety and comfort.

As for driving green development, Ford implements the concept of sustainable development and builds a green auto business. Ford promotes electrification transformation by strengthening cooperation with partners, actively develops and applies sustainable materials to reduce its environmental impact and enhance the ecofriendly performance of its products, optimizes production processes to reduce resource consumption and carbon emissions and build a green manufacturing system, and constantly establishes sound green governance mechanisms to promote the green development of the supply chain and fulfill its corporate social responsibility.

To sum up, driving the high-quality development of the auto industry is the only path for Chongqing to achieve high-quality development. Chongqing's auto industry should learn from Ford's successful experience, follow the direction of high-end, intelligent and green development, strengthen technological innovation, optimize the industrial structure, improve the policy system, and build an auto industry cluster with international competitiveness, so as to inject new vitality into Chongqing's economic development and help the city achieve high-quality development.

Developing Intelligent Manufacturing to Propel the AI Industry and Build Chongqing into the Capital of Intelligent Manufacturing

So Jinwoo
Vice Chairman of SK Group

1. Developing Intelligent Manufacturing as the Strategic Direction for Chongqing's Industrial Upgrade

- 1.1 Intelligent manufacturing promotes the transformation and upgrade of traditional industries
- 1.2 Intelligent manufacturing promotes industrial structure optimization

2. Chongqing's Strengths and Challenges in Developing Intelligent Manufacturing

- 2.1 Solid industrial base for manufacturing
- 2.2 Chongqing Municipal People's Government's policies and action plans to encourage intelligent manufacturing development
- 2.3 Chongqing's weakness in innovation capacity and AI industrial development

3. International Experiences and Case Studies in Intelligent Manufacturing

- 3.1 Experiences of developed countries in promoting intelligent manufacturing
- 3.2 Cases of international enterprises in the innovation of intelligent manufacturing

4. Suggestions for Chongqing's Development of Intelligent Manufacturing and Building into a "Smart Manufacturing" Capital

- 4.1 Joint construction and sharing of intelligent manufacturing infrastructures
- 4.2 Incentive program
- 4.3 Cultivation of inter-disciplinary talents in large quantity

5. Conclusion

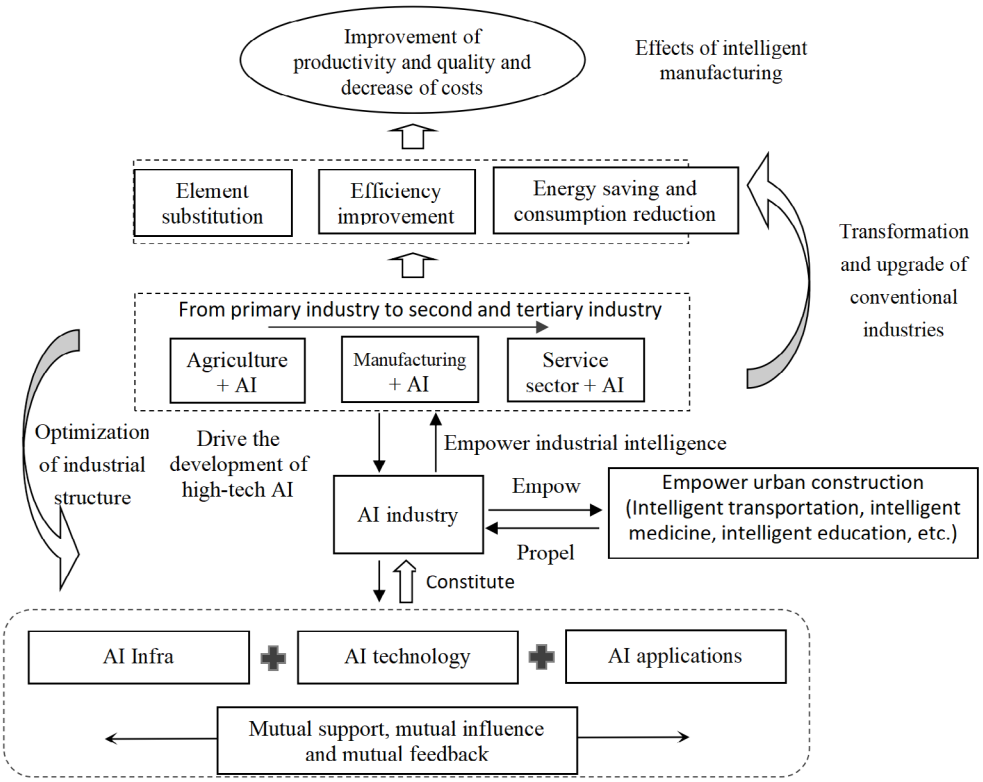
Chongqing is an important manufacturing hub in China and plays a key role in the country's strategy to become a "manufacturing powerhouse." During his inspection in Chongqing in April 2024, President Xi Jinping emphasized the need for the city to leverage scientific and technological innovation and to drive high-quality development in the manufacturing sector. A workman must first sharpen his tools if he is to do his work well. In the current era of rapid AI advancement, Chongqing should harness recent scientific and technological breakthroughs to drive innovation and transformation in its manufacturing industries, develop intelligent manufacturing, boost the AI industry, and position itself as a leading city in intelligent manufacturing not only in China but on the global stage.

1. Developing Intelligent Manufacturing as the Strategic Direction for Chongqing's Industrial Upgrade

1.1 Intelligent manufacturing promotes the transformation and upgrade of traditional industries

Chongqing boasts well-established industries in equipment manufacturing and consumer goods, with significant clusters in sectors such as automobiles, machine tools, electronics, and food. However, there is an urgent need for these industries to shift focus from expanding scale to enhancing quality, moving toward high-end, intelligent, and green development. To achieve these strategic developments, industries must accelerate their adoption of AI technologies to upgrade processes, deploy intelligent equipments, and transform production methods. These efforts aim to increase productivity, improve product quality, boost economic efficiency, and enhance market competitiveness. Additionally, in the face of saturated traditional product markets, intelligent manufacturing can facilitate product innovation and lead consumer upgrades (see Fig. 1). According to PwC, AI holds significant potential to empower traditional industries. By 2030, AI empowerment is expected to contribute $15.7 trillion to the global economy, with about 42% of this growth stemming from productivity improvements and 58% from consumption upgrades spurred by AI.

Fig. 1 Interaction Mechanism between Industrial Optimization and Upgrade and AI



1.2 Intelligent manufacturing promotes industrial structure optimization

Many practices and studies have demonstrated that developing intelligent manufacturing fosters industrial structural upgrades. First, intelligent manufacturing is evolving toward a service-oriented model, giving rise to new services, such as industrial design, O&M services, rental of facilities, and crowd outsourcing. Second, intelligent manufacturing drives the growth of related industries, including industrial softwares, industrial internet, IoT, data processing, and AI application services, thereby creating higher-value-added productive forces (see Fig. 1). Studies indicate that for every one percentage point increase in AI applications, the level of industrial structure sophistication rises by 4.86 percentage points. For Chongqing, developing intelligent manufacturing can gradually mitigate its current reliance on certain industrial sectors and enable it to seize the high ground in new quality productive forces.

2. Chongqing's Strengths and Challenges in Developing Intelligent Manufacturing

2.1 Solid industrial base for manufacturing

A robust industrial base is a prerequisite for the development of intelligent manufacturing. In 2023, Chongqing's secondary industry sector contributed RMB 1.17 trillion in industrial-added value, placing it second nationwide. Currently, the city is home to 7,860 industrial enterprises and

5,000 SMEs specializing in innovative and unique technologies. Key industries, such as smart vehicles, next-generation electronics, and advanced materials, have formed modern manufacturing clusters. Leading enterprises, such as CHANGAN AUTO, Tech-Front Computer, BOE Optoelectronics Technology, Loncin Motor, and Chongqing Iron & Steel, have made notable strides in intelligent manufacturing production models. Additionally, Chongqing hosts key semiconductor manufacturing enterprises, such as CR MICRO (wafer manufacturing), SK Hynix (package test), CETC (chip manufacturing), and STMicroelectronics. As the world's largest production base for laptops and smartphones, the city also boasts a growing industrial robotics sector. These strengths position Chongqing well to advance its intelligent manufacturing capabilities.

2.2 Chongqing Municipal People's Government's policies and action plans to encourage intelligent manufacturing development

In 2023, the city released the Action Plan for the Digital Transformation of Manufacturing (2023-2027) and the Action Plan for the High-quality Development of Intelligent Equipment and Intelligent Manufacturing Clusters (2023-2027). These plans outline 11 industrial clusters, including intelligent terminals, industrial robots, intelligent connected cars, intelligent manufacturing equipments, and intelligent supercomputing. In addition to seeking support from central government funds, Chongqing has attracted various forms of industrial investments to fund major technological innovations in intelligent manufacturing.

By the end of 2023, the city had implemented 6,725 intelligent transformation projects and recognized 144 intelligent factories and 958 digital workshops, yielding impressive results. Statistics show that enterprises implementing intelligent transformation contributed over 70% of the city's increased value of gross output.

2.3 Chongqing's weakness in innovation capacity and AI industrial development

Despite these achievements, Chongqing's overall level of digital transformation in manufacturing still lags behind that of more economically developed coastal cities. According to the Report on Digital Transformation and Development Index of Manufacturing (2024) issued by the China Software Industry Association, Chongqing ranks 10th among the 50 key cities for manufacturing digital transformation, behind Shanghai, Beijing, Shenzhen, Guangzhou, Hangzhou, Nanjing, Tianjin, Suzhou, and Chengdu. While Chongqing is relatively strong in hardware metrics, it falls behind in areas such as IT software, mode transformation, and comprehensive integration.

Additionally, in the ranking of China's New Generation Al Technology Industry Region Competitiveness Evaluation Index (2024) issued by the Chinese Institute of New Generation Artificial Intelligence Development Strategies, Chongqing ranks in the mid-range among 31 national provinces, municipalities, and autonomous regions but falls significantly behind the national 5th province, especially in AI innovation, resource integration, and government guidance (see Table 1).

Table 1 Ranking of AI Technology Industry Region Competitiveness Evaluation Index of Major Provinces and Municipalities (2024)

Ranking by indicator	Chongqing	Beijing	Guangdong	Shanghai	Primary considerations
Corporate capacity	14	1	2	3	Number of AI enterprises and innovation capacity
Academic ecology	18	1	2	5	Innovation capacity of universities and scientific research institutes
Capital environment	14	1	2	3	Number of financing relations/amount of financing and number of investment relations
International openness	16	1	2	3	Integration of international resources
Ability of linking	15	1	3	2	Ability of linking industry, university, and research
Government response	18	6	1	4	Number of industrial parks and governmental policies
Comprehensive ranking	16	1	2	3	

3. International Experiences and Case Studies in Intelligent Manufacturing

3.1 Experiences of developed countries in promoting intelligent manufacturing

(1) Germany: Unite enterprises to establish unified standards and develop industry 4.0 with cyber-physical systems (CPS) at the core

In 2012, Germany launched its Industry 4.0 High-tech Strategic Plan, with the intelligent factory as its central focus. The plan encourages collaboration between manufacturers and IT firms to develop cyber-physical systems (CPS) and unify relevant technological standards, thereby driving the intelligent transformation of manufacturing for different sectors. CPS refers to the standard specification system that integrates IT and industrial technologies, enabling enterprises to achieve the integration of information systems and data sharing, and based on this foundation, to develop distinct transformation models for manufacturing.

(2) Korea: Establish an intelligent manufacturing industry alliance and support pilot demonstration and talent cultivation

In May 2024, to promote intelligent manufacturing, the Korean government released the AI Intelligent Manufacturing Strategy 1.0, which includes the following measures:

① Establish the AI Intelligent Manufacturing Alliance to build a friendly ecosystem. Members of the Alliance include government, research institutes, associations, major enterprises of different sectors, etc. The Alliance coordinates efforts in industry-university-research collaboration, data sharing and utilization, legal framework improvements, and inter-ministry cooperation.

② Support AI Intelligent Manufacturing Innovation through concentrated funding for large pilot and demonstration projects.

③ Train 13,000 professionals and fostering over 250 specialized companies under a "local-led, central-supported" model.

From these examples, we can observe that standardization plays a critical role in enabling enterprises to develop intelligent manufacturing solutions at multiple levels, from technical systems to management. It addresses challenges related to system interoperability and data sharing, meeting both internal needs for intelligent transformation and external supply chain management requirements.

Additionally, establishing an alliance that unites manufacturing and AI enterprises for joint research and development efforts is an important governmental measure for advancing intelligent manufacturing.

3.2 Cases of international enterprises in the innovation of intelligent manufacturing

(1) SK C&C: Comprehensive integration of various intelligent systems.

SK C&C, an IT system integration enterprise under SK Group, specializes in intelligent manufacturing solutions and has extensive experience in the field. The company excels at integrating and connecting previously isolated enterprise systems, such as workshop production management, equipment management, logistics management, warehousing management, supply chain management, financial management, and human resources, into a more comprehensive and intelligent management system. In recent years, SK C&C has successfully upgraded several domestic and international enterprises with intelligent solutions, achieving significant results.

In 2016, SK C&C transformed Foxconn's printer production line in Chongqing, incorporating intelligent scheduling, automatic material delivery, fully digitized production process management, and a paperless, unmanned, and fully recorded system of intelligent manufacturing. This created a cloud-based, intelligent, mobile, and eco-friendly factory, reducing labor costs by about 35% and increasing output by approximately 25%.

(2) Pohang Iron and Steel: Utilize AI technology to achieve precise control over the production process.

Pohang Iron and Steel, one of the world's earliest and most successful lighthouse factories, developed the intelligent manufacturing platform PosFrame, which integrates IoT, sensors, big data, machine learning, and other AI technologies. This platform automates the monitoring of the production process across various factories and production stages, enabling timely detection of quality issues, causal analysis, and swift correction. By reducing labor costs and minimizing human error, the platform significantly improves production efficiency (refer to Attached Table 1). After four years of intelligent transformation, Pohang Iron and Steel saved approximately KRW 250

billion (USD 1.3 billion) in operational costs.

These cases demonstrate that advancing intelligent manufacturing requires both AI enterprises to provide cutting-edge technological services and manufacturing enterprises to develop solutions tailored to their specific needs.

4. Suggestions for Chongqing's Development of Intelligent Manufacturing and Building into a "Smart Manufacturing" Capital

4.1 Joint construction and sharing of intelligent manufacturing infrastructures

(1) It is recommended the Chongqing Municipal People's Government, in partnership with enterprises, should consider jointly build a public technology service platform. The platform can facilitate R&D collaboration between manufacturing and AI enterprises, ensure compatibility between complete-machine enterprises and component enterprises, test and validate intelligent tools and applications, and support collaboration between software and hardware enterprises. Given the complexity of intelligent manufacturing infrastructure, no single enterprise can build this alone—it requires government guidance and collective effort.

(2) Establish an industrial alliance serving AI applications and innovations. Intelligent manufacturing requires long-chain, coordinated innovation. To support this, I suggest the Chongqing government should consider integrate resources and guide the formation of alliance between AI enterprises, manufacturing enterprises, scientific research institutions, and talent cultivation organizations. The alliance should establish unified standards and foster long-chain coordination mechanisms.

(3) Drive the development of AI industry and intelligent computing. Leveraging Chongqing's market for intelligent manufacturing, the government can stimulate growth in local AI-related industries such as networks, software, and data. In particular, as a national hub for intelligent computing, the city should accelerate the development of its intelligent computing center to support the growth of both intelligent manufacturing and the AI industry.

4.2 Incentive program

It is recommended that Chongqing initiate intelligent manufacturing pilot demonstrations within its key manufacturing industries. These pilot programs should be implemented by industry, production stage, and operational model. The government should provide targeted financial support or preferential policies to these pilot projects. In turn, participating enterprises should take on the responsibility of sharing their experiences and promoting relevant technologies as part of their public service obligations.

Additionally, the municipal government can consider establishing an intelligent manufacturing guidance fund to provide investment support to manufacturing enterprises undergoing intelligent transformation. Priorities should be given to selections of pilot projects across key sectors, with enterprises and fund managers jointly evaluating the feasibility of these projects. This approach—based on shared risk and reward—will ensure successful outcomes.

4.3 Cultivation of inter-disciplinary talents in large quantity

The municipal government should consider cultivate a large pool of interdisciplinary talents in intelligent manufacturing. Given the need for substantial interdisciplinary talents in intelligent manufacturing, local universities and colleges should be encouraged to expand the number of students enrolled in AI-related disciplines and promote interdisciplinary learning. Additionally, companies should be provided with opportunities and financial support to retrain technical personnel in relevant fields. In line with corporate demand, the government could compile a catalog of urgently needed skills for intelligent manufacturing and designate training institutions and internship programs eligible for subsidies Furthermore, the municipal government should introduce more talent incentive policies for intelligent manufacturing, such as talent awards, housing guarantees, innovation and entrepreneurship subsidies, to attract top talent to Chongqing.

5. Conclusion

AI represents a transformative technological revolution with profound impacts on global economic development and urban competitiveness, creating strategic opportunities for the high-quality development of the manufacturing industry in Chongqing. We have high expectations for the city to stand at the forefront of the era to seize development opportunities and become the leading capital of intelligent manufacturing in China and globally.

Attached Table 1 Comparison Before and After the Intelligent Transformation of the Pohang Iron and Steel Factory

Steelmaking Process	Issues before Transformation	Measures	Effects
Order Management (Production Planning)	 Manual confirmation of all orders and manual calculation is required for small-quantity orders to determine feasibility	Identify 12 influencing factors of order and construct the learning model for AI to determine relevant orders	 Automatic determination of small-quantity orders with accuracy reaching 99.99% and the time required is shortened from 12 hours → 1 hour
Milling	 Manual check of the temperature of liquid iron every two hours and take samples to check the conditions of fuel	Automatically learn from big data through digital and programmed deep learning of decisive variables	 Automatic check of the smelter through IoT and camera, capable of predicting the status one hour in advance

Steelmaking		Temperature check based on experience and manual inspection and stoppage is required in the event of abnormality	Analysis of 125,000 situations and develop the integrated continuous control system		Real-time monitoring of time, temperature, and burden, with temperature accuracy improved from 80% → 90%
Continuous Casting		100% check of representative materials, but the rate of defect is lower than 10%	Automatic collection of operation data and development of surface quality prediction model		Automatic warning upon spotting defect materials and unnecessary checks are reduced, with costs saved by KRW 600 million per year
Rolling		Manual analysis of thick plate flatness for TMCP engineering	Use big data to create models and learn to analyze the relevance of thick plate		Automatic generation of optimal TMCP conditions and correction rate after TMCP is reduced by 50%
Coating		Manual control of coating targets and measurement is only available after zinc coating is coagulated	Develop ultra-precise AI coating control technology		Automatic learning of coating targets based on relevant conditions with a success rate improved from 89% → 99%

Note: TMCP (Thermo Mechanical Control Process)

Accelerating AI Capabilities to Drive Intelligent Manufacturing in Chongqing

Ernest Nicolas
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Chapter 1. Introduction

Chapter 2. Overview of Chongqing's AI application in manufacturing

Chapter 3. Challenges for Chongqing's AI development in manufacturing

- Insufficient development of intelligent manufacturing infrastructure
- Data-related challenges for industrial AI development
- SMEs' slow adoption of digitalization and AI technologies

Chapter 4.Recommendation

- Enhance the digital infrastructure of Chongqing's manufacturing industry
- Ensure high-quality industrial data
- Empower SMEs by fostering collaborations within the industry ecosystem

Chapter 5.Concluding remarks

1. Introduction

It is no secret that artificial intelligence (AI) technologies are the future of manufacturing, with companies striving to achieve Industry 4.0–also known as the Fourth Industrial Revolution. The use of AI in industrial sectors can significantly boost productivity, improve management, and enhance product quality. Currently, the global AI in manufacturing market is valued at USD 3.2 billion (~RMB 23.3 billion) and is set to grow to USD 20.8 billion (~RMB 150.8 billion) by 2028. [1]

There are five main areas where AI is applied in manufacturing businesses: intelligent production, products and services, enterprise operation management, supply chains, and business model decision-making. [2] AI usage within intelligent production is usually seen in the automation of production factories, specifically order management and product quality monitoring. In the product and service area, AI can shorten the product design cycle and personalize customer experiences, which improves marketing efficiency. For supply chain AI applications, more accurate, machine-learning-driven forecasting is an important benefit. Finally, within enterprise operations, AI is used for more productive management.

China also recognizes the important role that AI plays in driving productivity and fostering growth. AI is identified by the Chinese leadership as part of the new quality productive forces that will spearhead the transformation of the country's manufacturing sectors.

Capitalizing on the advancements in AI, the Chongqing government is strategically leveraging AI technology to fortify its manufacturing sector and has released a series of policies aimed at bolstering the use of AI in manufacturing. These initiatives are centered around promoting the utilization of AI to drive a new wave of industrialization, expediting the fusion of AI technologies like large models, deep learning, and image recognition with manufacturing processes. They also involve creating typical AI demonstration scenarios in key areas, such as product design, resource planning, and quality control.

Chongqing possesses distinctive advantages when it comes to accelerating AI in manufacturing. These include its abundance of industrial data and its robust computing capabilities, attributed to the city's participation in the "East Data, West Computing" initiative.

Nonetheless, several challenges should also be addressed to facilitate the broader and more in-depth adoption of AI within the manufacturing realm. These challenges include insufficient digital infrastructure within manufacturing facilities, a scarcity of high-quality integrated industrial data, and a tepid reception among small and medium-sized enterprises (SMEs).

[1] Source: World Economic Forum (link)

[2] Source: Deloitte (link)

By addressing these obstacles and building upon its existing strengths, Chongqing can pave the way for a more robust and AI-driven manufacturing landscape, ensuring sustainable growth and competitiveness within the industry.

2. Overview of Chongqing's AI application in manufacturing

AI plays an increasingly important role in manufacturing. Utilizing AI can improve overall efficiency in all aspects of the manufacturing process–from idea development to building the product. Key manufacturing processes where AI is currently being deployed include design, operations, autonomous supply chains, predictive maintenance, and quality checks.[3]

At the design stage, generative AI can be used for product conceptualization by analyzing market trends in quicker, more comprehensive ways. Based on AI-insights, product designers then innovate and tweak the ideas to comply with specifications and regulations.

Next, in the production phase, intelligent manufacturing can be seen in operations and autonomous supply chains. Many operations have started to integrate systems like the Artificial Intelligence of Things (AIoT) to boost human–machine interactions in the build process, as well as process optimization.[4] Additionally, AIoT, along with machine learning (ML) and big data analytics, help manufacturers achieve autonomous supply chains that maintain performance even in unstable circumstances.

During the build phase, artificial intelligence can also be used in predictive maintenance and even preventing machine breakdowns. AI is used to gauge the health of the machinery, which enables manufacturers to accurately predict when to replace spare parts and keep the production line operational. This results in both cost efficiency and an improvement in productivity overall.

Finally, as the product is finished, artificial intelligence is used for quality checks. Technologies such as AI image recognition can detect product defects, as an HP manufacturing line in Brazil has shown.[5] Similarly, HP workstations are making important improvements in auto manufacturing. These workstations are equipped with high computational power to support AI operations. Sound testing of motors through traditional means is prone to human error, inefficiencies, and scalability constraints. By deploying HP workstations, manufacturers can overcome these problems by utilizing AI algorithms to analyze sound patterns and identify motor quality and performance indicators.

In sum, artificial intelligence can be employed to promote efficiency in all aspects of the

[3] Source: World Economic Forum (link)

[4] Sources: Forbes (link)

[5] Source: Institute of Electrical and Electronics Engineers (link)

manufacturing process.

The Chongqing government aims to increase AI adoption to enhance its manufacturing sector. As one of China's most important traditional industrial bases, Chongqing has a robust industrial foundation. In 2021, Chongqing's industrial sector accounted for 28.3% of its GDP.[6] The city boasts over 8,000 manufacturing businesses above designated size. Currently, Chongqing has developed an industry system centered around automobiles, electronics, equipment, materials, pharmaceuticals, consumer goods, and energy.[7]

In recent years, the local government has actively promoted the intelligent transformation of traditional and emerging industries, such as automotive, equipment manufacturing, materials, and electronic information. This process has focused on integrating digital technologies into production lines, workshops, and factories.[8]

Chongqing has achieved digital transformation in multiple areas of its manufacturing industry, including process R&D and design, production scheduling, and warehousing.[9] By the end of 2023, Chongqing had established 144 smart factories and 958 digital workshops.[10] Among these, 26 projects were selected by the Ministry of Industry and Information Technology (MIIT) for the 2023 list of intelligent manufacturing demonstration factories and outstanding scenarios.[11]

Notably, some of the government's policies have focused specifically on bolstering AI application in manufacturing. For example, the Action Plan for High-Quality Development of the AI Industry Driven by Scenarios *(2023-2025)* [12] aims to propel the growth of the AI industry by facilitating data resource circulation, boosting hardware capabilities, and pioneering AI's new application scenarios. The city is also accelerating the construction of AI pilot factories. It encourages the use of AI to empower new industrialization, involving the integration of AI technologies (such as large models, deep learning, and image recognition) with manufacturing processes. It also aims to establish AI landmark demonstration scenarios in areas like product design, resource planning, and quality control.[13]

In addition to a solid industrial base and clear policy guidance, Chongqing's advantages for AI transformation also stem from its high volume of industrial data and its growing computing

[6] Source: Chongqing Municipal Bureau of Statistics (link)

[7] Source: MIIT (link)

[8] Source: State Council (link)

[9] Source: Xinhua Net (link)

[10] Source: Xinhua Net (link)

[11] Source: Chongqing Municipal Government (link)

[12] Source: Chongqing Municipal Government (link)

[13] Source: Chongqing Municipal Economic and Information Technology Commission (link)

power. Chongqing possesses 39 out of the 41 major industrial categories recognized nationwide. This extensive industrial diversity has led to the accumulation of a vast amount of industrial data. [14] Being one of the ten national data clusters under the "East Data, West Computing" project, the city has established three smart computing centers and a high-performance computing center.[15] These centers are utilized to provide computing power in various industries including manufacturing. [16]

With these distinctive advantages, Chongqing is well positioned to accelerate AI applications in its manufacturing industry.

3. Challenges for Chongqing's AI development in manufacturing

AI adoption in Chongqing's manufacturing industry also faces challenges, including inadequate digital infrastructure within manufacturing, a deficiency of high-quality integrated industrial data, and sluggish uptake among SMEs. Addressing these challenges will allow for accelerated AI adoption in industrial sectors, thereby enhancing productivity, quality, and innovation.

1) Insufficient development of intelligent manufacturing infrastructure

Integrating AI technologies in manufacturing has to be built on digitalization and interconnectivity of devices and systems. Before AI can be more widely adopted in manufacturing, digital and smart manufacturing infrastructure must be enhanced first. Currently, the use of AI is limited in manufacturing in China and the sector's digital transformation is an ongoing process. Compared with Western developed countries, China has a weak foundation for intelligent manufacturing[17] as the country's industrial process only started from the 1950s onwards.[18] China is still at the late stage of "Industry 2.0" (electrification), while transitioning to "Industry 3.0" (informatization). It is concurrently taking steps towards "Industry 4.0" to integrate intelligent technologies into manufacturing processes. [19]

Several challenges exist in the scaling up of intelligent manufacturing in regions across China, including Chongqing. To start with, the country's level of automation and informatization of systems is still comparatively low.[20] While developed countries have achieved 33% digitalization in the manufacturing sector, the figure is 19.5% for China.[21] Traditional manufacturing businesses tend to find digitalization a complex and challenging process. So far it has mainly been carried out in China

[14] Source: Chongqing Municipal Government (link)
[15] Source: Xinhua Net (link)
[16] Source: Xinhua Net (link)
[17] Source: Science Direct (link)
[18] Source: International Poverty Reduction Center in China (link)
[19] Source: Qianzhan Industrial Research Institute (link)
[20] Source: Seeyon (link)
[21] Source: CCISERV (link)

by state-owned enterprises (SOEs) and big private companies. At this level, digitalization usually requires an investment of between RMB 1 million (~USD 138,000) and RMB 5 million (~USD 690,000) and takes 4 to 18 months to complete.[22] During this process, the success of the transition hinges on factors such as senior management's awareness, the IT department's technological capability, and coordination between different departments.

Even for companies that have intentions to digitalize, they may lack the means to do so due to a shortage of suitable digital technologies and third-party services. While China has seen the rise of hugely popular consumer applications such as WeChat and Alipay, its industrial enterprise applications lag developed countries, including Enterprise Resource Planning (ERP) and Software-as-a-Service (SaaS) applications.[23] This is partly due to an insufficient understanding of the complexity of industrial processes. Different from developing consumer applications, developing industrial apps requires accumulation of large amounts of high-quality industrial data and insights from industrial models and processes – areas where Chinese companies are still catching up.

Additionally, the smart transformation of the manufacturing sector will not be possible without intelligent transformation of supply chains, a process which relies on the adoption of industrial internet platforms. Currently, China's industrial internet platforms are still at the early stage of development with relatively low acceptance amongst enterprises, technology bottlenecks, and a lack of product differentiation to serve customers.[24] Chongqing has made important progress in this area, including achieving an annual industrial Internet industry added value of over RMB 100 billion (~USD 13.98 billion) by the end of 2023. However, its industrial internet platform development still lags behind eastern provinces, indicating there is still room for expansion and development. [25]

2) Data-related challenges for industrial AI development

The Chongqing government has released the *14th Five-Year Plan on Data Governance (2021-2025)* aimed at enhancing data integration and increasing data sharing in the city. These efforts will allow the city to unleash the value of data and accelerate economic growth and improve social management. Nevertheless, the measures in the plan focus more on improving governance of public and government data, as opposed to sectoral data including industrial data.

We believe the management and utilization of industrial data should also be improved as the quality of training data underpins the performance, accuracy, and reliability of industrial AI models, especially those driven by machine learning. Currently, several issues hinder the collection of high-

[22] Source: 36Kr (link)

[23] Source: National Governance Weekly (link)

[24] Source: Jiangsu NOW (link)

[25] Source: China Academy of Industrial Internet (link)

quality integrated data within manufacturing enterprises in Chongqing. These include data silos, a lack of interoperability of data systems, and data and cybersecurity concerns.

Firstly, the issue of data silos prevents integration of data across different departments within a company. Data silos refer to a situation in which repositories of information are stored within individual business units but remain inaccessible to other teams. For example, silos may cause data collected and managed by the product development team to be inaccessible to sales, HR, and logistics. In practice, data silos are commonplace within an organization. In many cases, they can be attributed to different departments adopting separate data management systems. In other scenarios, concerns about data security and privacy prevent individual departments from sharing key data with other teams.

The lack of interoperability of data systems, such as between engineering, design and factory, and between operational technology (OT) and information technology (IT)[26] also causes difficulties in data integration and utilization within an organization. Common obstacles to data interoperability include a lack of standardized data formats across different systems and applications; disparate data sources, such as legacy systems, third-party vendors, and cloud-based systems; and data quality issues caused by missing or incorrect values, and repetitive information. [27]

Additionally, companies may be concerned about data privacy and cybersecurity. The possibility of data leaks and cyberattacks to their industrial internet systems makes some companies unwilling to undergo intelligent transformation. The hesitance around digital and smart transformation, however, leads to a lack of industrial data. This, in turn, creates difficulties for gaining insights into business operations and production and developing AI applications and services useful and relevant to specific industrial domains. To address such dilemmas, HP's Z workstations, for example, enable businesses to process data locally, reducing business concerns about data and cybersecurity. While cloud solutions provide substantial power and capacity, a local workstation can often run multiple applications more efficiently, more securely and without the potential for unexpected costs–particularly when developing and testing models.

Unlike general purpose AI models, industrial AI models rely on a feed of large amounts of highly relevant and high-quality training data.[28] Missing, noisy, and irrelevant data as well as inconsistency in data formatting and labeling hinder models' ability to learn effectively and cause inaccuracy in results they generate. Therefore, it is important that these challenges are addressed to improve the quality of industrial data. The Chongqing government is aware of the challenges relating to industrial data and has taken some steps to deal with related challenges, such as

[26] Source: MIT Technology Review (link)

[27] Source: Reltio (link)

[28] Source: Industrial Internet World Network (link)

promoting industrial internet platforms amongst manufacturing businesses.[29] However, a more targeted and systemic approach is required to address various challenges contributing to the issue of low-quality industrial data.

3) SMEs' slow adoption of digitalization and AI technologies

Small and medium-sized enterprises (SMEs) are the backbone of Chongqing's industrial innovation and high-quality manufacturing, driving growth, employment, and innovation. Chongqing has nearly one million SMEs,[30] including 5,035 "specialized, sophisticated, and innovative" enterprises in key technology sectors.[31] By fully leveraging the opportunities presented by AI technology, Chongqing's SMEs have the potential to expedite the city's industrial smart transformation. However, as with many other regions in China, SMEs in Chongqing are only slowly integrating AI into their businesses. The Chongqing Municipal Economic and Information Commission has observed that SMEs in the city face significant obstacles in their digital transformation, characterized by a "sense of fear, reluctance, and lack of knowledge." [32]

One key challenge SMEs face is insufficient funding. According to a survey conducted by the China Academy of Information and Communications Technology (CAICT), about 63% of medium-sized enterprises in China have difficulty finding suitable digital solutions for themselves. Products customized for large enterprises are often too costly, while simpler solutions fail to meet their more complex requirements [33]. A similar situation can be observed in Chongqing.

The long-term and complex nature of digital transformation presents challenges in building business capabilities and cultivating talent. SMEs rely on a small group of highly skilled individuals to maintain market competitiveness and drive innovation. The smooth adoption of new technology and systems within an organization is not possible without the foresight and support of the right talent. Yet, most SMEs currently lack the digital and management talent capable of initiating and facilitating the intelligent transformation process. They also struggle to compete for talent as they lack the resources to invest in talent attraction, retention, and development. SMEs often lose their most talented and skilled candidates to larger organizations or MNCs that offer higher salaries or promises of career growth. Additionally, Chongqing faces a structural mismatch with a lack of high-skilled workers and difficulty in attracting new graduates to traditional factory work.[34] Thus, the most pressing tasks for manufacturing SMEs in the city are to identify the job competencies and skills required in the digital workplace and to attract as well as effectively train and develop talent.

[29] Source: Chongqing Municipal Government (link)

[30] Source: Chongqing Municipal Government (Link)

[31] Source: Chongqing Municipal Government (Link)

[32] Source: Chongqing Municipal Government (link)

[33] Source: CAICT (link)

[34] Source: Chongqing Municipal Government (Link)

A noticeable digital divide and low levels of industrial collaboration further exacerbate the slow adoption of digitalization in manufacturing among SMEs. Most of these enterprises have limited digital capabilities and weak foundations in networking and intelligent systems. The inadequate supply of core digital technologies and third-party services, along with SMEs' limited manpower and financial resources, make bridging the digital divide challenging. Leading enterprises primarily focus on internal integration for industrial internet development with inadequate synergy among businesses along the value chain. Moreover, industrial internet platforms' openness concerning user access, data sharing, and manufacturing capabilities remains generally low, requiring collaboration across the industrial chain to support SMEs.

4. Recommendations

1) Enhance the digital infrastructure of Chongqing's manufacturing industry

As a first step to increase AI adoption in the manufacturing industry, digital infrastructure must be enhanced. This requires several parallel efforts: accelerating awareness and capacity-building amongst traditional manufacturing businesses, strengthening R&D of local industrial technologies including industrial applications and industrial internet platforms, and attracting digital infrastructure solution providers.

- **Awareness and capacity-building**

The Chongqing government is in the process of establishing centers for empowering the digital transformation of the manufacturing industry.[35] These centers will provide training and services to enterprises that plan to digitalize. We believe that these centers would benefit from partnerships with foreign companies that are experienced in intelligent transformation and able to provide useful solutions, perspectives, and experience. The government should also continue to provide support, including financial incentives for companies that assist the digitalization of local enterprises alongside the supply chain.

- **Strengthen R&D for industrial AI solutions including industrial applications**

The Chongqing government should continue to encourage R&D around industrial solutions for AI. This includes industrial applications that cater to specific industrial domains and different stages of industrial processes, including design and R&D, process control, and simulation and testing. Leading companies should be encouraged to work together and achieve breakthroughs in industrial applications. They should also work closely with universities, research institutes, and industry participants to absorb research outcomes from higher education institutions and incorporate

[35] Source: Chongqing Municipal Government Economy and Informatization Commission (link)

feedback from application users. This collaborative approach will drive continuous upgrades and improvements to industrial applications and solutions. For example, HP has been collaborating with Zhejiang University to enhance the use of AI to improve sound testing during manufacturing.

- **Enhance industrial internet platform construction**

Factors negatively impacting industrial internet platform development include a lack of uniformity in industrial internet standards as well as a lack of uniformity in data standards of industrial applications. A lack of incentives amongst enterprises to adopt industrial internet also contributes to the challenge. Therefore, we would recommend that the Chongqing government accelerate the establishment of industrial network standards across different enterprises. This will help create a more unified and interoperable ecosystem. Secondly, the government should also encourage the development of data standards for industrial applications which can be adopted widely within the industry. Consistent data standards are crucial for enabling seamless data exchange and integration across different systems and platforms. Thirdly, incentives should also be increased to encourage enterprises to adopt industrial internet platforms. This could involve providing financial incentives, subsidies, or other support mechanisms to lower the perceived costs and barriers for businesses.

2) Ensure high-quality industrial data

We recommend that the Chongqing government take further measures to encourage and guide data integration and sharing within enterprises and the industry. This data will provide valuable insights into industrial processes and support the development of high-quality industrial AI solutions.

- **Promote best practices for data management**

We recommend that the government work closely with industry participants and service providers to establish and promote best practices regarding data management within manufacturing businesses. This should include developing internal standards and techniques for data standardization and normalization, creating interoperability frameworks and protocols, and promoting strategies to enable seamless data exchange between systems. Standardizing and normalizing data formats can ensure information is structured uniformly within a manufacturing enterprise, facilitating easier integration and utilization. Interoperability frameworks and protocols provide guidelines and standards to further enable the integration and sharing of data.

- **Establish best practices for the use of AI and data in manufacturing**

The government should also work with companies to develop best practices around the use of AI and data in industrial manufacturing. This requires the establishment of high-quality industrial

datasets, involving steps such as data integration, cleaning, and labeling. These high-quality datasets not only inform businesses about industrial processes but also serve as valuable resources for training AI systems, enabling businesses to optimize operations more effectively. This optimization spans from enhancing supply chain management to facilitating predictive maintenance.

- **Offer financial incentives to attract and incentivize solution providers**

Financial incentives and tax benefits can be explored to attract more solution providers to the city and enhance their offerings to customers. These include products to enhance industrial enterprises' security systems and "data middle offices" to integrate data within organizations. Additionally, the government should also establish a workforce to identify gaps between business needs and product offerings in the market in terms of enhancing data integration. It should encourage R&D to ensure the development and delivery of the best and most relevant solutions to businesses.

3) Empower SMEs by fostering collaborations within the industry ecosystem

Recognizing the role of SMEs in the region's economic development, Chongqing aims to facilitate the digital transformation of over 5,000 SMEs by 2024 and 15,000 by 2027.[36] Both central and local-level governments have proposed policy directives to facilitate SMEs' digital transformation. These include providing funding, specialized loans, tailored financial products and services, building supply chain platforms, and digital transformation centers. To facilitate the implementation of existing policies and expedite AI-driven manufacturing, Chongqing should empower SMEs by strengthening collaboration with leading companies and solution providers, driving holistic transformation across the industrial ecosystem.

- **Provide tailored financial support for SMEs**

Tailored financial incentive programs such as specialized loans and subsidies can reduce common transformation costs for SMEs. Government funding can be allocated for technology demonstration projects that seek to develop, identify, and demonstrate cost-effective solutions specifically for SMEs' digital transformation. These solutions should address top challenges facing SMEs along the supply chain as they undergo the digital transition. The IP of companies that participate in these technology demonstration projects should be strictly protected to maintain ongoing incentives to participate in similar initiatives in the future.

- **Establish "government-academia-industry" talent cultivation platforms**

Bridging the structural mismatch in the labor market requires collaborative efforts from

[36] Source: Chongqing Municipal Government (Link)

government, academic institutions, and employers. Chongqing has established public training centers to support upskilling and employment.[37] We believe that the city can commit further efforts to attract and cultivate talent (including young graduates), equipping them with the skillsets required to drive new industrialization. Incentives should be provided to attract high-skilled workers and talent from elsewhere to work in Chongqing. We also recommend that the Chongqing government create mechanisms of comprehensive cooperation between educational institutions and manufacturing businesses in training talent needed to support AI development. A collaborative approach that bridges the gap between education and industry needs is essential for SMEs who rely on a small but skilled workforce equipped to leverage AI technology in manufacturing.

HP has established a collaboration with Chongqing University on talent cultivation and is committed to continuing to work together with institutions in Chongqing to cultivate the talent SMEs need.

- **Accelerate intelligent equipment renewals to comprehensively integrate AI in manufacturing**

In line with central government directives and Chongqing's own plan in this area, supporting equipment renewal within the industry helps SMEs attain the necessary tools to leverage intelligent technologies. These include industrial devices and equipment, such as IoT devices, and smart office appliances capable of optimizing management and improving efficiency. For example, HP's flexible AI PC product portfolio and innovative solutions provide accessible tools for SMEs to drive digital transformation with enhanced efficiency, reduced costs, and increased competitiveness. HP's AI workstations also enhance businesses' internal circulation and processing of data, meeting SMEs' needs for efficient data analytics. Additionally, our AI hybrid cloud-edge solutions optimize industrial digital transformation by combining the advantages of cloud and edge computing. HP looks forward to working with the Chongqing government to enhance offerings of intelligent devices to SMEs and support their smart transformation. As the Chongqing government works to empower SMEs, the city's digitalization empowerment centers[38] can also guide product and service providers in developing tailored solutions to support SMEs.

5. Concluding remarks

AI is playing an increasingly important role in our society, particularly in improving productivity and fostering growth. It is part of the new quality productive forces that the Chinese leadership recognizes as pivotal for sustainably propelling China's development. In manufacturing, AI helps increase efficiency, enhance product quality, and improve supply chain management. The Chongqing government has been implementing a series of measures to drive the intelligent

[37] Link: Chongqing Municipal Government (Link)

[38] Source: Chongqing Manufacturing Digitalization Empowerment Center (Link)

transformation of its traditional manufacturing industry, including by incorporating AI technology into industrial production processes.

Chongqing possesses several inherent strengths in accelerating its industrial intelligent transformation, which include its substantial reservoirs of industrial data and its growing computing power. However, several challenges also impede its potential for broader AI integration in manufacturing. We identify three key issues: the need to strengthen Chongqing's digital infrastructure foundation; the necessity of high-quality industrial data; and the need to enhance policy support for industrial SMEs. We have provided corresponding policy suggestions in this paper with a view to helping Chongqing accelerate AI adoption in its manufacturing sector.

HP is committed to collaborating closely with the Chongqing government in this process to provide the necessary support in technology, talent, and solutions. By bolstering AI, we believe Chongqing's manufacturing landscape will undergo further enhancement, increasing its resilience and international competitiveness.

Contributing to Smart Transformations through CPS (Cyber Physical Systems)

Seiji Imai
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Chapter 1. Introduction

Chapter 2. Overview of CPS

Chapter 3. Examples of CPS Utilization by Japanese Companies

- Examples of Utilization for Human Resource Development
- Examples of Utilization for Solving Labor Shortages
- Examples of Utilization for Improving Productivity

Chapter 4. The Possibilities for Collaboration with China based on the Strengths of Japan and its Industries

- The Winning Strategies of Japan and its Industries

  (1) Winning Through Experiential Value / Content

  (2) Winning Through Solving Social Issues

  (3) Winning Through Components

- Possibilities for Collaboration with China

Chapter 5. Conclusion: Possibilities for Collaboration with Chongqing City

Chapter 1. Introduction

CPS (Cyber Physical Systems) can enable smart transformations and improve operational efficiency in manufacturing and non-manufacturing sectors. These systems are already beginning to be used in Japan and are expected to be used around the world in the future.

This paper first provides an overview of CPS, followed by examples of its utilization by Japanese companies. Finally, it will explore the possibilities for collaboration with China and Chongqing City based on the strengths of Japan and its industries. Chapter 2 will provide more detail through a deeper dive into CPS. Chapter 3 will examine examples of CPS utilization by Japanese companies based on purpose. Chapter 4 will then consider winning strategies by Japan and its industries and the possibilities for collaboration with China through each strategy. Finally, Chapter 5 will also consider the possibilities for collaboration with Chongqing City.

Chapter 2. Overview of CPS

CPS stands for Cyber Physical Systems, a general term for systems that merge the physical and virtual worlds. Specifically, CPS involves collecting diverse data in the physical space using sensors and transferring it to virtual spaces where large-scale statistical data processing and simulations are utilized for deeper analysis. It generally refers to systems that use the insights and results obtained in this way to attempt to solve various issues in the physical space or create new added value. The benefits of CPS include improved production efficiency through digital twins, enhanced workforce productivity through remotely operated robots, and the creation of new experiential value using VR (Virtual Reality) or AR (Augmented Reality).

The main issues currently facing Japanese industry include interrupted skills succession, labor shortages, and low labor productivity. CPS, with its benefits mentioned above, could be a key to solving these issues. The next chapter describes how Japanese companies have used CPS to address these issues.

Chapter 3. Examples of CPS Utilization by Japanese Companies

This chapter will introduce examples of how Japanese companies currently use CPS to solve various issues related to human resource development, labor shortages, and productivity.

Examples of Utilization for Human Resource Development

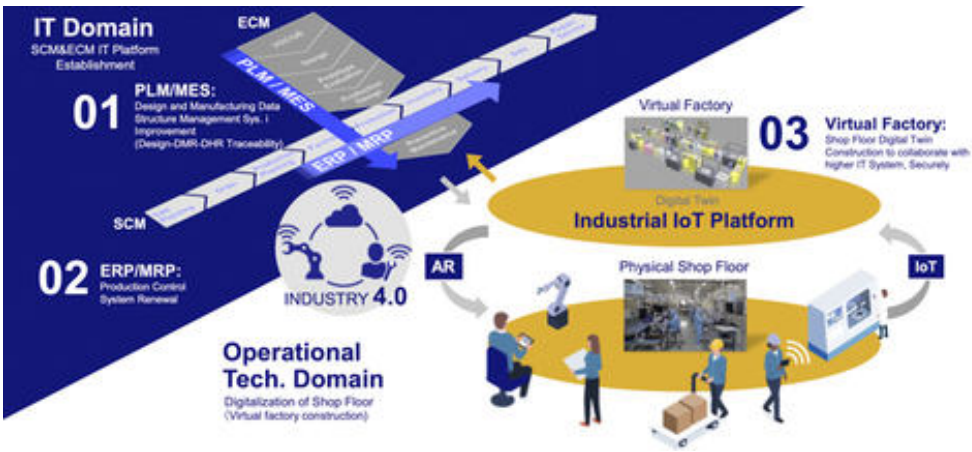
First, we will look at examples of using CPS in human resource development by the optical equipment manufacturer Olympus and the restaurant chain Royal Host. At Olympus, a system has been introduced that detects and digitizes the hand movements of veteran technicians using sensors. Specifically, measuring devices are attached to areas such as the hand joints of skilled technicians

to detect their bone structure. Their movements, such as how they wrap cables, are then recorded as coordinate data in 3D. Once digitized, these movements can be reviewed anytime using VR goggles and can be used to shorten training periods ([Figure 1]).

The restaurant chain Royal Host has introduced a CPS system in collaboration with the National Institute of Advanced Industrial Science and Technology to provide training in customer service tasks in the virtual space. Training participants become staff in a virtual store and need to handle a series of tasks from customer arrival, menu, and dish delivery to table cleaning simultaneously at each table, gaining experience close to actual work ([Figure 2]).

[Figure 1] Image of Olympus's CPS Utilization: Supporting On-Site Plant Operations Using an Industrial IoT Platform

(1) Streamlining auxiliary tasks, (2) Supporting manual work, (3) Enhancing skills succession



Source: Compiled by the Industry Research Department of Mizuho Bank based on Olympus's website

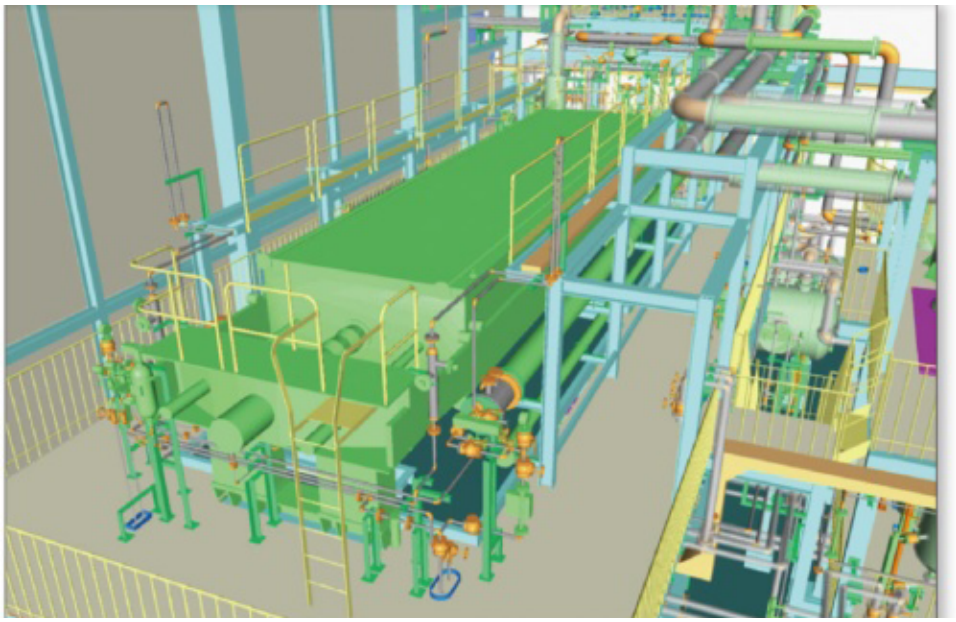
[Figure 2] Example of CPS Use at Royal Host: Training Customer Service Tasks in a Virtual Space

Compiled by the Industry Research Department of Mizuho Bank based on the National Institute of Advanced Industrial Science and Technology website

Examples of Utilization for Solving Labor Shortages

Next, as an example of using CPS to solve labor shortages, we will introduce the efforts of Asahi Kasei, a general chemical manufacturer. Asahi Kasei is constructing a digital twin environment at its hydrogen production plant. It is difficult to standardize the series of responses needed when equipment abnormalities occur at the plant, requiring individualized responses by veteran technicians in many cases. For this reason, it previously took time to respond to abnormalities if these staff were not in the area. However, through the digital twin, they can now respond remotely as if they were on-site, thus shortening the time from alert generation to problem resolution ([Figure 3]).

[Figure 3] Example of CPS Utilization by Asahi Kasei: Remote Response Using Digital Twin Technology at Plants



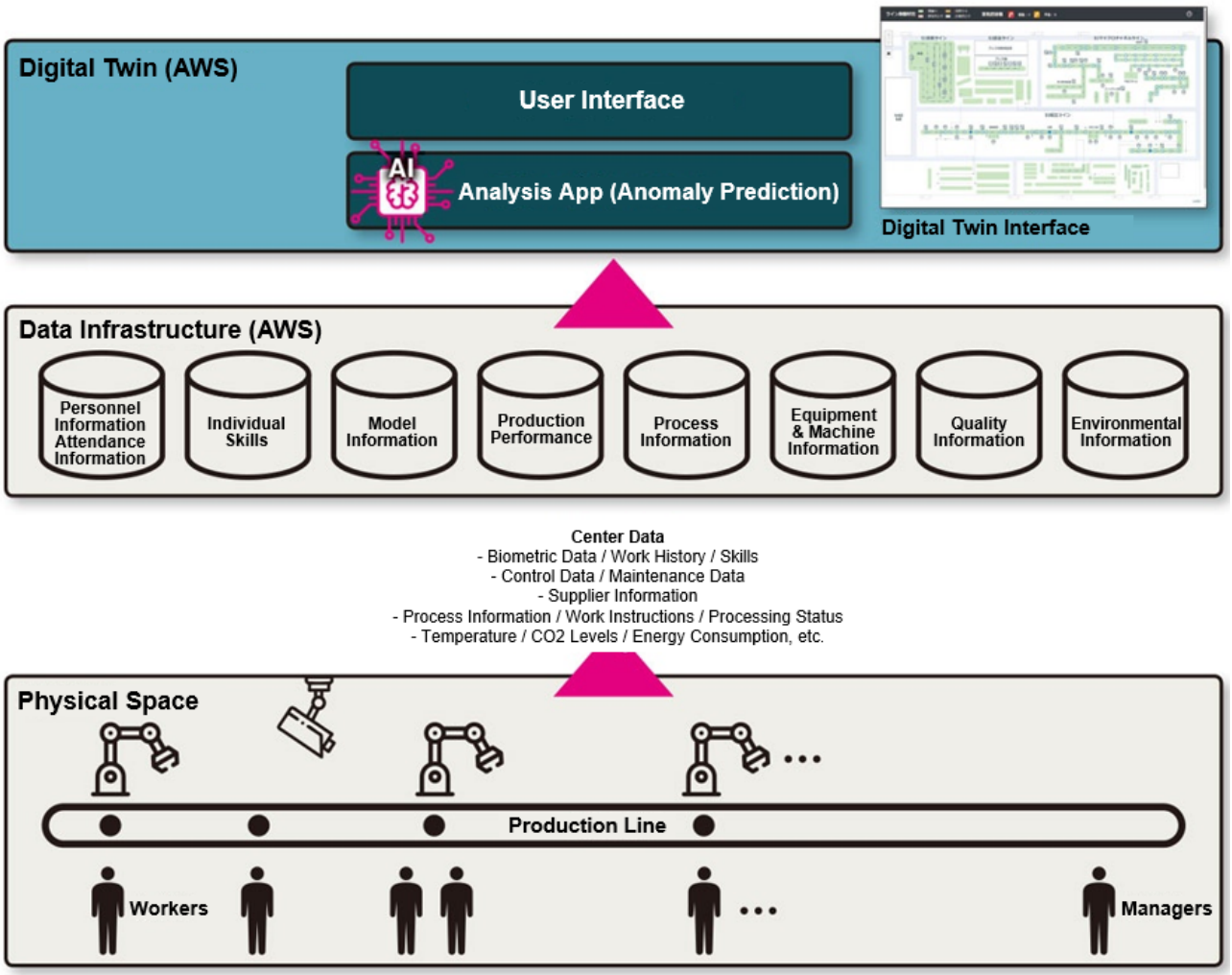
Compiled by the Industry Research Department of Mizuho Bank based on an article from Nikkei Cross Tech

Examples of Utilization for Improving Productivity

Finally, to provide examples of using CPS to improve productivity, we will examine use cases at air conditioning manufacturer Daikin Industries and Toyota Motor Corporation. Daikin Industries has introduced a production management system using digital twin technology. By acquiring data through cameras and sensors installed in the plant, it has reproduced processes such as assembly, pressing, and painting in the virtual space. This enables it to predict equipment anomalies and

subsequent line stagnations, reducing time and cost losses by over 30% compared to before the system's introduction ([Figure 4]). Toyota Motor Corporation is working to create Woven City (a smart city being built by the company in Susono City, Shizuoka Prefecture) and has recreated people, mobility, and infrastructure in this virtual space. The company simulates traffic conditions, human flows, and risks associated with traffic accidents during automated driving, enhancing its productivity through the project's promotion ([Figure 5]).

[Figure 4] Example of CPS Utilization by Daikin Industries: Efficiency in Production Management Using Digital Twins



Compiled by the Industry Research Department of Mizuho Bank based on Nikkei Cross Tech

[Figure 5] Example of CPS Utilization by Toyota Motor Corporation: Various Simulations to Help Complete a Smart City

Compiled by the Industry Research Department of Mizuho Bank based on the TOYOTA WOVEN CITY website

Chapter 4. The Possibilities for Collaboration with China based on the Strengths of Japan and its Industries

Chapter 3 introduced examples of CPS that are already being implemented. Chapter 4 will present a long-term vision for CPS and a future path that Japan and its industries should take. More specifically, it will examine the possible winning strategies that Japan and its industries could realize through leveraging this technology. Additionally, we will consider the possibilities for collaboration with China for each strategy.

Japan's and Japanese Industry's Winning Strategies

This paper broadly divides the winning strategies of Japan and its industries into three directions: (i) Winning Through Experiential Value / Content By Leveraging CPS, (ii) Winning Through Solving Social Issues By Leveraging CPS, (iii) Winning Through Components By Capturing the Global Spread of CPS.

(i) Winning Through Experiential Value / Content refers to the shift from functional value to experiential value, in other words, the acceleration of the shift from product consumption to experience consumption. This involves leveraging the strengths of Japan's content industry while

enhancing UX (User Experience) through CPS or creating new UX. By utilizing CPS, we believe a more personalized UX can be provided to each customer compared to traditional content. We also believe that entirely new UXes using virtual spaces such as VR (Virtual Reality) and AR (Augmented Reality) can be realized.

(ii) Winning Through Solving Social Issues refers to leveraging CPS to solve social issues that Japan faces ahead of other countries, improving the competitiveness and sustainability of Japanese industries, and extending solutions to resolve social issues overseas. Many social issues that Japan faces, such as its aging population and declining birthrate, are more advanced than in other countries. This means Japan already possesses a wealth of data, know-how, technologies, and products related to this social issue. Facing a social issue ahead of other countries may seem negative at first glance. However, it can be an opportunity to transform from a country with advanced social issues to one that is advanced in solving them. Chapter 3 introduced examples of CPS utilization for addressing issues such as human resource development and solving labor shortages, and this winning strategy can be seen in these initiatives.

Finally, (iii) Winning Through Components refers to capturing the spread of CPS, especially in China and advanced countries, significantly raising Japan's presence in components (parts and materials). As mentioned above, CPS is a system that merges physical and virtual spaces in a sophisticated manner. For it to function fully, it requires sensors that can quickly and accurately capture data from objects and events in the physical space, computers for processing and analyzing vast data quickly in a virtual space, and actuators for correctly feeding back the insights and calculation results obtained in a virtual space to the physical space. Therefore, CPS's global spread and utilization are expected to create a massive demand for high-quality, high-functioning components. By responding to this demand, Japan can significantly expand its business.

Possibilities for Collaboration with China

The three winning strategies also provide opportunities for collaboration with China. In this chapter, we will discuss the possibilities for collaboration presented through each strategy.

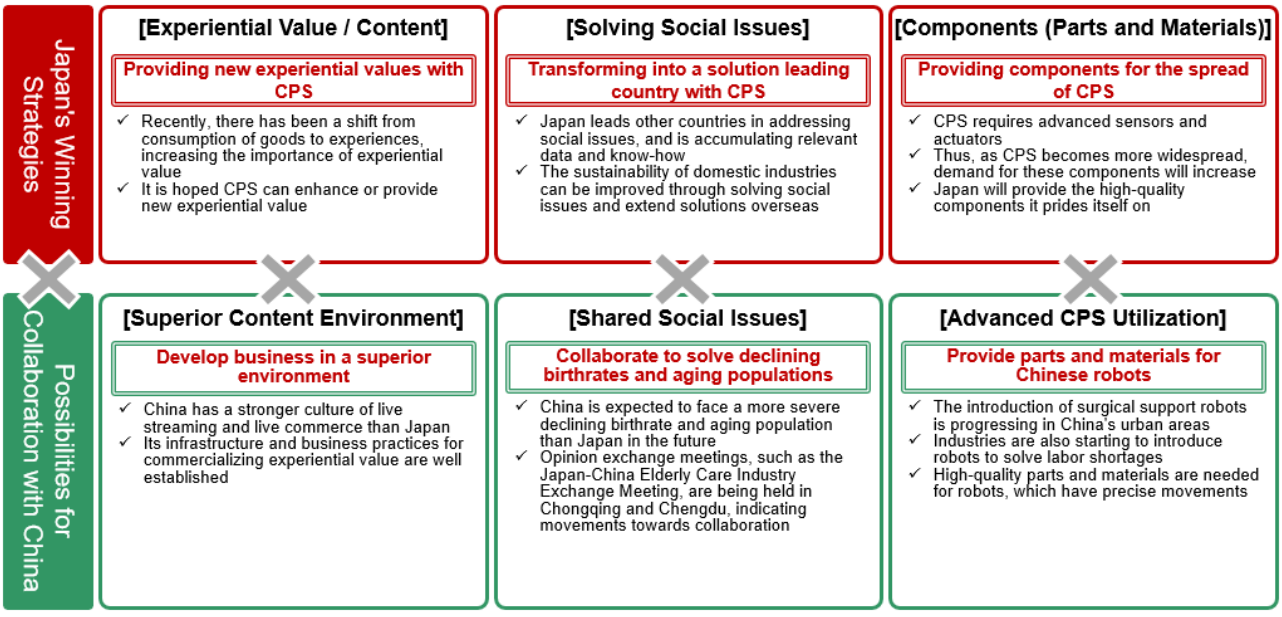
First, we will examine the possibilities for collaboration in (i) Winning Through Experiential Value / Content. Japan's strength lies in its ability to create content and the IP (Intellectual Property) it has generated so far, but the revenue obtained from this potential remains small. Therefore, even if Japan can create innovative experiential value using CPS, such as through VR and AR, there are concerns that this may not lead to sufficient revenue opportunities. However, China's environment for commercializing experiential value is more advanced than Japan's. Specifically, live streaming and live commerce are more deeply embedded in China, and the infrastructure and business practices for commercializing experiential value are well established. Leveraging this advanced environment and exploring domestic demand in China through cooperation between Japanese and

Chinese companies will benefit both sides significantly.

Next, we will explore the potential for collaboration with China in (ii) Winning Through Solving Social Issues. Currently, China's working-age population is declining, and it is expected that the aging of its population and the decline in its birthrates will progress even faster than in Japan. Thus, China shares social issues with Japan, such as an aging/declining population and associated labor shortages and caregiving challenges. It is, therefore, entirely feasible to envision a future where Japan and China collaborate to develop solutions. In fact, JETRO (Japan External Trade Organization) has previously hosted an opinion exchange meeting (the Japan-China Elderly Care Industry Exchange Meeting) in Chongqing and Chengdu, suggesting budding possibilities for collaboration with around 380 business talks held in total across both cities.

Finally, we will envision a future of Japan-China collaboration in (iii) Winning Through Components. The utilization of CPS is more advanced in China than in Japan. Examples include the utilization of robots in medicine. Supported by government aid in insurance points and regulatory flexibility, the introduction of surgical support robots is progressing in China's urban areas. The spread of CPS utilization in China means the demand for high-quality, high-function components (parts and functional materials) for precise medical and industrial robots is increasing. Since the utilization and sophistication of CPS are expected to progress, Japan and China can leverage each other's strengths to nurture their respective domains of components and finished products (robots, etc.) ([Figure 6]).

[Figure 6] The Strengths of Japan and its Industries and The Possibilities for Collaboration with Chongqing City



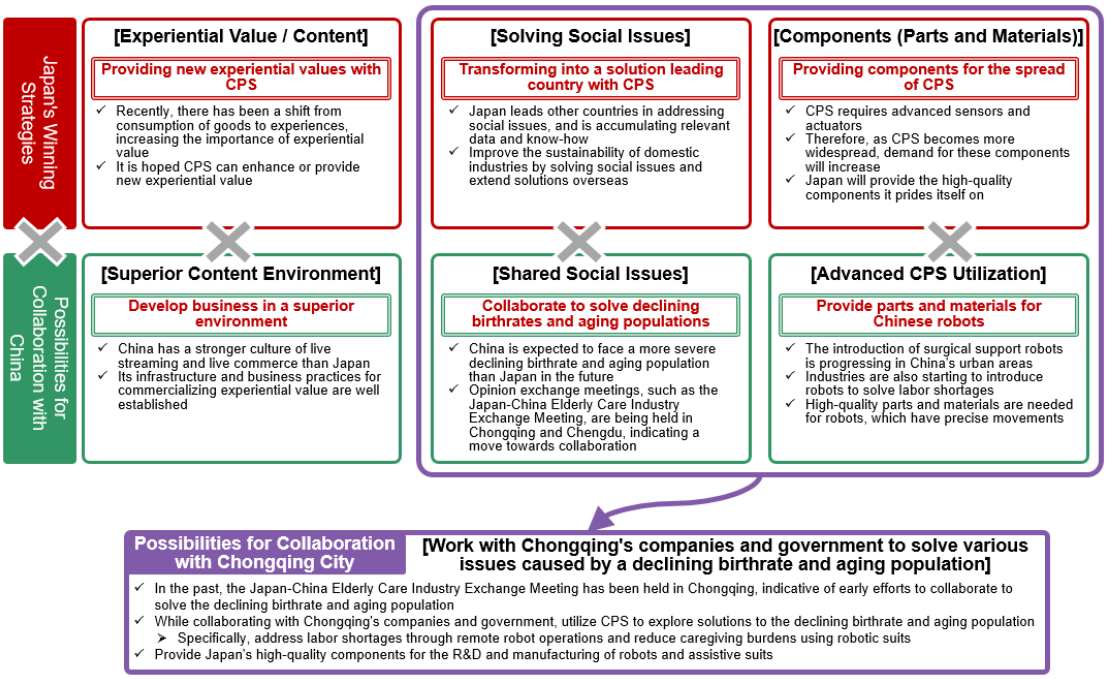
Source: Compiled by Mizuho Bank Industry Research Department

Chapter 5. Conclusion: Possibilities for Collaboration with Chongqing City

Chapter 4 examined the winning strategies of Japan and its industries and the possibilities for collaboration with China in those areas. We saw that China, with its advanced environment for commercializing experiential value, its social issues, such as an aging population and declining birthrate, and its progressive utilization of CPS, as a beneficial partner that can produce mutual benefits with Japan.

Finally, we will consider the possibilities for collaboration with Chongqing City. As mentioned in Chapter 4, there are already points of contact with Chongqing City, such as the Japan-China Elderly Care Industry Exchange Meeting. One example of collaboration can be envisioned where Japanese companies work with Chongqing's companies and government to solve issues related to its aging population and declining birthrate, labor shortages, and caregiving problems using CPS. Specifically, addressing labor shortages through remote robots or reducing caregiving burdens using robotic suits. To achieve this, high-performance robots or robotic suits are required; therefore, high-quality components will also be needed. Japan can respond to this demand through its excellent components. A collaboration with Chongqing City such as this is entirely conceivable ([Figure 7]).

[Figure 7] Possibilities for Collaboration with Chongqing City



Source: Compiled by Mizuho Bank Industry Research Department

We hope for a bright future where Japan and Chongqing City contribute to solving the issues surrounding aging populations and decreasing birthrates that countries worldwide will eventually face.

Fuel the new engine of "Chongqing Smart Manufacturing" with the new development of the intelligent terminal industry

Frank Meng
Executive Vice President, Chairman of Qualcomm China

Artificial Intelligence (AI) is an important driving force for a new round of technological revolution and industrial transformation. Generative Artificial Intelligence (AIGC) will further enhance the transformation and upgrading of AI-empowered industries to generate new quality productivity. In 2024, "Artificial Intelligence+" (AI+) appeared for the first time in the government work report, making a strategic deployment for accelerating AI empowerment. The implementation of "AI+" is supported by intelligent terminals, so on-device AI capabilities have become the key to the realization of "AI+". Chongqing has outstanding advantages in the production and manufacturing of intelligent terminals such as automobiles, mobile phones, PCs, and Internet of Things devices. Therefore, Chongqing should seize the development opportunities of "AI+", promote the innovation and development of the intelligent terminal industry, and help the intelligent, clustered, and systematic development of manufacturing.

Firstly, "Artificial Intelligence +" opens up a new space for the intelligent terminal industry.

1. The deep integration of the digital technology and the real economy would unleash the demand for smart terminals.

From the perspective of the macro environment, in the face of opportunities and challenges such as rising labor costs, demographic changes, and unmanned factories, manufacturing enterprises are actively promoting the integration of digital technology into various business processes to achieve cost reduction, efficiency increase, transformation and upgrading. In 2024, China Mobile launches the first commercial deployment of 5G-A, which is regarded as the first year of 5G-A commercial use. 5G-A is more than 10 times more capable of connecting than existing 5G in terms of connection rate and low latency, which not only provides a stable network foundation for the deep integration of data and reality, but also drives the market demand for intelligent terminal markets such as PLCs, intelligent gateways, meters, industrial cameras, industrial robots, and industrial drones that support 5G-A. Taking industrial robots as an example, according to the Ministry of Industry and Information Technology, the density of industrial robots in China will reach 392 units per 10,000 workers in 2022. According to the International Federation of Robotics, Korea ranked first in the world in 2022 with an industrial robot density of 1,012 units per 10,000 workers, and the main industry users came from electronic information manufacturing and automobiles. In contrast,

China's industrial robot market has huge potential.

2. Large-scale expansion of AIGC and improvement of on-device AI witness "two-way efforts".

With the popularity of ChatGPT and Sora, large models with hundreds of billions or even trillions of parameters continue to emerge; large models that process multimodal forms such as speech, images, and text continue to upgrade and iterate; AI large model training continues to be optimized and matured; the demand for AI inference and industry-specific AI inference continues to increase; and the cost of computing power is also rising. In order to reduce the cost of AI computing, it has become a development trend to migrate AI inference to the edge and terminal side. Therefore, the improvement of AI capabilities on the device side has become the key to promoting AIGC to empower thousands of industries. On the other hand, AIGC has driven a new round of smart hardware upgrades, changing the slow development of mobile phones, laptops and other markets. IDC predicts that by 2027, global AI mobile phone shipments will reach 827 million units, AI PCs will account for more than 60% of global PC shipments, and China's Internet of Things spending will reach $300 billion, accounting for about 25% of the world's total. In 2024, mainstream mobile phone manufacturers such as Honor, OPPO, and Samsung will launch AI mobile phones, equipped with SoCs that support device-side AIGC models. PC manufacturers such as Lenovo and Microsoft have launched AI PCs with integrated AI functions in the operating system.

3. Open-up innovative industrial ecosystem promotes the innovation and development of the intelligent terminal industry.

Currently AI has entered the stage of comprehensive transformation from AI industrialization to industrial AI, but there is still a long way to go before it is universally applied. There is still a vast uncharted area for the large-scale application of AI technology in various industries. It has been a common choice for developers, AI software and hardware companies, and vertical industry enterprises to jointly build an open-up and innovative industrial ecosystem. Enterprises in the ecosystem have strengthened collaboration to verify products with each other and promoted the implementation of "AI+". In the face of special digital transformation needs, partners in the ecosystem pool their technological advantages to solve them. As the practical foundation of "AI+", the open-up and innovative industrial ecosystem has also become the "source of living water" to promote its innovation and development. In the face of the diverse application needs of "AI+", cross-category terminal product integration and customized terminals have become a trend. Enriching the underlying hardware categories such as CPU, NPU, GPU, etc., expanding the software stack and open product ecology such as the AI open-source community, will support the free combination and secondary development of intelligent terminal manufacturers to meet the diverse needs of customers. For some industry users whose AI needs are unclear, ecological enterprises need to jointly explore and promote terminal innovation.

Secondly, the development status and improvement direction of Chongqing's modern manufacturing cluster

1. The development status

As China's old industrial base, Chongqing is home to 39 of the 41 industrial categories. Pillar industries such as automobiles, electronic information, and equipment manufacturing continue to grow and develop. According to relevant statistics, in 2023, Chongqing ranked second in China in terms of automobile production, and first in the world and fourth in China in terms of laptop and smartphone production, respectively. The new digital infrastructure such as the industrial Internet identification analysis system and the artificial intelligence innovation center is complete, providing a solid foundation for manufacturing enterprises to "use data to empower intelligence" and build " Chongqing smart manufacturing ".

2. The improvement direction

As an important part of the modern manufacturing cluster, Chongqing's intelligent terminal industry plays an important role in the "AI+" manufacturing industry. Combined with trends such as AIGC and "AI+", Chongqing should accelerate product innovation to adapt to new technologies such as 5G-A and AIGC, enhance the global influence of smart terminals, deepen the collaborative innovation mechanism between schools and enterprises, promote the innovation and development of the intelligent terminal industry, and help the transformation and upgrading of the manufacturing industry.

Thirdly, suggestions for the development of intelligent terminal industrial cluster in Chongqing

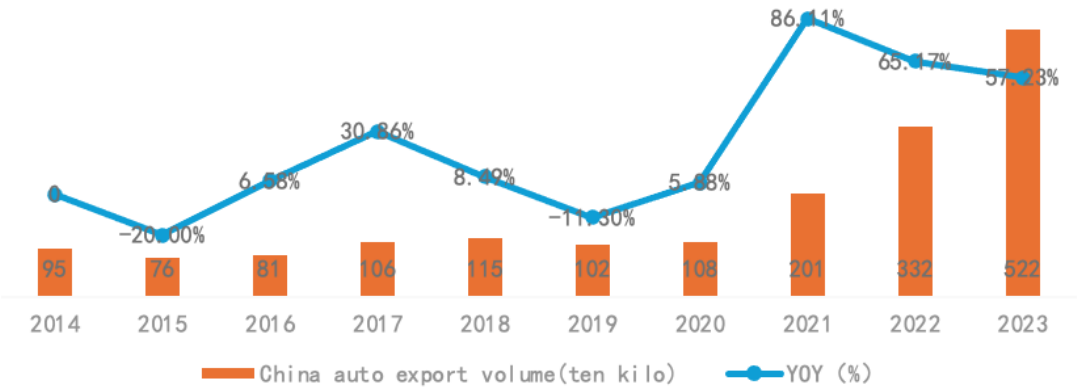
1. Promote the innovation and development of intelligent networked vehicles and enter the global market.

In the first half of 2024, Chongqing returns to the "No. 1 Automobile City in China" and also has China's leading intelligent networked vehicle testing and application foundation. From the perspective of the industry, the tide of China's cars going overseas has appeared, and the development of smart cars has accelerated. According to the statistics of the China Association of Automobile Manufacturers, China's automobile exports in 2023 reach 4.85 million units, a year-on-year increase of 56%, becoming the largest exporter of automobiles, with Europe and Asia as the main export destinations; NEV passenger vehicle exports totaled 1.12 million units, reflecting a 73% y/y increase. According to the statistics of the China Passenger Car Association, from January to February 2024, the loading rate of L2 and above assisted driving functions of China's new energy passenger vehicles reached 62.5%. Chongqing should seize the development opportunities of intelligent networked vehicles and automobiles going overseas, build a global industrial ecosystem,

and promote automobile manufacturing, products and culture to go overseas.

Intelligent driving, intelligent cockpit, and Internet of vehicles are the key technologies of intelligent networked vehicles. AIGC-enabled intelligent connected vehicles will reshape the driving experience of the future. The high computing power and scalability of the underlying hardware have become

Fig.1 China automobile export volume and growth rate from 2014 to 2023



Data Source: China Customs, China Passenger Car Association

the key foundation for AIGC empowerment. Qualcomm has built the "Snapdragon Digital Chassis" around the intelligence and networking of vehicles, including the Snapdragon Automotive Intelligent Connectivity Platform, Snapdragon Cockpit Platform, Autonomous Driving Platform, and Snapdragon Vehicle-to-Cloud Services. Among them, the Snapdragon cockpit platform is a global technology leader in the field of intelligent cockpits, with the largest market share in the world. The fourth-generation Snapdragon cockpit platform is integrated into the AIGC application, supporting the integration of cabin functions such as automatic parking, and supporting function expansion, which can realize user personalization, in-car virtual assistant, natural voice control, driver monitoring and other functions. According to public statistics, so far in 2023, more than 30 new models have been equipped with the fourth-generation Snapdragon cockpit platform and the Zhiji L6 is based on this platform to realize the customized acceleration of Carlog video functions.

In addition, Qualcomm has formed long-term and stable cooperative relationships with global automakers and in-vehicle software manufacturers to jointly promote the evolution of intelligent connected vehicles. Up to now, Qualcomm has cooperated with almost all global automakers such as Audi, BMW, Buick, BYD, Geely, Great Wall, etc., and more than 350 million vehicles around the world have adopted Snapdragon digital chassis solutions. In order to expand its automotive business in Europe, Qualcomm has set up offices in many locations to support customers' customized needs. Establish a long-term cooperation with Google, and use the advantages of the Google Auto Service ecosystem to enrich the functions of the Snapdragon cockpit platform and optimize the

user experience. To this end, Qualcomm hopes to give full play to the advantages of digital chassis technology and global ecology, and use the Chongqing Institute of Collaborative Innovation of Intelligent Connected Vehicles as a platform to jointly explore the integration path of AIGC with intelligent cockpit, intelligent driving and Internet of Vehicles, so as to help Chongqing automobile manufacturers create high-quality products and promote Chongqing Automobile to integrate into the global cycle.

2. Improve the AI software ecosystem and seize the opportunities of mobile phones and PCs.

Chongqing's intelligent terminal production base is the world's leading, and the software and information service industry is developing rapidly. The revenue of the city's software industry increased from 248.1 billion yuan in 2021 to 315.2 billion yuan by the end of 2023, employing more than 340,000 people, providing "hard support" for the sustainable development of the intelligent terminal industry. From the perspective of the industry, AIGC has become a new driving force for the growth of mobile phones, PCs and other shipments. Mobile phones and PCs embedded with AI large model capabilities can provide smoother human-computer interaction through applications such as intelligent assistants, which will deeply empower scenarios such as office production, education and teaching in the future. The high performance and low power consumption characteristics of ARM-based PC chips are more suitable for on-device AI computing tasks and will gradually replace X86 chips, which is generally recognized by the industry experts. However, at present, the AIGC-enabled device side is still in the stage of adaptation of software and hardware products, and the AI software ecosystem is not perfect. The large models of various vendors have not formed a communication ecosystem with each APP, resulting in a large number of just-needed applications or killer applications. Chongqing should seize the trend of AI mobile phones and AI PCs, give full play to the advantages of intelligent terminal manufacturing and software industry, enrich the AI software ecosystem, encourage the development of ARM native applications, and seize the opportunity of industrial development.

Fig.2 AI PC global shipments and PC chip market share

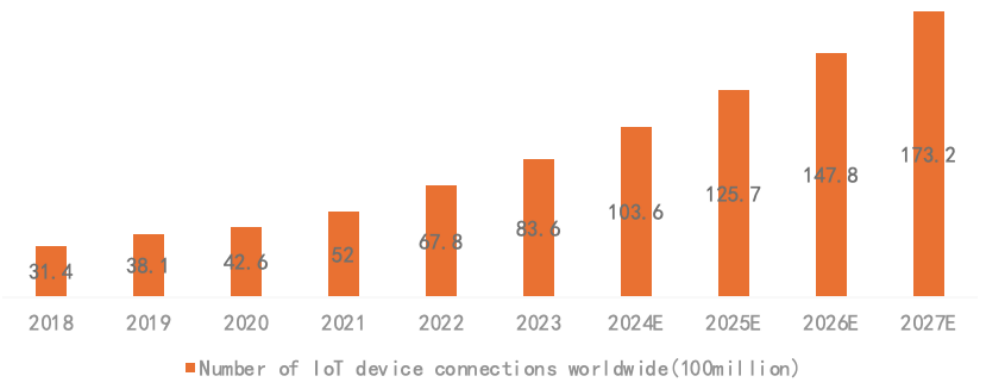
Data Source: Counterpoint

In the field of mobile SoCs, Qualcomm occupies a major share in mid-to-high-end Android mobile phones, and Android mobile phone brands such as Xiaomi, Samsung, OPPO, vivo, and OnePlus are equipped with Qualcomm Snapdragon chips in all flagship models or main models. In the PC field, Qualcomm's X Elite processor is designed, based on the ARM instruction set and applied to Microsoft's AI PC. Over the years, Qualcomm's AI R&D team has worked closely with AI research institutes to continuously improve AI capabilities on the device side. In order to further stimulate the market potential of AI mobile phones and AI PCs, Qualcomm hopes to strengthen cooperation with Chongqing in the AI software ecosystem. Through developer conferences, open-source platforms, etc., Qualcomm shares the development trends of global end-side AI application software with developers, and improves the application capabilities of device-side AI large models with rich applications.

3. Build an open-up innovative ecosystem and enter a new blue ocean of the Internet of Things.

Chongqing's Internet of Things business is developing rapidly. The production of IoT terminals such as smart homes, sensors, industrial robots, and drones has formed a new growth point. From the perspective of the industry, as the Internet of Everything network technology, 5G-A and AIGC will accelerate the penetration of the Internet of Things into all walks of life. As the "traffic entrance" of "AI+", the number of connections will continue to rise. Build an open and innovative industrial ecosystem, which is in line with the characteristics of a wide range of users in the Internet of Things industry.

Fig.3 Number of IoT device connections worldwide



Data Source: Statista

Over the years, Qualcomm has worked closely with leading terminal and module manufacturers in the field of Internet of Things to create industry solutions and accumulate practical experience with technology accumulation and product advantages in connectivity, computing, and AI. In July 2024, Qualcomm, Ericsson, and Dronus, a provider of industrial drone solutions,

completed the testing of manufacturing and warehousing use cases using 5G mmWave drones. Qualcomm, module manufacturer MeiG Intelligence, and system manufacturer Yinghantong jointly built a robot remote maintenance system to achieve predictive maintenance of robots and greatly reduce downtime. In addition, in view of the characteristics of many scenarios and scattered needs in the Internet of Things industry, Qualcomm has built a Linux-based open source platform and developer community for small and micro enterprises and individual developers, and Qualcomm engineers provide technical support to jointly explore potential scenarios.

Qualcomm and Chongqing have a solid foundation for cooperation. In 2016, it established a joint venture with Thundersoft in Chongqing. Since its establishment, Thundercomm has developed IoT modules, development boards, edge computing boxes and other products based on Qualcomm products, and provided IoT solutions for manufacturing, smart cities, factory inspections and other scenarios, not only empowering local "AI+" practices, but also providing technical support for upstream and downstream SMEs through product testing and verification to help agglomeration development. In 2021, Qualcomm and Tencent jointly held an entrepreneurship competition in Chongqing to tap new talents in the 5G empowerment industry; In September 2024, Qualcomm and Chang'an will jointly hold an automotive technology experience day. To this end, Qualcomm hopes to work with Chongqing to build an open and innovative IoT industry ecosystem, continue to improve the construction of the IoT developer community with Thundercomm as the carrier, link small and medium-sized enterprises and industry developers, share Qualcomm's innovative applications and practical cases in the field of the Internet of Things, provide underlying technical support, and collaboratively promote IoT terminal innovation.

Therefore, We suggest that the Chongqing Government promote the innovation and development of the intelligent terminal industry from the following aspects:

The first is to enhance the global competitiveness of intelligent networked vehicles. Continuing to taking effective measures to encourage automakers to increase R&D investment is essential to improving product performance and competitiveness, promoting the use of large AI models on the bus, grasping the trend of which the computing unit supports the integration of intelligent cockpit and intelligent driving at the same time, reducing development costs, optimizing the utilization of computing power. Relying on the platform of Chongqing Intelligent Connected Vehicle Collaborative Innovation Research Institute, and with the help of Chongqing's international logistics system, it enables to link global industrial resources and strengthen global cooperation.

The second is to strongly support the open-source ecosystem. Relying on the Chongqing Artificial Intelligence Innovation Center, to attract and develop AI open-source software companies and build an AI open-source community is necessary; Regularly hold AI developer conferences to discuss global AI application trends. Relying on the technical foundation of Thundercomm,

Qualcomm and other enterprises, to improve the Internet of Things developer community and explore potential scenarios, and innovate terminal products is essential.

The third is to further increase the training of AI application developers. Encourage colleges and universities and technical colleges to offer courses such as ARM native application development and AI software development. Relying on Chongqing Software Park and the cultivation plans of Mantianxing, Beidouxing, and Qimingxing, to cooperate with enterprises such as AI chips, modules, intelligent terminals, software platforms, and vertical industries set up AI software talent training bases, and organize AI software training such as ARM native application development.

As a global leader in mobile communication technology and a leader in chip design, Qualcomm hopes to deepen cooperation with Chongqing in building a global ecosystem, open-source community, and talent training, so as to help "Chongqing Smart Manufacturing" take off.

Accelerate Chongqing's Intelligent Manufacturing by upgrading traditional manufacturing and developing lowand zero-carbon industries

Nathan Stoner
Cummins Vice President and Chairman of Cummins China

The manufacturing industry is a crucial pillar of the economy. Promoting the development of manufacturing clusters is a key strategy for achieving high-quality economic growth. This approach not only advances industries towards higher value levels but also enhances the resilience and safety of industrial and supply chains. It fosters economies of scale and competitive advantages through collaborative innovation, talent development, cost reduction, and efficiency improvement.

Cummins operates approximately 150 manufacturing facilities worldwide, including 26 in China. The company is at the forefront of intelligent manufacturing, having created a digital manufacturing ecosystem that incorporates industrial Internet of Things (IoT), advanced manufacturing technologies such as robotics, standardized systems (safety, quality, efficiency, etc.), secure and reliable network systems, and other essential elements like talent. In China, Cummins leverages its facilities, including Chongqing Cummins Engine Co. Ltd. (CCEC), to develop intelligent manufacturing as a group, support regional advanced manufacturing clusters, and drive upgrades in intelligent equipment, new energy, and energy storage technologies.

1. Practice and sharing of Cummins China's intelligent manufacturing systems

In China, Cummins has formed an Intelligent Manufacturing Program Team, and its factories across the country are actively advancing the transformation towards intelligent manufacturing and the implementation of related projects. Building on the practical experiences of each factory, Cummins China is now embarking on its next phase of intensive, systematic, and ecological intelligent manufacturing strategies.

(1) Engaging top leadership in China and establishing Intelligent Manufacturing Leadership Committee in China

Cummins China has placed significant importance on intelligent manufacturing. The company began planning this initiative as a group in 2019 and officially established the China Intelligent Manufacturing Program Leadership Committee and China Intelligent Manufacturing Program Team in 2020. These are supported by CEO and CFO in China region and are led by the China

Manufacturing Director and Supply Chain Director. The manufacturing engineering and IT functions, plus all business units are fully involved.

(2) Achievement and Recognition Received

Under the unified leadership of Cummins China, its factories, including CCEC, are actively promoting the transformation to intelligent manufacturing and the implementation of new projects to improve operational levels. The recognition and honors received include:

- Recognitions on Innovations: companies in China like Foton Cummins, Dongfeng Cummins, and Guangxi Cummins have been recognized as national or regional intelligent manufacturing leaders.
- Intelligent Manufacturing Demonstration Enterprises: Companies such as CCEC, Cummins Wuxi Turbocharger, Cummins Wuhan Fuel System, and Dongfeng Cummins Emission System have been awarded the qualifications of intelligent manufacturing demonstration enterprises by provincial, municipal, and district governments.
- Industry Awards: Cummins China's Industrial General Analysis Platform won the IDC Annual Special Innovation Award for its role in promoting intelligent transformation and enhancing productivity. Foton Cummins was also awarded as "Lighthouse Factory" by the World Economic Forum and McKinsey.
- Capability Ratings: Most Cummins factories in China have received a Level 2 rating in the Smart Manufacturing Capability Maturity Assessment (CMMM), with some moving towards Level 3. For example, Cummins Wuxi Turbochargers achieved a high score in the CMMM Level 3 evaluation.

(3) Future measures of Intelligent Manufacturing

Based on extensive practice, Cummins China is focusing on the next steps for intensive, systematic, and ecological intelligent manufacturing promotions. This includes:

- Introducing Advanced Technologies: Incorporating advanced industry technologies into intelligent manufacturing projects. Examples include:
    - Piloting comprehensive industrial 5G for intelligent park management, safety management, and equipment high-speed networking.
    - Utilizing IoT technology to integrate data from personnel, equipment, materials, environment, and energy at the factory level, forming a centralized data hub.

  - Introducing key AI technologies to improve factory quality inspection, control, processing technology, and operational efficiency, thereby transforming data assets into business value.

- Enhancing Employee Learning: Focusing on empowering frontline employees with new technologies. This includes conducting extensive training, learning courses, on-site exercises, and performance evaluations on innovation. The goal is to lower technical barriers through low coding, tools and platforms.

- Creating a Technology Platform: Establishing a common technology platform and inviting external partners to achieve ecological synergy and promote the transformation of intelligent manufacturing in multiple, fast, efficient, and cost-effective ways.

2. CCEC's Practices and Future Focus in Intelligent and Green Manufacturing

CCEC has been actively participating in the clustering of the manufacturing industry, including having established a digital committee, and has achieved significant results in the construction of intelligent manufacturing demonstration factories, application of new and green technologies in manufacturing scenarios. This not only improves the company's own high-end, intelligent, and green performance but also offers resources to other brother enterprises in the industry.

(1) Achievements in Intelligent Manufacturing

CCEC has made significant progress:

- Organizational, Financial and Talent Support: A company-level digitalization committee led by the general manager, covering cross functional teams such as product planning, production, Industry 4.0, IT, manufacturing engineering, etc., oversees its digital reforms. The implementation of digital reform has been ensured through organizational structure and talent allocation, with an annual investment of over 20 million yuan spending on continuous research and development of digital products and upgrading of intelligent manufacturing production lines.

- Intelligent Manufacturing Demonstration Factories: the company benchmarks a national intelligent manufacturing demonstration factory, and focuses on digital products, intelligent production, intelligent supply chain, green manufacturing, network security, etc. covering a total of 25 scenarios, including simulation design, digital twin, advanced logistics, end-to-end visualization of supply chain, energy management, 5G network, equipment health

prediction, robotics and automation, manufacturing data analysis, etc. The company has reduced overall operating costs by 18%, decreased quality failures by 10%, and cut CO2 emissions by 12%.

- Transformation Initiatives: CCEC has actively participated in establishing and validating intelligent manufacturing transformation planning methods, implemented the first intelligent LOTO (Tag Lock) application among Cummins companies in China, and introduced AI visual intelligent recognition solutions. These efforts have enhanced safety, quality control and operational efficiency.

- Other achievements include applying new technologies in manufacturing such as intelligent park management system, having trained a digital talent team, etc.

- Future plans: CCEC worked out its Industry 4.0 roadmap using a complete set of methodologies, pointing out the direction for the development of intelligent manufacturing in the factory in the next three years. The focus includes: (1) build a general data analysis platform to provide analysis models and computing power for manufacturing process data analysis; (2) realize unmanned black light production line by upgrading automation level; (3) utilize simulation and digital twin technology to enhance the level of product design and process design; (4) use AI to predict the health status of equipment and reduce equipment downtime; (5) build a smart park platform to achieve real-time perception of data within the park to improve operational efficiency, and reduce operational risks; (6) have non-IT employee participate in the development and production of business automation applications by the use of such tools as low code application platform.

(2) Achievements in Green Manufacturing

CCEC has made strides in green manufacturing as well through:

- Green Practices: Implementing plant planning, R&D design, production, supply chain management and carbon reduction practice with a focus on green and efficiency optimization. Projects include Plant green and high efficiency design using BIM, Green designing platform on LCA, Green supply chain intelligent management on SRM platform, Cummins energy management system, rainwater collection, reclaimed water reuse, and power recovery systems from test cells, solar power generation, etc., from which, the company has received honors such as National Green Factory and Chongqing Green Factory.

- Future Plans on green manufacturing: Chongqing Cummins will invest in energy storage, exhaust heat recovery, energy management system upgrading, air compressor improvement etc. to achieve company's Destination Zero targets.

3. Cummins' Recommendations for Building a Modern Manufacturing Cluster System in Chongqing

From Chongqing's manufacturing industry advantages and Cummins' industrial technology practices, Cummins' suggestions for building a modern manufacturing industry cluster system in Chongqing are as follows: building a manufacturing industry cluster intelligence sharing platform, accelerating the development of specified industry clusters such as hydrogen energy industry, as well as promoting both emerging and traditional industries.

(1) Building an Intelligence Sharing Platform

- Intelligence collection and sharing: One suggestion is for the Chongqing Government to take the lead in collecting the practices and achievements of key enterprises in the high-end, intelligent, green, and clustered development of the manufacturing industry, for learning and replication among all manufacturing plants. From the perspective of the development of manufacturing clusters, it is suggested that, for example, through pilot projects, the upstream and downstream can be connected, and some digital sharing platforms can be established to share information throughout the industrial chain (such as market forecast information sharing).

- Technology Platforms: Utilize the intelligent manufacturing general technology integration platform to address various business problems, enhancing innovation and accelerating digital transformation.

(2) Accelerating the Development of Low and Zero-Carbon Industrial Clusters, such as hydrogen

- Hydrogen as Energy: Focus on developing hydrogen as energy industries, by leveraging Chongqing's strengths in advanced equipment manufacturing, chemistry and automotive parts. Promote hydrogen fuel cell vehicles and establish hydrogen energy applications in transportation and industrial sectors. Through cross regional technology linkage, attract advanced hydrogen energy technologies and products from both local and other regions to be applied in Chongqing, prioritize applications over local investment, and promote the joint development of (green) hydrogen production, hydrogen fuel cell vehicles, hydrogen power generation and hydrogen chemical industries.

- Expanding Application Scenarios. (1) Transportation: based on Chongqing's current measures the promotion and application of hydrogen fuel cell vehicles, suggest increasing

the pilot of fuel cell vehicles, especially on the "Chengdu Chongqing Hydrogen Corridor". Encourage advanced hydrogen fuel cell technologies and products from home and out of Chongqing to be put into operation on the Chongqing Hydrogen Expressway and provide cost reduction support in terms of operations and highway toll fee. At the same time, under the background of the national trade in policy, encourage end users to purchase hydrogen fuel cell vehicles to eliminate high emission diesel vehicles. (2) Encourage the use of low-carbon and zero carbon transportation vehicles in logistics for large enterprises and municipal construction projects and establish carbon reduction targets for relevant enterprises. (3) For key areas of environmental protection, such as urban waste transportation, policy incentives could be given to increase the use of hydrogen powered waste trucks. For enterprises that use zero carbon transportation vehicles, incentives such as “right of way” (i.e. transportation without time restrictions) and bonus points could be given. (4) Pilot projects to adopt hydrogen energy technology for power generation in data centers and industrial sectors. (5) Encourage PEM electrolyzer for green hydrogen production, as well as one-site hydrogen production and filling.

- Further Opening: suggest not to set local investment (R&D, production) requirements for hydrogen applications and fully encourage healthy competition among enterprises both from and out of Chongqing.

(3) Joint Development of Emerging and Traditional Industries

- Balancing Development: Recognize the importance of both emerging industries (like new energy vehicles) and traditional manufacturing industries. Support the transformation and upgrading of traditional industries while fostering the growth of emerging sectors.

- Supporting Measures: Accelerate digital transformation and green development of traditional industries through stronger policy guidance, financial incentives, and talent cultivation. Build a digital ecosystem to enhance manufacturing clusters and achieve traditional industry’s upgrading.

By implementing these measures, Chongqing can leverage its manufacturing strengths and expertise to build a robust and modern manufacturing cluster system.

Accelerating the Green Transition for the High-Quality Development of Chongqing's Manufacturing Cluster

Saw Choon Seong
Global Vice President, President China of Air Products

Amidst the significant energy and environmental sustainability challenges faced by the world today, green and low-carbon transformation has become an irreversible global development trend. China has been actively and steadily progressing toward the goals for carbon peak and carbon neutrality. We are pleased to see that the Chinese government has recently released new work plan focused on carbon emission for accelerating the comprehensive green transformation of economic and social development.

Chongqing, as the economic center of Southwest China and the growth engine of regional development, is deeply advancing the high-quality development of manufacturing in the new era and new journey, building a modern manufacturing cluster system, upgrading the manufacturing industry structure, and striving to become a national center for advanced manufacturing. At the same time, the development of Chongqing's modern manufacturing clusters is closely connected with the global and Chinese goals of green, environmentally friendly and sustainable development, actively responding to the country's "dual carbon" actions.

Air Products is the world's leading industrial gas supplier and the largest hydrogen supplier. With 18 years of deep cultivation in Chongqing, we has invested in several state-of-the-art production facilities, providing strong support for key industries such as chemical, steel, advanced equipment, and electronics. We are not only an important witnesses to but also an active participant in Chongqing's development. In the new era and new journey, in line with the company’s two pillars growth strategy and based on Chongqing’s energy endowment and industrial development needs, we are willing to leverage our experience and expertise accumulated from over 80 years operation focused on serving energy, environment, and emerging markets , to support the green transition and high-quality development of Chongqing's manufacturing industry and generate a cleaner future together.

Leveraging our leading-edge technologies and best practices worldwide, we would like to provide the following three suggestions and thoughts for Chongqing to build a modern manufacturing cluster system from two key areas: integrated gas supply for industrial parks and

clusters for low-carbon development; hydrogen energy and the clean and efficient use of energy for sustainable development.

I. Introduce world-class green and low-carbon technologies to drive innovation-led development

Achieving the strategic goals of carbon peak before 2030 and carbon neutrality before 2060 has become a major national strategy of our country. Given that China still mainly relies on coal as the main energy consumption, CCUS (Carbon Capture, Utilization, and Storage) technology plays a crucial role in achieving the goals. Technological innovation is the core driving force for carbon neutrality. Although China started late in CCUS technology, it has made significant progress in various technical links after years of rapid development.

Chongqing, with its unique resource endowment and strong industrial foundation, has become an important national base for energy and chemical industry, especially with a solid foundation in the natural gas chemical industry. Faced with the scientific layout of the energy industry and the green transformation needs of key industries, the promotion and application of CCUS technology in industries such as chemical and steel will effectively reduce carbon emissions and accelerate the green transformation process of the industry.

We suggest deploying CCUS technology demonstration projects in industrial parks, exploring commercial operation models, and achieving rational allocation and comprehensive utilization of resources. By introducing safe and intelligent high-level management, we can achieve clean and efficient use of energy in the modern industrial system, meeting the multifaceted needs of economic development, energy supply, energy structure optimization, industrial development, and energy-saving emission reduction, thus becoming a strategic technological choice for building a modern industrial system.

Promoting CCUS technology research and innovation and reducing costs is key to achieving its large-scale commercial development. The development of core technologies, such as low-cost and low-energy carbon capture technology, and the high-value transformation and utilization of CO2, requires the government to provide funding and tax incentives, and incentivize enterprises to increase R&D investment.

Strengthening international cooperation and introducing advanced technology and management experience is an important way to accelerate local CCUS development. Global CCUS technology is mainly mastered by large enterprises in the fields of industrial gases, petrochemicals, and engineering technology. Against the backdrop of countries proposing carbon neutrality goals, cooperation with major countries and regions such as Europe and the United States, and learning

from the experience of large-scale full-process CCUS projects abroad, will inject new momentum into the development of local CCUS technology.

As a global leader of technical options for capturing CO2 from fossil fuel conversion before it reaches the atmosphere, Air Products has a comprehensive range of carbon dioxide separation and adsorption technologies, providing full-chain solutions from pre-combustion to post-combustion. The company's accumulated engineering and operational experience worldwide provides a reference model and strong technical support for carbon emission reduction in Chongqing's industrial parks.

At present, Air Products is engaged in in-depth exchanges with some park and local enterprises, providing integrated industrial gas island solutions from centralized design, investment, construction, and operation. By recycling and utilizing the carbon dioxide emitted by enterprises in the park and converting it into synthesis gas, it provides high added-value raw materials for park enterprises, helping Chongqing to achieve clean and low-carbon energy transition and making a positive contribution to achieving the goal of carbon neutrality.

II. Support the scale development of new-generation electronic information manufacturing industry to accelerate the formation of industrial clusters

Chongqing's new generation of electronic information manufacturing industry occupies a core position in the "33618" modern manufacturing cluster system with its huge industry scale, high enterprise aggregation, strong innovation capability, perfect industrial support, extensive open cooperation, and regional collaborative development. As one of the three trillion-level leading industry clusters, Chongqing is promoting the high-end, intelligent, and green transformation of the industry through the plan, aiming to build a globally competitive industrial cluster. In this process, industrial gases, as a supporting element of the electronic information manufacturing industry, play a crucial role.

It is suggested that the government vigorously promote the centralized supply of industrial gases in the electronic industry park, build an integrated industrial gas island, and use the pipeline system to provide a comprehensive supply of industrial gases for park enterprises. This model will enhance the supporting capacity of the industrial chain and achieve an organic combination of operational efficiency and economy. The centralized gas supply network, with multiple sets of devices as backups for each other, greatly improves the safety, reliability, and stability of gas supply.

The integrated gas supply solution covers the entire chain from gas supply planning, facility construction to operational management, helping modern electronic parks to achieve environmentally friendly operations at a low cost, and providing a stable and reliable gas supply for the park, and promoting the sustainable development of the park. The stability, economy, and safety of centralized supply can not only meet the diversified needs of gas types and quality in the

electronic manufacturing process but also enhance the overall supporting capacity of the industrial chain. In addition, this model has a strong attraction for leading enterprises in the electronics industry to invest in Chongqing, further promoting the formation and expansion of industrial clusters.

As a world's leading supplier of high-purity industrial gases for the electronics manufacturing industry, Air Products has rich experience in providing overall solutions for the electronics industry. In high-tech parks such as Silicon Valley in the United States, Pyeongtaek in South Korea, and Kulim in Malaysia, our gas pipeline network has successfully supported the rapid development of the local electronics industry. In Guangzhou, Nanjing, Xi'an, and other places in China, our gas pipeline network has also helped local electronics industry achieve high-quality growth.

In summary, the Chongqing government's promotion of centralized supply of industrial gases in the electronic industry park can not only significantly improve the level of industrial infrastructure in the park but also effectively promote the agglomeration and development of the electronics industry, which has far-reaching strategic significance for the transformation and upgrading of the regional economy. Through this strategy, Chongqing will further consolidate its leading position in the global electronic information manufacturing industry, injecting new momentum into the continuous prosperity of the regional economy.

III. Build a full hydrogen value chain to drive industrial decarbonization and green transportation development

China's "dual carbon" goals are of great significance in leading the efforts to combat climate change for global sustainable development. Hydrogen energy, as an important carrier of energy transition, plays a key role in achieving this goal. The hydrogen energy industry not only represents the future direction of China's energy system but also an important way to promote the green and low-carbon transformation of the economy.

Chongqing has made significant achievements in building the hydrogen energy industry chain. By cooperating with Chengdu, it has jointly created the "Chengdu-Chongqing Hydrogen Corridor," forming an interconnected network of hydrogen economy in the region, laying the foundation for the formation and development of the hydrogen energy industry cluster. A series of support policies issued by Chongqing cover key areas such as hydrogen energy technology research and development, financial support, and promotion and application, accelerating the popularization and application of hydrogen energy technology. At the same time, Chongqing's rich industrial by-product hydrogen resources provide a stable and cost-effective hydrogen supply for the hydrogen fuel cell vehicle industry. This indicates that Chongqing is gradually building a hydrogen energy industry system with international competitiveness, helping the region's economy to transform green and low carbon.

Based on this, it is suggested that Chongqing further plans the hydrogen energy industry, relying on rich hydrogen resources and technological innovation, to improve the "production-storage-transportation-refueling-use" links of the entire hydrogen energy industry chain. Specific suggestions are as follows:

1. Strengthen standard setting: Ensure the safe and efficient operation of the hydrogen energy industry by formulating and implementing a series of industry standards and specifications.

2. Policy Guidance and Support: Increase policy support to encourage technological innovation and demonstration applications, especially special policies for liquid hydrogen technology, to promote the research and development of liquid hydrogen preparation, storage, transportation, and application technologies, and build a complete liquid hydrogen industry chain. Liquid hydrogen technology, with its efficient storage and transportation capabilities, is of great significance for the large-scale application of hydrogen energy.

3. Explore Application Scenarios: Actively expand the application of hydrogen energy in zero-emission transportation and industrial carbon reduction, promoting the extension and expansion of the hydrogen energy industry chain.

4. Take the lead in researching and deploying the development path of low-carbon and zero hydrocarbon industry.

Air Products, as a global leader in hydrogen supply and a pioneer in low- and zero-carbon megaprojects, has over 65 years of experience in operation in the hydrogen energy value chain. We provide full hydrogen value chain solution covering hydrogen production, liquefaction, storage, transportation, refueling, and applications. The company has the world's longest hydrogen pipeline system and serves the market with various supply methods such as on-site hydrogen production, high-pressure tube trailers, liquid hydrogen tank trucks, and pipelines. We have hands-on operating experience with more than 250 hydrogen refueling station projects worldwide, with over 1.5 million refueling operations annually.

As a world-class liquid hydrogen supplier, Air Products is investing in the building of the first 30-ton/day commercial liquid hydrogen production facility in Haiyan county, Jiaxing city, Zhejiang province, China, as well as forming a liquid hydrogen transportation fleet. We have invested in building nearly ten hydrogen and liquid hydrogen refueling stations in China's five major hydrogen energy demonstration clusters, several of which have been put into operation. The company is investing $15 billion globally in green and blue hydrogen megaprojects to drive the clean energy transition.

Through cooperation with Chongqing, Air Products looks forward to contributing to the development of the hydrogen energy industry and jointly driving the realization of hydrogen full value chain for energy transition.

In summary, we look forward to working closely with the Chongqing government and industrial partners to share resources, technology, and experience, and jointly explore and practice new paths of high-quality development. We believe that through unremitting efforts and in-depth cooperation, we can contribute to the transformation and upgrading of Chongqing's manufacturing industry and sustainable development, and usher in a new era and journey of high-quality development.

Enhancing Value through Industry Upgrading and Optimizing Efficiency in High-End Manufacturing through Digital Intelligence
Suggestions for the Transformation of Chongqing's Modern Manufacturing Industry Clusters

John Zhang
Senior vice president and general manager, Corning Asia

Abstract

Chongqing is a manufacturing hub in the western region, and since the 14th Five-Year Plan, it has made significant progress in manufacturing, achieving notable results. Recently, the added value of the secondary industry and the added value of large-scale industrial enterprises have ranked among the top in the country. Development of industrial clusters such as the automotive industry, electronic information industry, and display technology have also been prominent. While achieving outstanding development results, Chongqing's manufacturing sector still faces some challenges in profitability, innovation capability, value layout, and digital transformation when compared to international and domestic benchmarks.

The central government places great importance on the development of Chongqing's manufacturing sector, requiring Chongqing to make high-quality development of manufacturing a higher priority, accelerate the construction of a modern industrial system with strong competitiveness and sustainability, build a important national advanced manufacturing center, and foster advanced manufacturing clusters with international competitiveness. Chongqing is actively deploying a "33618" modern manufacturing cluster system, setting clear development goals for high-quality manufacturing development and the advancement and intelligence of industries. Looking outward, in terms of industrial advancement, several internationally leading urban industrial clusters each have their own development characteristics, which are worthy of reference by Chongqing. In terms of intelligence, the best practices of "Lighthouse Factories" selected by the World Economic Forum can also be learned from.

We recommend that Chongqing emphasizes the role of innovation leadership, ensures safeguards such as intellectual property protection, builds on its strengths, further improves the business environment, and attracts world-class companies to continuously invest and settle down in Chongqing, helping to advance the manufacturing industry and enhance industrial value.

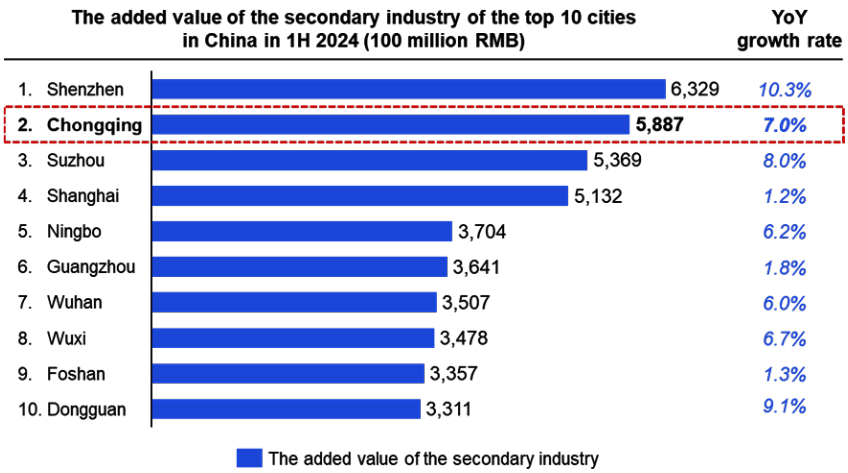
In intelligent manufacturing, Chongqing can learn from the digital transformation practices of "Lighthouse Factories," solidly carry out transformation work in three dimensions – business, organization, and technology, learn from and build "lighthouses," and promote advanced experiences throughout the region to benefit more enterprises. Through intelligent manufacturing, Chongqing can significantly improve efficiency and enhance the competitiveness of its manufacturing industry.

Part One: Where We Are – The Current State and Challenges of Chongqing's Manufacturing Industry and Industrial Clusters

1.1 Building a solid foundation, achieving notable results, and leading in manufacturing development

Chongqing is a manufacturing hub in the western region, endowed with abundant resources and a vast market space. The manufacturing sector plays a pivotal role in Chongqing's economic development. Since the 14th Five-Year Plan, Chongqing's manufacturing industry has achieved significant progress with remarkable results. In the first half of 2024, Chongqing ranked second in the country for added value in the secondary industry, just behind Shenzhen. The growth rate of the secondary industry reached 7.0%.

Figure 1: The added value of the secondary industry in Chongqing ranked second among the cities in China in the first half of 2024.



(Source: National Bureau of Statistics)

In terms of industrial cluster development, Chongqing also stands out with its achievements.

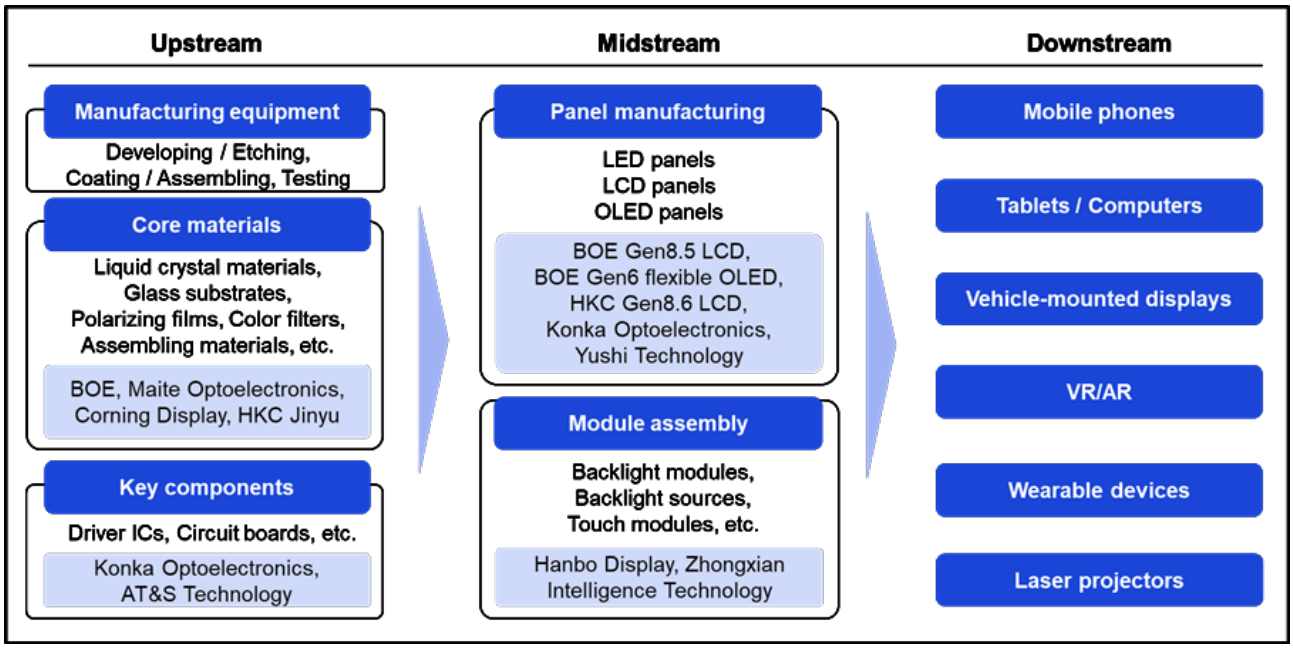
In the automotive industry, from January to June 2024, Chongqing produced 1.214 million vehicles, ranking first among all cities in the country. During the same period, the production of new energy vehicles in Chongqing reached 391,000 units, a year-on-year increase of 1.5x, making it the fastest-growing among the top ten provinces and cities in terms of vehicle production.

In the electronic information industry, the Chengdu-Chongqing region's electronic information industrial cluster reached a production value over 2 trillion yuan in 2023, accounting for over 14% of the national electronic information industry. The scale of the new display industry accounted for more than 30% of the national total. Chongqing has made significant progress in the layout of the "chip-display-end-core-network" industrial chain. The improvement of this industrial chain layout has enabled Chongqing's electronic information industry to expand from the single production of notebook computers to a comprehensive range, including the production of mobile phones, printers, displays, routers, switches, and other products, forming a "1+N" diversified combination industrial structure. The Liangjiang New Area has established an electronic information industrial development pattern of "new display + integrated circuits + smart terminals."

Corning's investment in Chongqing primarily focuses on the display technology industry. In 2023, Chongqing's new display industry cluster achieved a production value of 76.9 billion yuan, with the capacity and output of liquid crystal panels ranking among the top in the country. By attracting and nurturing leading enterprises, a complete industrial ecosystem has been built. For example, BOE Chongqing's 6th generation AMOLED (flexible) panel production line officially went into mass production, mainly producing flexible display products for smartphones, automotive use, and foldable notebooks. These technologies not only have the potential to significantly change the way a person interacts with a device, but also initiate a new round of display revolution.

Moreover, building upon its existing display glass finishing line facility in Chongqing, Corning invested in a display glass melting facility in 2021, with phase two of the project investment valued at approximately $1 billion. This further consolidated the entire industrial ecosystem of "glass substrate–display panel–display module," aiding Chongqing in realizing its strategic goal of the display industry transitioning from "sand to television sets," improving production efficiency and reducing costs. In 2021, Corning also introduced its first Corning® Gorilla® Glass manufacturing project in China mainland, primarily used for cover glass in consumer electronics and automotive displays. Currently, Chongqing has gathered nearly 60 upstream and downstream enterprises in the new display industry chain, such as BOE, HKC Jinyu, Konka, Corning, and Lianchuang Electronics. An entire industrial chain has been constructed, ranging from raw materials and component support to glass substrates, liquid crystal panels, display modules, and complete devices. Among these, advanced display technologies such as new quantum dot films and Mini/MicroLED are leading within the industry.

Figure 2: Value chain of the new display industry in Chongqing



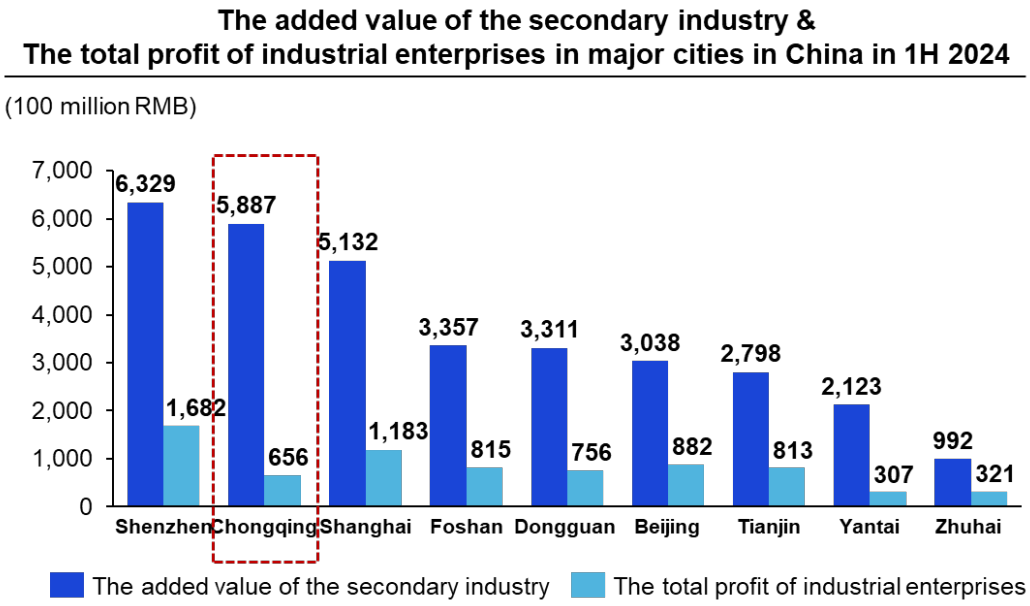
In addition, Chongqing has made remarkable achievements in the development and construction of advanced materials, intelligent equipment, software information services, food processing, and other industries. We sincerely admire Chongqing's development achievements in manufacturing and industrial clusters.

1.2 Marked successes and boundless potential for growth amid challenges with high-quality efficiency

While the results are gratifying, we believe that Chongqing's manufacturing industry still has the potential and space for further improvement in terms of high value creation and efficient operation.

Profitability: From the data point of view, although Chongqing is in the forefront of the country in the first half of 2024, the total industrial profit above the designated size is 65.62 billion yuan, lagging behind Beijing, Shanghai, and other cities with smaller industrial added value. Compared with the leading cities in China, Chongqing's manufacturing industry still has opportunity to catch up in terms of value creation.

Figure 3: The added value of the secondary industry and total industrial profits in major cities in China in the first half of 2024



(Source: National Bureau of Statistics)

Innovation ability: An important support behind profitability is the innovation ability of enterprises and cities. According to the information released by the Chongqing Science and Technology Work Conference in March this year, Chongqing's R&D investment intensity was 2.45% in 2023, lower than the national R&D investment intensity of 2.64%. During the same period, the leading provinces (cities) in the intensity of R&D investment in the whole society were Beijing (more than 6.0%), Shanghai (4.4%), Tianjin (3.49%), and Guangdong (3.39%), Jiangsu (3.20%) and Zhejiang (3.15%).

Value layout: In terms of R&D and production of high-end chips in the electronic information and semiconductor industry, there is still a gap with the domestic advanced level. In terms of core technology fields such as automotive chips and autonomous driving algorithms, as well as the supply of high value-added components, there is a lack of complete local industrial chain support.

Digital and intelligent transformation: Chongqing has clearly identified intelligent manufacturing as its main direction, promoting the deep integration of digital technology with the manufacturing sector to accelerate the formation of new productive capabilities. It has released the "Chongqing Industrial Brain Construction Guide (1.0)" to foster an ecosystem of "smart factories + industrial brain," accelerating the construction of intelligent factories and digital workshops. However, when measured against global benchmarks, there is still a gap. In the World Economic Forum's global "Lighthouse Factory" network, by the end of 2023, 153 factories had been selected, with 62 of them located in China; however, no enterprise from Chongqing has yet made it into this list as a world-class benchmark in intelligent manufacturing.

Part Two: Where We Are Heading – Future Goals and Advanced Cases for the Advancement and Intelligence of Chongqing's Manufacturing Industry

2.1 High-quality development, clear goals, and determination to seek breakthroughs[111]

The Central Committee of the Communist Party of China and the State Council attach great importance to the development of Chongqing's manufacturing industry. They require Chongqing to place high-quality development of manufacturing in a more prominent position, accelerate the construction of a modern industrial system that is highly competitive and sustainable, build a national center for important advanced manufacturing, and foster advanced manufacturing clusters with international competitiveness.

During his inspection of Chongqing in April 2024, Xi Jinping, general secretary of the Communist Party of China Central Committee, pointed out that Chongqing has a solid foundation in manufacturing and is rich in scientific, educational, and human resources. Efforts should be made to build a modern industrial system with advanced manufacturing as its backbone. It is essential to deeply implement major technological transformation and upgrades in manufacturing, as well as large-scale equipment renewal, to accelerate the transformation and upgrading of traditional industries. Chongqing should actively foster strategic emerging industries with international advanced levels and competitiveness. It should strengthen major scientific and technological breakthroughs, promote deep integration of scientific innovation and industrial innovation, and actively cultivate new business forms, models, and driving forces. Chongqing must also adapt to local conditions to develop new forms of productive capacity and actively promote the construction of the Chengdu-Chongqing Economic Circle to better play the role of an important growth pole and a new source of momentum for high-quality development nationwide.

In 2023, Chongqing held a high-level conference to promote high-quality development in the city's manufacturing sector and formulated and implemented the "Action Plan for Deepening High-Quality Development of Manufacturing in a New Era and New Journey in New Chongqing (2023-2027)." This action plan sets primary goals for breakthroughs in areas such as scale and capacity, innovation empowerment, structural optimization, green and low-carbon development, spatial layout, and enterprise entities. It also deploys the creation of a "33618" modern manufacturing cluster system and identifies comprehensive digital transformation as a special action, proposing specific requirements.

Figure 4: The goals of the action plan for promoting high-quality manufacturing development of new Chongqing in the new era and new journey

Development Direction	Specific Goals
Achieve new breakthroughs in scale and energy level	The operating income of industrial enterprises above designated size steps onto the 4 trillion yuan level. The proportion of manufacturing added value in the regional GDP increases to 28%. The proportion of digital economy added value in the regional GDP exceeds 50%.
Achieve new breakthroughs in innovation empowerment	The R&D investment of designated-sized industrial enterprises exceeds 80 billion yuan. The investment intensity rises to 2%. The proportions of enterprises with R&D institutions and activities increase to 40% and 60%. Labor productivity per capita reaches 500,000 yuan. The manufacturing quality competitiveness index exceeds 92.
Achieve new breakthroughs in structure optimization	The "33618" modern manufacturing cluster system is initially formed. The proportions of strategic emerging and high-tech manufacturing added value increase to 36% and 22%. The proportion of technological transformation investment rises to 40%.
Achieve new breakthroughs in green and low-carbon transformation	The energy consumption per unit added value of designated-sized industrial enterprises decreases by 13% compared with 2022. The decline of carbon dioxide emissions exceeds that of the whole society.
Achieve new breakthroughs in spatial layout	The coordinated development pattern of the city's manufacturing industry is formed. Western Chongqing becomes a manufacturing highland. The position of industrial parks is consolidated. The operating income of designated-sized industrial enterprises in parks accounts for 90%. The output per unit of industrial land increases to 7.5 billion yuan per square kilometer.
Achieve new breakthroughs in the upgrading of enterprise entities	The number of industrial enterprises with annual incomes of over 100 billion yuan, over 10 billion yuan and listed ones increases to 5, 50 and 100 respectively. The numbers of four types of enterprises, including manufacturing single champions, etc., quadruple to 30, 500, 12,700 and 86,000, respectively.

(Source: Chongqing Municipal Government)

2.2 With unique endowments and a solid foundation, Chongqing is poised for development

Chongqing is located in the southwest of China, with a unique geographical location, and is an important transportation hub connecting China with Southeast Asia and South Asia, which provides convenient logistics conditions and broad market space for the development of Chongqing's manufacturing industry. In the construction of the Chengdu-Chongqing Economic Circle, Chongqing has given full play to its own advantages; complemented Chengdu; coordinated the development of electronic information, automobile manufacturing, and other industries; strengthened the interconnection of transportation infrastructure; and promoted the flow of talents, capital and other factors, injecting strong impetus into the development of the Chengdu-Chongqing Economic Circle.

Chongqing has a solid foundation with the electronic information industry, covering electronic equipment manufacturing, communication equipment, computers, software and information services and other fields. Chongqing's automobile and motorcycle parts industry and electronic information industry have formed a double pillar. Based on Chongqing's unique endowment and foundation in the electronic information industry, the Chongqing government has promoted the opening and innovative development of the industry through policy guidance and support, laying a solid foundation for the rapid development of the industry.

In addition, the Chongqing Municipal Government attaches great importance to the development of the manufacturing industry, offering policy guidance and support to help the industry achieve a higher level of openness and innovative development. In response to "33618," a series of industrial policies has been introduced, and at the same time, the "horse racing system (challenge-based innovation)" has been adopted to attract investment to promote projects and investment in various districts and counties, and to promote the entry of industrial capital into Chongqing.

Based on the solid manufacturing foundation, unique location endowment, and the government's great attention to the development of the manufacturing industry, we believe Chongqing has the ability and conditions to achieve the high-quality development of modern manufacturing industrial clusters, reach a new level in important aspects such as high-end and intelligent manufacturing, and achieve the expectations of the central government and Chongqing's development goals.

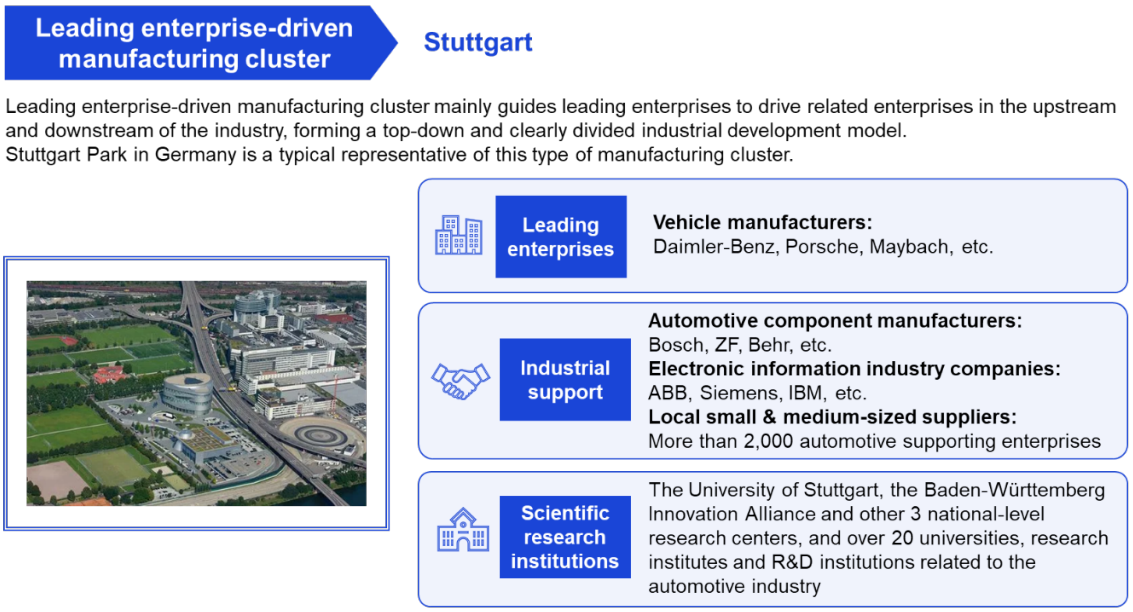
2.3 Enhancing high-end quality, promoting efficiency through digitalization and intelligence, and drawing on advanced cases for reference [2] [3]

Case 1: Enterprise-Driven Cluster – Stuttgart, Germany [4]

The automotive industrial cluster in Stuttgart, Germany, is one of the four major automotive industrial clusters in the world. It currently hosts more than 2,000 automotive-related enterprises and over 20 universities, research institutes, and development organizations related to the automotive industry. This includes leading global automotive giants such as Daimler Group and Porsche, as well as numerous top-tier automotive parts manufacturers like Bosch, ZF, and Mahle.

The century-long development of the Stuttgart automotive industrial cluster has followed a trajectory characterized by the idea of being "led by enterprises, supported by industrial support, and driven by R&D and innovation."

Figure 5: Manufacturing Cluster Development Model on
– Leading Enterprise-Driven Manufacturing Cluster



Leading enterprises drive development: The Stuttgart industrial cluster is led by the world's leading vehicle companies such as Daimler and Porsche and has gathered a large number of suppliers in various subdivided product fields to form a complete supporting system for the automotive industry. On one hand, the development of leading vehicle enterprises relies on the industrial system in the cluster. On the other hand, with the advantages of leading enterprises in technology, capital and market, the supporting industries are stimulated, and a coordinated development pattern is built, consisting of upstream and downstream enterprises with leading enterprises of vehicles and parts as the core.

Industrial Chain Support: Stuttgart is also home to internationally renowned automotive parts manufacturers such as Bosch, ZF, and Mahle, along with many small- and medium-sized supporting enterprises. Most of these firms specialize in high-tech components and possess leading global technologies in their respective fields. By closely integrating with leading enterprises, they drive the Stuttgart automotive industry chain to achieve excellence at every link. In addition, there are numerous electronics and information technology companies such as ABB, Siemens, and IBM, which promote the continuous upgrade of automotive electronics and control systems toward smarter and more digitalized solutions.

Continuous innovation ecosystem: In the Stuttgart region, the geographical concentration of the automotive cluster provides a solid foundation for effectively conducting innovative activities by entities such as vehicle manufacturers and parts producers, facilitating rapid information flow and efficient conversion of R&D results into practical applications. Additionally, the numerous research institutions and universities in Stuttgart provide knowledge supplementation for the

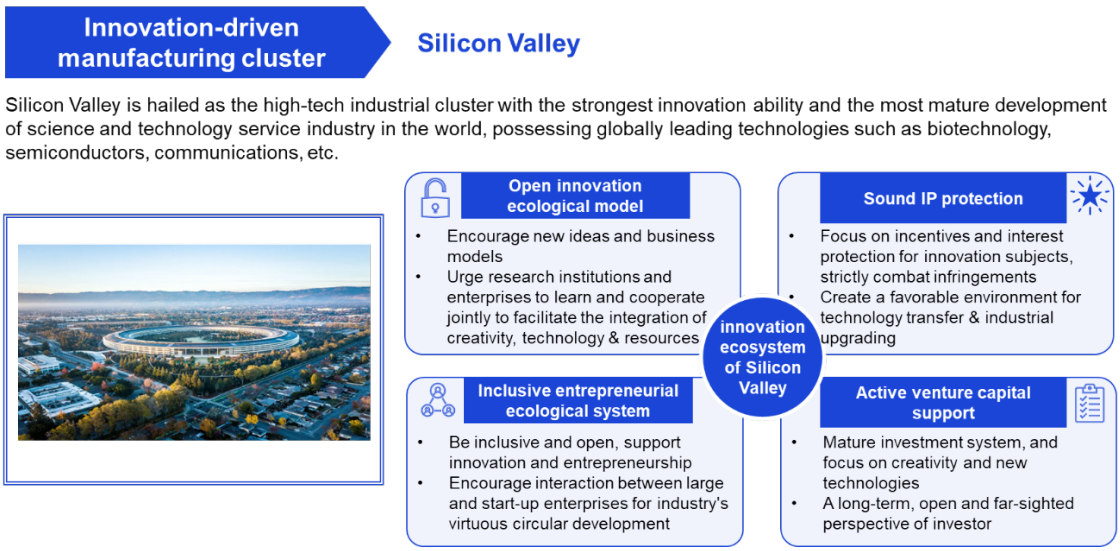
foundational theories and technological innovations in automotive manufacturing, continuously supplying specialized talent to businesses year after year. In Stuttgart, industry, academia, and research collaborate deeply through technical strategic alliances, enabling innovative entities within the cluster to better understand market demands, discover innovation opportunities, and achieve complementary innovation resources.

Case 2: Innovation-Driven Industrial Cluster – Silicon Valley, U.S. [5] [6]

Silicon Valley is known as a high-tech industrial cluster with the strongest innovation capability and the most mature development of the technology service industry in the world, with world-leading technologies such as biotechnology, semiconductors, and communications.

As a highly developed electronic information industry cluster, Silicon Valley has gathered world-renowned high-tech enterprises such as Apple, Google, Intel, NVIDIA, Cisco, and HP. Its success stems from an open innovation ecosystem, an inclusive start-up ecosystem, robust intellectual property protection, and active venture capital support.

Figure 6: Manufacturing Cluster Development Model two – Innovation-Driven Industrial Clusters



Open innovation ecosystem: Whether it is in the early stage of development, or in the rising stage, or even in the take-off stage, Silicon Valley has always maintained the opportunity for continuous independent innovation. Silicon Valley's innovation culture encourages people to try new ideas and business models, and also encourages research institutions, high-tech startups in different fields, production technology companies, and non-production service companies to learn from each other, to cooperate extensively, and to promote the integration of ideas, technologies, and resources.

Robust intellectual property protection: The mature and ever-improving intellectual property system in Silicon Valley provides continuous incentives and protection for the interests

of entrepreneurs and corresponding innovation subjects, which is also the foundation of Silicon Valley's innovation vitality. Silicon Valley attaches great importance to the strict protection of patents, copyrights, and trademarks, and effectively supervises and cracks down on intellectual property infringement through comprehensive laws and regulations and strict law enforcement, so as to protect the economic benefits obtained by enterprises through technological innovation and to promote the emergence of technological innovation in an endless stream. These measures encourage enterprises to attach great importance to intellectual property rights, to regard them as the core of enterprise development strategies and market competition, to promote industry self-discipline and cooperation, and to jointly create and maintain a good market order and competitive environment. At the same time, the local government has also included intellectual property rights as a key part of trade policies, creating an environment for international cooperation and exchanges that is more respectful of intellectual property rights. Strict intellectual property protection creates a good external environment for innovative enterprises, guarantees the ownership of innovation achievements, and thus promotes technology transfer and industrial upgrading.

Inclusive Startup Ecosystem: Silicon Valley's inclusive and open culture encourages entrepreneurs to explore and practice. Through abundant entrepreneurial resources such as incubators and accelerators, the local government provides entrepreneurs with a broader stage and all-around support in terms of policies, funds, technology, and markets. At the same time, large enterprises and start-ups are encouraged to actively interact and coexist in harmony. Start-ups earn money from the sale of products and services and balance their interests with large corporations through IP protection. At the same time, large enterprises can also quickly achieve their market goals by the acquisition of start-ups. In this way, large enterprises and start-ups will form a virtuous circle of common development, and enhance the vitality of the industrial cluster ecosystem.

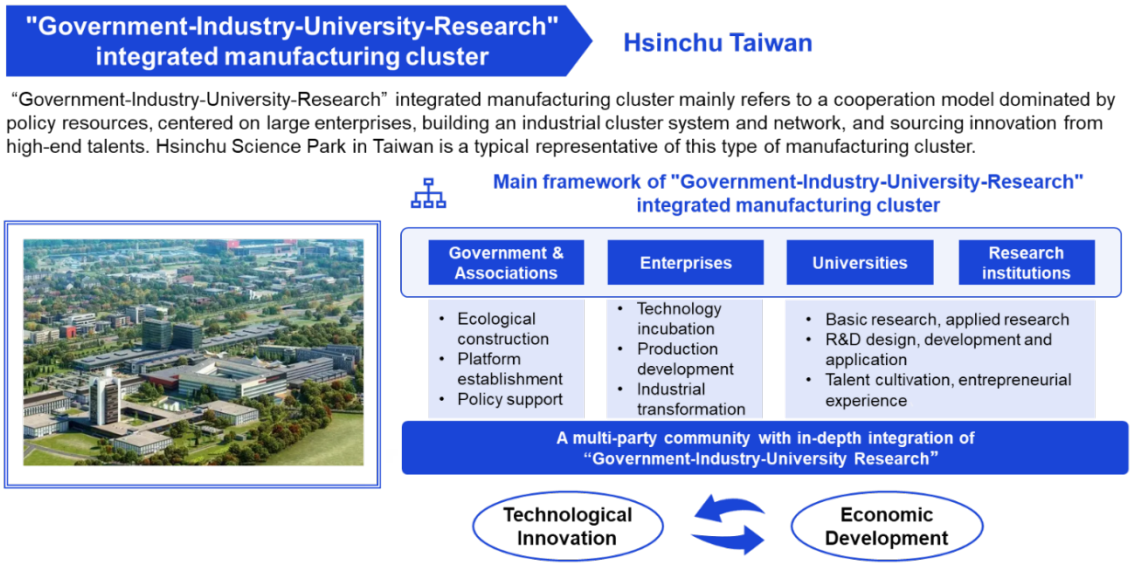
Active venture capital support: Silicon Valley has a mature venture capital system, and any valuable ideas and technologies can be well invested and helped. In Silicon Valley, venture capital tends to break through the corporate level and weave a vibrant network of innovation at the societal level, encouraging the free flow of new ideas. In investment evaluation, investors pay more attention to long-term vision rather than short-term results.

Case 3: "Government-Industry-University-Research" Integrated Manufacturing Cluster – Hsinchu, Taiwan [7]

Taiwan is the world's fourth largest integrated circuit manufacturing base after the United States, Japan, and Korea, and has developed into an integrated circuit industry cluster with Hsinchu Science Industrial Park as the core and Taichung and Tainan Science Park as the linkage, forming a complete industrial chain covering upstream chip design, midstream wafer production, downstream packaging and testing, and equipment and materials. The Hsinchu Science Park, guided by policy resources and centered around large leading enterprises, constructs an industrial cluster system

and network, becoming representative of a globally integrated "government-industry-university-research" manufacturing cluster.

Figure 7: Manufacturing cluster development model three: "government-industry-university-research" integrated advanced manufacturing



Government-Led Top-Down Industrial Planning: The local government focuses on industrial planning, construction management, and legal safeguards as key points, vigorously promoting the "Integrated Circuit (IC) Plan." It has established the Electronics Industry Research Institute as the implementing entity for this plan, actively planning the construction of the IC core business park, and establishing a top-down management system. At the same time, it adheres to the concept of "governing the park according to law," placing great emphasis on the legal system within the park. A dedicated legal affairs working group for the park has been formed, which has subsequently issued numerous regulations and rules.

Cultivating leading enterprises in industrial clusters: Hsinchu fosters leading enterprises as the primary drivers of industrial development, nurturing top-tier global companies such as TSMC and UMC. It fully leverages the leading, demonstrative, and driving role of these flagship enterprises, promoting innovation and entrepreneurship among upstream and downstream companies through various methods including joint technology development, supply chain coordination, capital investment, startup incubation, and industrial alliances. This approach has established a collaborative development model characterized by "leading enterprises at the core and small and medium-sized enterprises as the main body."

Building an industrial cluster innovation network: Taiwan's integrated circuit industry has created an innovation network system characterized by "government as the guarantor, research institutions as the leaders, universities as the supports, and enterprises as the main bodies." With

the Industrial Technology Research Institute (ITRI) at its core, each entity fully leverages its own strengths, jointly investing resources required at different stages of technological innovation and collaboratively engaging in innovation activities. The government focuses on fostering an innovative environment, formulating and implementing policies that encourage innovation, and providing financial support. Research institutions, as the primary undertakers of R&D, closely align with market needs to conduct cutting-edge innovation. Universities promote industry-academia integration, providing talent cultivation and technological support for the industry while also undertaking some research and development work. Enterprises, as the main bodies of innovation, increase R&D efforts and actively transform and apply technological achievements.

Establishing a Policy System Covering Industrial Development: The local government has introduced a series of supportive policies covering areas such as infrastructure, human capital, R&D innovation, enterprise cultivation, intellectual property rights, and market services throughout the various stages of the integrated circuit industry's development. In terms of R&D innovation, substantial financial rewards are provided for innovative products and numerous other fields. For enterprise cultivation, development funds are established, and low-interest loans are offered jointly with banks, along with tax relief benefits. Regarding intellectual property protection, an IC licensing mechanism is established to facilitate fair transactions of intellectual property rights; an independent intellectual property management system and sharing mechanism are also set up to encourage lawful sharing of property rights.

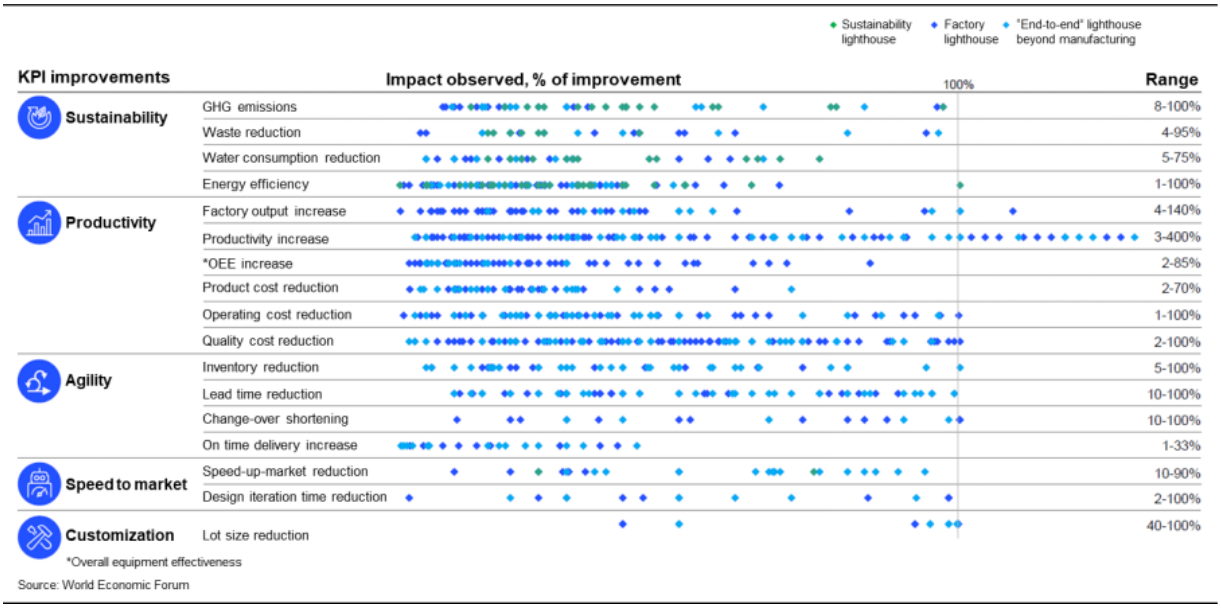
Case 4: A Global Benchmark for Intelligent Manufacturing – The World Economic Forum's "Lighthouse Factory" Network

Significantly improving financial performance, operational metrics, and sustainability through intelligent manufacturing and digital transformation, and achieving high-quality development, has become a widely recognized consensus. International organizations such as the World Economic Forum (WEF) have even defined this as part of the Fourth Industrial Revolution. [8]

To systematically promote intelligent manufacturing and help manufacturing enterprises across various industries leverage it as a key lever to improve efficiency and add value, the WEF, in collaboration with McKinsey & Company, launched the "Lighthouse Factory Network" initiative worldwide in 2018. This initiative aims to evaluate and select benchmark enterprises in intelligent manufacturing from dimensions such as business value realization, integration of digital use cases, enabling factors, and digital technology platforms. The initiative promotes these as best practices across industries and sectors to achieve broader and sustainable digital transformation value. By the end of 2023, 153 factories globally were designated as WEF "Lighthouse Factories." Thanks to a strong focus on intelligent manufacturing and a solid foundation in manufacturing, China holds 62 of these lighthouse factories within the global network.

From the perspective of value creation, Lighthouse Factories have achieved impressive results through digital transformation, including improvements in key business metrics such as output per unit, overall equipment effectiveness, product cost, operational cost, inventory, delivery timeliness, speed to market, energy efficiency, and carbon footprint.

Figure 8: Improvement of business indicators achieved by "Lighthouse Factories"
(Source: World Economic Forum, McKinsey & Company)



In reviewing the World Economic Forum's Global Lighthouse Network White Paper published in 2023, we find several encouraging examples of progress through digital transformation, such as:

In the electronic information industry, Lenovo's production base in Hefei, the world's largest single PC factory, faced intense competition, significant demand fluctuations, and growing demand for product customization. To address these challenges, the factory deployed over 30 Industry 4.0 automation and advanced analytics use cases, significantly enhancing labor productivity, reducing supplier quality issues, and managing a high level of customized orders effectively. The "Smart Workforce Planning and Optimization" use case improved workforce utilization by 31%; the "Cloud AI-Driven Supply Chain Quality Management" reduced supply chain quality rejection rates by 55%; "Lights-Out Flexible Assembly and Testing Automation" helped reduce changeover times by 80%; and the "Smart Bottleneck Identification and Closed-Loop Problem Resolution" use case increased individual hourly output (UPPH) by 30%.

In the automotive industry, Bosch's powertrain solutions plant in Bursa, Turkey, needed to strengthen its cost leadership to ensure a return on investment for future new product production, such as hydrogen components. By deploying artificial intelligence applications and upskilling all employees in digital skills, they successfully reduced unit manufacturing costs by 9% and

increased Overall Equipment Effectiveness (OEE) by 9%. The "AI Optical Inspection for Coating Defect Recognition" use case improved productivity by 12%, "Smart Process Control During Water Erosion" reduced defect rates by 50%, and the "Digital Logistics Alert" use case helped lower inventory levels by 23%. By introducing AI and other technologies to optimize production processes, the plant achieved more precise and efficient manufacturing, enhancing product competitiveness and market position. Additionally, upskilling all employees strengthened the team's overall capability, laying a solid foundation for sustained future development.

Part Three: How to Proceed – Recommendations for the High-End and Intelligent Development of Chongqing's Manufacturing Industry Clusters

In terms of the high-end development of manufacturing industry clusters, we suggest that Chongqing emphasize the leadership role of innovation, ensure adequate protection of intellectual property, and continuously improve a top-tier business environment surrounding the priority industries outlined in the "33618" plan to attract high-quality investments.

Regarding the intelligent transformation of manufacturing, Chongqing can learn from the advanced experiences of the "Lighthouse Factory" network, focusing on three dimensions: business, organization, and technology. By learning from and building "lighthouses," and subsequently promoting and disseminating these practices more broadly, significant efficiency improvements can be achieved.

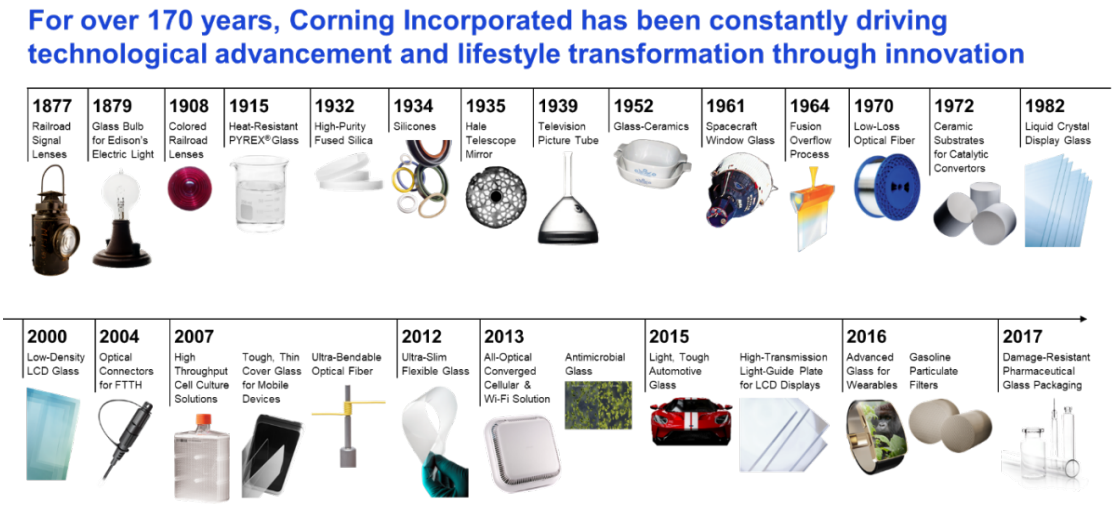
3.1 Emphasizing the role of innovation leadership, improving business environment to attract leading companies, enhancing value of high-end industries

Innovation leadership: We recommend that Chongqing draw on the successful experiences of advanced international manufacturing clusters, emphasizing the leading role of innovation in development. We suggest comprehensive promotion of an innovation ecosystem led by enterprises, oriented toward the market, and supported by government, industry, academia, and research. This can strengthen the position of enterprises as the primary innovators; foster high-tech enterprises and specialized and innovative "little giant" companies; and drive industrial innovation through scientific and technological innovation to accelerate the formation of new productive capacities. According to market demand and orientation, Chongqing should focus on increasing R&D investment and support in foundational research for future frontier or core technologies in advantageous fields – such as electronic information, automobiles, and new display technologies – to push the industrial chain toward higher-end advancements.

The experience of Corning Incorporated tells us that only by adhering to innovation can one occupy a high-value position within an industry, thereby ensuring long-term success. Based on its inherent strengths, Corning invests patient capital and continuously builds forward-looking

capabilities around "three core technologies, four manufacturing and process platforms, and five market access platforms." Through expertise and innovation in special glass, ceramic materials, and optical physics, Corning has led revolutionary changes in the industry, enhancing the quality of life for people. Since creating the first glass bulb for Edison's electric light, Corning has been using the power of science to illuminate the beacon of human civilization. More than fifty years ago, Corning invented the first low-loss optical fiber, igniting the spark of a telecommunications revolution. In the field of display technology, Corning pioneered the fusion draw process, producing precision glass substrates that are thin and flat, with excellent stability and superior surface quality, and environmentally conscious, contributing to the birth of the LCD industry. In 2007, we introduced Corning® Gorilla® Glass, a tough and thin glass designed for mobile devices, which has since been used in over 8 billion devices by more than 45 major brands. Corning consistently invests approximately 8% of its sales revenue into R&D, working closely with customers and partners to tackle challenging technical problems. From initial idea formation, through research, product development, and engineering development, to manufacturing, Corning's innovation pipeline remains dynamic. This continuous creation of new growth curves over more than 170 years is a crucial support for Corning's enduring success.

Figure 9: Corning Incorporated persists in promoting progress through innovation. Major innovation achievements are as follows



Escort guarantee: To foster an environment that fully mobilizes corporate innovation initiatives and encourages businesses to confidently invest in innovation, it is essential to ensure robust protection of intellectual property (IP) rights. Providing ongoing incentives and protecting the interests of innovators is also a key factor behind the success of innovation hubs such as Silicon Valley. [9] Here are several proposals for strengthening IP protection:

a) Improve laws and regulations: Ensure comprehensive and effective legal protection for all types of intellectual property, clearly defining acts of infringement and corresponding legal liabilities.

b) Enhance law enforcement and collaboration: Strengthen the enforcement capabilities of relevant departments, intensify investigations and crack down on acts of infringement, strictly enforce laws, and increase the costs associated with infringement.

c) Perfect the supervision system and rights protection mechanisms: Establish a sound supervision system for IP protection, enhancing the effectiveness and efficiency of oversight by all relevant institutions throughout society. Set up fast-track IP rights protection bodies to provide rights holders with convenient and efficient channels for rights protection, shorten the duration of rights protection processes, and reduce associated costs.

d) Promote international cooperation and exchange: Actively organize and participate in international exchanges and cooperation concerning IP protection, enhance coordination and cooperation in cross-border IP protection, and jointly combat cross-border infringements.

From Corning's investment and development experience in China, we deeply understand the importance of intellectual property (IP) protection in maintaining the confidence of enterprises to continue investing. Corning has been deeply engaged in the Chinese market for over 40 years, and IP protection has been critical to Corning's success. In the past, we had to contend with trade secret theft by individual Chinese domestic companies. Fortunately, through the active participation and support of both central and local governments, these issues were resolved. The proper resolution of these issues allowed us to continue investing. However, this remains an ongoing challenge that requires continued attention from the central government and local governments like those in Chongqing. We are confident that with the active support of the government, justice will be upheld, legal rights protected, and these issues properly addressed once again. We will continue to adhere to the philosophy of " in China, for China, with China" supporting the transformation and upgrading of industries and promoting high-quality development.

Cultivating an Environment to Attract Leading Companies: Corning's development in Chongqing began with the establishment of an LCD display glass substrate production facility in 2015, followed by the gradual expansion of logistics operations and the establishment of a distribution center in Chongqing over the subsequent years. In June 2021, Corning announced the addition of display glass melting capabilities for Gen 8.5-and-above display glass substrates at its Chongqing facility. This project marked Corning Display Technologies' first full display industry value chain project in Western China. Through continuous investment, Corning has played an active role in promoting and consolidating the formation of a complete display glass manufacturing project in Chongqing, from glass substrates to display panels and modules. In September 2021, Corning signed an agreement with Liangjiang New Area in Chongqing to invest in a cover glass project, primarily producing Corning® Gorilla® Glass. This project officially commenced production operations by the end of 2023.

We are pleased to see that Chongqing's business environment continues to improve and is now among the best in the country. Much of Corning's continued investment in Chongqing can be attributed to the city's superior business environment and the efficient and pragmatic working style of the local government departments. For example, the government has established dedicated teams to follow up with companies, promptly interpreting policies and responding to their needs; is ensuring stable electricity supply to remove concerns about production; and is actively promoting preferential tax policies to help alleviate operating pressures. With Corning Display Technologies' successful experience in Chongqing and its robust R&D capabilities, combined with the vision of building an internationally competitive advanced manufacturing cluster in the Chengdu-Chongqing Economic Circle, Corning looks forward to exploring even more possibilities. [10]

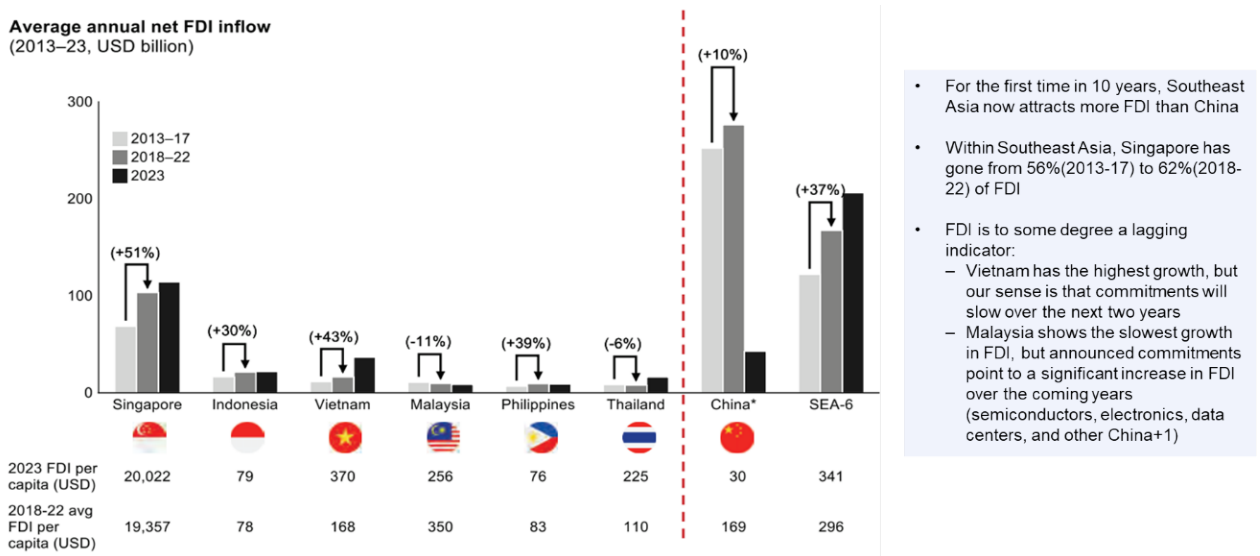
Figure 10: Evaluation and ranking of business environment in 31 provincial administrative regions in China

Rank	Provincial administrative region
1~2	Shanghai, Beijing
3~5	Zhejiang, Guangdong, Sichuan
6~10	Shandong, Jiangsu, Anhui, Chongqing, Guizhou
11~20	Hubei, Henan, Jilin, Yunnan, Tianjin, Jiangxi, Fujian, Hebei, Ningxia, Hainan
21~31	Xinjiang, Guangxi, Hunan, Inner Mongolia, Shanxi, Gansu, Shaanxi, Liaoning, Heilongjiang, Qinghai, Tibet

(Source: China Provincial Business Environment Research Report 2023).

We have also observed that in recent years, there has been a profound shift in the global trade and supply chain landscape. The six Southeast Asian countries (Vietnam, Singapore, Malaysia, Thailand, Indonesia, and the Philippines) have seen significant success in attracting foreign direct investment (FDI). In 2023, the total amount of FDI attracted by these Southeast Asian countries surpassed that of China for the first time.

Figure 11: Comparison of annual net FDI inflow between SEA-6 countries and China



(Source: Bain & Company, Singapore DBS Bank)

The main reasons for this are as follows:

1. **Supply Chain Considerations:** Following the COVID-19 pandemic, multinational corporations have increasingly sought to diversify their supply chains. The geographical advantages and continuously developing infrastructure of Southeast Asia provide assurance for smooth resource and goods flow. Under the "China + 1" strategy, some companies are looking to reduce their over-reliance on China, and countries like Vietnam have become popular alternative destinations for multinational enterprises.

2. **Trade Tariff Considerations:** The escalation of trade wars between some developed countries and China has led to tariff adjustments and increased costs for Chinese exports. For Southeast Asian countries, the implementation of trade agreements such as the Regional Comprehensive Economic Partnership (RCEP) has lowered tariff barriers, creating more favorable conditions for multinational enterprises to enter these markets.

3. **Improvement in Industrial Policies and Business Environment:** In emerging industries, countries like Vietnam show significant potential in sectors such as new energy vehicles and solar cell manufacturing. Singapore, among others, is demonstrating great potential in semiconductors and data centers. Governments in these countries are actively pushing policy reforms, improving the business environment, and offering preferential policies to bolster foreign investor confidence and attract FDI, providing strong support for economic growth.

4. **Labor Costs:** Countries such as Vietnam, with abundant labor resources, offer competitive advantages in attracting foreign investment, especially beneficial for labor-intensive enterprises.

Compared to places like Vietnam, Chongqing has its own advantages. Firstly, Chongqing provides a stable environment for foreign investment, with political stability and a sound legal system. Secondly, after years of development, Chongqing's infrastructure has steadily improved. Thirdly, in terms of market access, investing in Chongqing offers multinationals the opportunity to participate in the dual circulation model, not only engaging in external circulation but also tapping into the vast domestic market of China through Chongqing's hub position in the central and western regions. Fourthly, in the industrial sector, Chongqing has a solid foundation and strength in manufacturing areas such as electronics and automobiles, with a complete industrial supply chain that aids in the sustainable development of multinational enterprises. Lastly, in terms of industrial talent, and particularly technical talent, Chongqing has a more evident advantage compared to some Southeast Asian countries that are just starting out.

Figure 12: Comparison of strength between Vietnam and Chongqing in attracting foreign investment [11]

	Vietnam	Chongqing
Strength	• **Seize the "China + 1" opportunity:** Fully prepared for export-oriented economy, optimizing industrial structure and improving infrastructure • **Trade tariffs:** The entry into force of trade agreements like RCEP has reduced tariff barriers, creating more favorable conditions for multinationals to enter • **Large market potential:** With nearly 100 million population, a young structure and rising domestic consumption demand • **Highly diversified FDI sources:** Enterprises from many countries and regions like Europe, the US, Japan and South Korea, covering manufacturing, service industries, etc. • **Greater policy preferences:** Such as tax reduction, preferential land use rights and simplified investment procedures, helping to reduce business operation costs and increase return on investment • **Superior geographical location:** An important hub connecting Asia and the Pacific region, conducive to the development of trade and logistics transportation for foreign-funded enterprises • **Lower economic factor costs:** Abundant young labor force with low cost, significantly lower than China; low land cost, reducing upfront costs for foreign-funded enterprises, having certain competitiveness in labor-intensive industries	• **Political stability and sound laws:** The political environment is highly stable. Governments at all levels are proactive. The sound legal system guarantees enterprise development • **Well-developed infrastructure:** Heavy investment in infrastructure like transportation, energy and communication. Developed transportation networks. A key hub in western China. Stable energy supply and advanced communication facilities meet the needs of foreign enterprises • **Strong industrial foundation:** A complete industrial system covering various sectors like automobiles, electronics, equipment manufacturing and chemicals. Provides a good industrial environment for foreign enterprises and facilitates industrial chain cooperation • **Strong market radiation ability:** Superior location and strong radiation ability. With the dual circulation, it can cover the vast Chinese market and expand internationally • **Strong policy support:** Local governments value attracting foreign investment. Provide a good policy environment for foreign enterprises in Chongqing through policy guidance and preferential measures • **Rich industrial and technical talents:** Many universities and research institutions supply talents to enterprises • **Great potential in intelligent manufacturing:** Use advanced technology to improve efficiency, reduce reliance on manpower, mitigate the impact of rising labor costs, and enhance industrial upgrading and competitiveness

Despite the current phenomenon of foreign investment spillover, we believe that Chongqing and the many foreign investors operating here should remain optimistic about the future. Chongqing's numerous unique advantages lay a solid foundation for its sustained development. We look forward to the Chongqing government continuing to optimize the business environment, further enhancing the openness and fairness of the market. For instance, we hope to see the further establishment and improvement of an intellectual property protection system to safeguard the innovative achievements and legitimate rights of enterprises, as well as the formulation and refinement of tax incentives and related measures to encourage enterprise innovation and development. We firmly believe that with the proactive guidance and full support of the government, Chongqing will surely leverage its own strengths to create an attractive environment for first-class enterprises with strategic foresight to continuously invest in Chongqing. We also anticipate contributing to the economic development and high-end transformation of Chongqing's manufacturing sector during this process.

3.2 Building Lighthouses, promoting radiation, and improving efficiency in Intelligent Manufacturing

In terms of intelligent manufacturing, we recommend that Chongqing first learn from the "lighthouses" and then work to build its own "lighthouses," subsequently radiating and promoting these advanced experiences. As initiators of the "Lighthouse Factory" network, the World Economic

Forum and international consulting firms like McKinsey have summarized the keys to digital transformation across three dimensions: business, organization, and technology.

Business: The starting point for digital transformation should be the tangible enhancement of business value that enterprises achieve through digitization and intelligent manufacturing. This includes optimizing business metrics such as unit output, productivity, material consumption, energy consumption indicators, personnel efficiency, quality levels, delivery times, and time-to-market for new products. Digital transformation requires enterprises to first conduct top-level design, thinking from a business perspective about which pain points can be addressed through digitization. After clearly diagnosing these business pain points, the next step is to consider how digital and intelligent manufacturing can be utilized as enabling elements to resolve these issues. This involves identifying the relevant digital application scenarios and use cases, examining whether there are any applicable cases from "Lighthouse Factories" or other advanced benchmarks in similar industries, setting clear objectives for the improvements expected from the deployment of these digital use cases, and determining the resources required.

Organization: According to research by the World Economic Forum and McKinsey & Company, 45% of executives believe that the most challenging aspect of digital transformation, especially during the scale-up phase, is the lack of digital talent and organizational capabilities. For digital transformation to be sustainable, enterprises must have a clear transformation strategy, active participation from employees at all levels, large-scale digital capability building, and agile organizational implementation of digital use case development and deployment. They should also summarize these efforts into a set of digital transformation management mechanisms to continuously drive implementation.

Technology: The implementation of digital business use cases ultimately relies on advanced industrial IoT architectures and secure, stable data infrastructures. Enterprises also need to build their own technological ecosystems for digital transformation.

In recent years, Corning has actively promoted intelligent manufacturing, deploying and implementing digital transformation across multiple production facilities, including the Chongqing plant, achieving initially positive results.

At Corning, we adhere to the principle that business benefits should lead digital transformation, ensuring that intelligent manufacturing serves to enhance business efficiency. Our focus is on improving elements such as quality, cost, delivery, morale, safety, and innovation within our factories. We seek improvement potential in value stream mapping and implement enhancements through the design and deployment of digital use cases. Our digital scenarios cover AI applications throughout the entire production process, from the glass melting tanks to the finishing line cutting processes, and include smart analytics models that support engineers and office staff in making

more efficient and accurate on-site decisions. Take Corning Display Technologies' Chongqing plant as an example:

Digital Use Case 1: In traditional manufacturing environments, cleanroom inspection systems categorize defects based on predefined rules, requiring operators to manually confirm them, a task that is both time-consuming and prone to errors. To optimize the production process within the cleanroom, reduce the burden on operators, and improve overall efficiency, the digital team at Corning's Chongqing base adopted advanced AI image recognition technology to develop an automatic defect classification tool. This tool, through automated and intelligent defect detection, effectively avoids missed detections caused by human factors, significantly enhancing product quality and consistency. This technological innovation not only optimized the production process but also reduced the workload of cleanroom inspectors by approximately 44% in 2024, providing solid technical support for ensuring the high quality of the final product.

Digital Use Case 2: To address the common issue of glass breakage during the manufacturing process, our team developed a full-line AI breakage monitoring system. This system is widely deployed in key areas of the finishing line glass cutting process, capable of real-time monitoring and timely identification of potential breakage risks, effectively reducing breakage rates. This not only minimized glass loss but also improved the overall operational efficiency of the production line and equipment, positively impacting capacity enhancement and cost reduction.

Digital Use Case 3: Responding to global energy-saving and sustainability initiatives and China's "3060" carbon neutrality goals, the Chongqing plant developed an intelligent cooling water optimization system. This system not only saved energy but also improved the overall utilization efficiency of the cooling water system. Additionally, the Chongqing team developed and deployed an energy and carbon management platform that can monitor the company's energy usage in real-time and provide detailed energy consumption reports and optimization suggestions via big data analysis. This helps the company adjust its energy usage strategies promptly and gain insights into its carbon emissions. These cases helped the Chongqing plant achieve an annual reduction of about 8% in energy consumption and a 4.8% improvement in energy efficiency ratio (CoP), significantly reducing the plant's energy expenditure.

On the organizational level, Corning strives to promote broad participation from managers, engineers, and technicians at all levels, placing great emphasis on building digital capabilities. By identifying gaps through digital capability diagnostics, formulating digital capability building plans, conducting digital capability certifications, and systematically enhancing organizational capabilities, we ensure the talent support and sustainability needed for digital transformation. We conduct a "Digital Transformation Olympics" activity across eight plants, evaluating advanced cases in business improvement, organizational promotion, and technology platforms, selecting best practices from pilot projects, and organizing publicity and promotion activities.

Figure 13: Corning Display Technologies "Digital Transformation Olympics" activity

On the technical level, Corning has made extensive deployments during its digital transformation, including connectivity, data infrastructure, and the construction of a technology ecosystem. Through an advanced data management framework, the company has gradually optimized the entire process from data collection, transmission, and storage to data analysis. This framework not only provides real-time data monitoring and intelligent analysis for production but also enhances decision support and early warning functions in production operations to ensure efficient, safe, and stable production. These implementations have significantly improved the company's overall operational efficiency and provided strong support for the advancement of intelligent manufacturing. Throughout the process of promoting digital transformation, Corning has always focused on comprehensive construction from data infrastructure to the technology ecosystem. By continuously innovating and optimizing, integrating innovative technologies and partner resources, Corning has formed a sustainable digital network. These efforts have enabled Corning to achieve remarkable results in the practice of digital transformation and further propelled the in-depth development of intelligent manufacturing.

While achieving initial benefits and successes, we also deeply understand that digital transformation is a long-term and continuously iterative process, not something accomplished overnight. We are very willing to learn from the advanced experiences of 'Lighthouse' benchmarks and engage in mutual exchanges with smart factories across various industries to learn from each other's strengths.

At the city level, we suggest that Chongqing formulate encouraging policies and incentive measures targeted at intelligent manufacturing. Examples include: interest subsidies for special loans for intelligent manufacturing projects, supportive award and subsidy policies for substantial

corporate investments, etc. We encourage enterprises in Chongqing with good foundational conditions to learn from "Lighthouse" examples and strive to become "Lighthouses" themselves. Furthermore, we propose constructing a network of "Lighthouse Factories" and various levels of intelligent manufacturing benchmark demonstration networks in Chongqing and the western region. This could involve building an "Industry Digital Use Case Library," conducting "Lighthouse Factory Preliminary Diagnostics," promoting "Digital Capability Building and Certification," and recognizing "Model Transformation Offices" to radiate advanced experiences of digital transformation, publicize best practices, and elevate the entire region's intelligent manufacturing standards. Ultimately, this will genuinely enhance efficiency, reduce costs, improve energy efficiency, shorten product development cycles, and boost the agility of enterprises in responding to market changes. By leveraging intelligent manufacturing, we aim to significantly enhance the competitiveness of Chongqing's manufacturing sector, making intelligent manufacturing a new business card for Chongqing.

Conclusion

The path to enhancing industrial value through high-end development and improving industrial efficiency via intelligent manufacturing is long and challenging, yet it is the necessary route for Chongqing's manufacturing sector to achieve high-quality development.

Chongqing can certainly explore a distinctive development path for its manufacturing industry and industrial clusters. This can be achieved by drawing on the development experiences of high-level industrial clusters worldwide, summarizing successful factors, and learning from the best practices of world-class intelligent manufacturing benchmarks, while combining Chongqing's unique resource endowments, the trends of the era and technological advancements, and relying on Chongqing's solid foundation in manufacturing. These actions would enable Chongqing to build itself into an important national center for advanced manufacturing and will nurture advanced manufacturing clusters with international competitiveness.

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Drawing on International Practices and Innovating to Achieve Green and Sustainable Development of Chongqing's Modern Manufacturing Industry

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1. Preface

In the Third (Rifkin) or Fourth (Schwab) industrial revolution, technological innovation is the main driving force for industrial development; Innovation is the most important driving force for a city's industrial green transformation and sustainable development.

The report of the 20th National Congress of the Communist Party of China has made a major deployment to accelerate the construction of a strong manufacturing country. In the decision to further comprehensively deepen the reform and promote the Chinese modernization, it was proposed to cultivate and expand advanced manufacturing clusters, promote high-end, intelligent and green development of manufacturing industry, and coordinate new industrialization, new urbanization and overall rural revitalization. In July of this year, the State Council issued the Five Year Action Plan for Deepening the Implementation of the People Centered New Urbanization Strategy, which proposed specific deployments including promoting the unity of urban development and industrial support, employment transfer, and population agglomeration, implementing the action to improve the urbanization level of potential areas, focusing on cultivating characteristic advantageous industrial clusters, promoting the upgrading and expansion of industrial parks, implementing the action to cultivate modern urban agglomerations, and strengthening industrial division of labor and cooperation.

As a global leader in lighting technology and a leading Dutch multinational, Signify (formerly Philips Lighting) hopes to share the international practices in achieving sustainable development in the manufacturing industry through collaborative innovation in Eindhoven of the Netherlands where the company located, and leading the lighting industry to achieve green transformation and development through technological innovation. It also proposes relevant suggestions for the sustainable development of modern manufacturing in Chongqing.

2. Green and sustainable development of modern manufacturing industry

- 1) Characteristics and development trends of modern manufacturing industry

Since the Industrial Revolution in the 19th century, manufacturing has become the foundation of modern industrial systems, providing indispensable material guarantees for the stable operation

and healthy development of urban economy and society. With the development and application of modern digital and other technologies, the manufacturing industry has entered a new era of development: shifting from mainly relying on labor capacity improvement to mainly relying on technological innovation and progress.

Advanced manufacturing industry includes both new industries, new business models, and new forms of business generated by new technologies, as well as traditional manufacturing industries that utilize advanced and applicable technologies, processes, materials, and management for transformation and improvement. Accelerating the development of advanced manufacturing industry is an important lever for achieving the transformation of development mode and an important support for building a modern economic system.

The development trend of advanced manufacturing industry is: 1) its industrial ecosystem will be continuously enriched with new technological innovation as the link, constantly expanding the boundaries of traditional industries, and building an emerging industrial ecosystem with application scenarios as the driving force; 2) under the background of "dual carbon", improving energy utilization efficiency will become an important direction for the green development of advanced manufacturing industry. 3) the development model of advanced manufacturing carriers led by parks, cities, and urban agglomerations continues to be updated, and a comprehensive industrial cooperation system jointly built by multiple parties and regions is constructed to form a multi-party innovation cooperation network that enhances collective innovation efficiency: A) industrial parks, as the main gathering places for the development of advanced manufacturing, are transforming towards a full industry chain development model, focusing on building a growth model driven by advanced technology and efficient industrial governance, and improving the science and technology service system; B) cities and metropolitan areas are important carriers for the development of advanced manufacturing industry, and are the main battlefield for continuous innovation and application of advanced manufacturing industry. The key to developing advanced manufacturing industry lies in stimulating industrial vitality, cultivating enterprise echelon, and leveraging development opportunities to enhance its industrial innovation ecological vitality.

- 2) Advanced manufacturing and urban competitiveness

From the perspective of modern human civilization, industrialization and urbanization promote each other, and the foundation of industrialization is manufacturing. With the continuous deepening of the technological revolution, especially the rapid development of information technology, the manufacturing industry is undergoing a profound revolution.

The transformation process of the global economic center since the Industrial Revolution has shown a pattern of mutual integration and promotion between manufacturing and urban development. Based on the development process of the industrial structure of world metropolises,

although there is an overall trend of evolution from manufacturing centers to service centers, the absolute value of manufacturing is still relatively large or continues to grow. Under the impact and influence of the global financial crisis, these cities have re examined the status and role of manufacturing, and have proposed a collaborative development model between manufacturing and service industries.

A. Manufacturing is a core element of urban competitiveness:

From the following main indicators, it can be seen that urban competitiveness is first reflected in the industrial scale and vitality of the city, especially in the rational structure of manufacturing and service industries in the industrial structure; Secondly, technological innovation capability reflects the city's ability to sustain industrial development; And factors such as infrastructure, location advantages, cultural brand influence, quality of life, and livability can help enhance and improve the city's image and environment, and better gather the city's industrial innovation and development elements.

B. Advanced manufacturing industry supports sustainable development of industries

Advanced manufacturing is the foundation for the sustainable development of urban industries and an important basis and carrier for the service economy. The urban manufacturing and service industries must maintain a relatively reasonable ratio. The world's major cities shifted from a manufacturing economy to a service-oriented economy only after the highly developed manufacturing industry. The joint development of manufacturing and service industries can effectively mitigate the impact of economic cycle fluctuations and maintain the sustainable development of urban economy.

Urban development is entering the stage of metropolitan development between central cities and surrounding cities. Within the metropolitan area, the relationship between factors and industries mainly involves radiation, spillover, and division of labor; The advanced manufacturing industry has an irreplaceable impact and role in the formation and implementation of this relationship. In the construction of modern industrial system, advanced manufacturing plays a decisive role as the main body.

The various contradictions and problems arising in urban development are resolved through development. In the current context, developing advanced manufacturing is an effective way to solve the problems of insufficient growth momentum and structural unemployment in urban industries. Among them, compared to the productive service industry, the manufacturing industry can accommodate a large number of people from different social classes for employment, better ensuring the level of urban employment. The sustainable development of cities largely requires a reasonable industrial structure to ensure the sustainable development of urban economy.

- 3) Conclusion

A. The modern industrial system based on advanced manufacturing reflects the scale and vitality of urban industries, is the core element of urban competitiveness, and is also an important guarantee for the sustainable development of industries; Meanwhile, the innovation capability of a city reflects its ability for future industrial development. The improvement and enhancement of urban culture, brand, and environment can better gather various elements required for sustainable industrial development.

B. Through continuous innovation, advanced manufacturing will continuously expand its industrial boundaries, build emerging industrial ecosystems based on urban application scenarios and new generation digital technologies, and promote the transformation and development of the entire manufacturing industry; Meanwhile, under the background of "dual carbon", improving energy utilization efficiency has become an important direction for the green transformation and development of advanced manufacturing industry.

C. The most important thing in building a modern industrial system based on advanced manufacturing is to construct and optimize a multi-party cooperation and innovation system in a city. Based on advanced manufacturing carriers such as industrial parks, cities, and metropolitan areas, we will continuously innovate multi-party cooperation models and achieve green and sustainable development of industries.

3. International practices

- 1) Collaborative innovation helps promote sustainable development of industries

Eindhoven is located in the southwest of the Netherlands and is the fourth largest city in the country. It is the heart of high-tech manufacturing in the Netherlands and one of Europe's leading technology centers and it was once referred to as the "most innovative city" by Forbes magazine.

In 1891, Signify, a global leader in lighting technology, was founded under the name Philips in Eindhoven, which was then an ordinary town. It began producing light bulbs and has been continuously innovating lighting technology and applications centered around Eindhoven for 133 years, leading the global lighting industry to constantly transform and develop. Therefore, Eindhoven is known as the "City of Light".

In the early 1990s, as technological innovation became increasingly important for industrial growth, more and more cities incorporated innovation into their development strategies. The joint innovation model was born, in which the government, enterprises and universities, as the three major elements of the innovation environment, formed a spiral collaborative model according to market requirements, improved the efficiency of innovation results transformation, and promoted

the sustainable development of industries. This cooperation model is the driving force for innovation and industrial development in the knowledge society, and at that time it was still in the theoretical model stage.

Eindhoven, which has a tradition of innovation, has become the first city to practice the multi-party cooperative innovation model. Firstly, the municipal government realizes that to achieve sustainable development of urban industries, it is necessary to continuously innovate based on its own characteristic industries; Secondly, important urban enterprises such as Signify (formerly Philips Lighting) continue to carry out open innovation and research and development of innovative lighting technologies and applications through joint universities, leading the establishment and expansion of industrial ecosystem clusters; Once again, renowned technical universities and institutions such as Eindhoven University of Technology continuously provide technical theories and professional talents for collaborative innovation.

For many years, the Eindhoven municipal government has actively implemented the "three party joint innovation model" as a strategic promoter, comprehensively planning and shaping the innovation ecological environment of the industry, formulating encouragement policies, and committed to technological innovation and application; And at the levels of high-tech park, city and metropolitan area, the practice and expansion of this joint innovation model have actively promoted the sustainable development of urban industries.

A. Eindhoven High-tech Campus

As a spatial carrier form that carries and promotes the sustainable development of industries, especially advanced manufacturing, industrial parks play an important role in enhancing technological innovation and land value related to industrial development, gathering population and capital accumulation.

In 1891, Signify (formerly Philips Lighting) was founded in the small town of Eindhoven and began producing light bulbs. At that time, lighting technology was still a new technology, and the company realized that it needed to invest heavily in lighting technology research in order to better develop. Therefore, the first research laboratory was established in Eindhoven to study lighting technology. With the development of the local economy, Eindhoven has gradually become a modern industrial city with a large number of highly skilled talents.

In the late 1990s, the company realized that the future knowledge economy required open innovation and the promotion of open communication among talents from different fields and backgrounds in order to develop innovative products. At that time, the company's research and development laboratories were scattered throughout Eindhoven. To address this issue, the Philips Research Park was established as an incubator for new industrial technologies, where R&D

personnel exchanged professional knowledge and ideas in an open working atmosphere. This collaboration and knowledge sharing are key to open innovation.

At first, there was only Philips as a company in this park. In 2003, it was named Eindhoven High-tech Campus and opened to other high-tech manufacturing companies and research institutions. A few years later, there were already dozens of companies here, but there were very few companies from other countries and regions. And these companies came to Eindhoven, wanting professional business and technical services. Therefore, after the park was opened to businesses, Philips further withdrew from the Eindhoven High-tech Campus and sold it to an independent operator in 2012. From then on, Philips became a member of the enterprises in the park and paid fees to the park operator.

The Eindhoven High-tech Campus has thus entered a new stage of development. Operators have strict requirements for enterprises entering the park, and the most important thing is to "contribute to the technological innovation and development of the park". The rent here is higher than that of the high-tech park in the city center, but there are still many companies queuing up. Because entering the Eindhoven High-tech Campus not only means having modern office space and professional service facilities, but also entering a mature industrial open innovation ecosystem, where companies can exchange ideas with world-class enterprises and talents, and have more industrial development space.

The Eindhoven High-tech Campus promotes sustainable industrial development through a multi-party collaborative innovation model. Currently, over 300 enterprises and institutions have settled in, gathering more than 10000 high-tech talents. About half of the innovative technologies in the Netherlands come from this park, which has been rated as the "Smartest Industrial Park".

B. City of Eindhoven

a. City promotion activities with characteristic industries as the theme

Creating a city brand that conforms to its temperament and historical heritage is extremely important for promoting the sustainable development of urban industries. Eindhoven innovatively creates its urban industrial image as the "City of Light" through a series of city themed activities, showcasing its vibrant and innovative environment and attracting the gathering of relevant industrial elements.

Among them, the most well-known is the Eindhoven International Light Art Festival, which has been held every November since 2006. The festival is jointly organized by the government, universities, and enterprises, inviting global artists to use the latest technologies such as intelligent connected lighting to showcase the unique charm of Eindhoven's "City of Light". It has become a

globally renowned light art festival. This festival designs different themes every year, using urban public spaces as the stage for lighting art projects. By designing tour routes, the audience can share their viewing experience with each other, attracting a large number of tourists from all over the world every year. The lighting art festival is a window for lighting technology leader Signify (formerly Philips Lighting) to showcase innovative technologies.

b. Reuse of Urban Industrial Historical Buildings

Signify was founded in 1891 as Philips and began producing light bulbs in Eindhoven. As a result, Eindhoven developed from a small town in the early 20th century into an advanced manufacturing and high-tech innovation center in the Netherlands and even Europe. During this process, industrial historical buildings such as factories, research and development laboratories, and office buildings were built throughout the city, becoming a unique and beautiful urban industrial cultural heritage.

A key focus of creating the "City of Light" image in Eindhoven is the renovation and reuse of industrial historical buildings such as Philips' previous factory and office areas, creatively endowing them with new uses in the knowledge economy era, creating a city cultural atmosphere that respects industrial traditions, and attracting more outstanding enterprises to come and develop.

Figure 1: previous first lighting bulb factory

Figure 2: Philips Museum today

Philips' first factory: As the company's first factory in Eindhoven (Figure 1), it has been producing carbon filament light bulbs since 1891. From 1951 to 1991, it was a laboratory for Philips Lighting, and since 2013, it has been transformed into the Philips Museum (Figure 2). The museum introduces Philips' transformation from a light bulb manufacturer to a globally renowned multinational enterprise, leading the green and sustainable development of the global lighting industry.

Figure 3: previous first research laboratory

Figure 4: new city community today

Philips' first research laboratory: This laboratory was established in 1914 (Figure 3) and was engaged in research on lighting technology, producing a large number of patent research results, laying the foundation for Signify (Philips Lighting) as a global leader in lighting technology. Since 2013, the laboratory has been transformed into a new urban community (Figure 4), providing a new functional space for creative design and artistic exchange, hosting events such as movies, theatrical performances, themed exhibitions, and seminars.

c. Urban Innovation laboratory

The Urban Innovation Laboratory is an innovative way to encourage the transformation of industrial scientific and technological achievements into effective applications in the real world, using the urban public space where citizens live as a carrier to carry out technological innovation and application practices. In 2006, the European Union launched the City Lab program, and Eindhoven became one of the first cities to join the program to explore the role of multi-party collaborative innovation models in promoting urban industrial technology innovation.

The city of Eindhoven has made innovation a key focus of its urban laboratory program to create a "City of Light" urban environment. In 2016, the municipal government released the "2030 Urban Lighting Roadmap": by 2030, the urban lighting system will be built into a comprehensive intelligent lighting network, which will promote the common development of urban manufacturing and service industries.

To this end, the municipal government announced that through this project, Eindhoven will become the world's first city to implement the "Four Party Joint Innovation Model", which involves the participation of citizens in building smart cities and realizing the vision of green and sustainable urban living. To this end, based on the professional knowledge and experience of the government, universities, enterprises and other parties, as well as the opinions and feedback of citizens, the

city of Eindhoven has formed a "Four Party Joint Innovation Model" for a period of 15 years of cooperation to jointly build a smart city through open innovation.

Signify (formerly Philips Lighting) and its partners are important partners in this project, providing green and smart city lighting facilities. This project includes innovative lighting applications in the development of urban public spaces, such as connected street lighting systems and maintenance and management of urban public lighting. The pilot work was launched in five pilot areas throughout the city in the autumn of 2016.

To achieve this vision, the city of Eindhoven has developed a citizen engagement plan that involves citizens in every step of the implementation of this smart city project, in order to improve the quality of life in their communities. The municipal government believes that many of the problems faced by citizens can be solved by the intelligent technology provided by urban lighting infrastructure. The combination of intelligent interconnected lighting systems with other intelligent systems, sensors, etc. makes urban lighting infrastructure an information highway, which can bring benefits to citizens and provide more services. For example, not only can it reduce energy consumption, but it can also apply lighting navigation technology to accurately guide emergency services to the scene of the incident or to the citizens in need of help; Smart lamp posts introduce innovative environmental monitoring and data collection to enhance urban intelligent management.

Figure 5: bridge with changing lights

Among them, a bridge built in the city of Eindhoven (Figure 5) displays traffic and weather conditions with constantly changing lights. Its constantly changing visual appearance is not only a city artwork, but also showcases the urban industrial characteristics of the "City of Light": warm weather, drivers can see red and orange, and blue and green in cold weather. The Signify (formerly Philips Lighting) connected lighting system achieves real-time monitoring, management, and control to ensure the visual comfort of drivers.

By implementing the "Four Party Joint Innovation Model" project, Eindhoven has become an innovative pioneer in the transformation and development towards smart cities. Public lighting has

become closely linked to urban infrastructure: in addition to providing lighting functions, urban public lighting has also become a digital platform that provides true value to citizens through the acquisition and sharing of information and services. As a result, the general public has become active participants in building smart cities.

C. Brainport of Eindhoven:

At the end of the last century, Eindhoven faced the problem of a lack of land space and the inability to achieve economies of scale in its development. Therefore, in 1993, it joined forces with about 20 surrounding cities to establish the Eindhoven metropolitan area, which covers an area of over 1400 square kilometers and has a population of nearly 800000, significantly expanding its development space.

In 2014, the city of Eindhoven proposed to upgrade this metropolitan area into a high-tech manufacturing technology cooperation zone, proposing the development concept of a "Brainport" metropolitan area, and cooperating with surrounding cities in key areas such as economy, environment, energy, and infrastructure. Through a multi-party joint innovation model, sustainable industrial development between cities can be achieved throughout the region, and an industrial innovation synergy zone can be constructed, including the establishment of an industrial fund to help manufacturing enterprises in the region transform; Eindhoven also encourages companies to leverage their technological and industrial chain advantages to upgrade nearby established enterprises and achieve green industrial transformation.

The urban laboratory plan in Eindhoven is also applied to a large number of villages within the ecological protection scope of the smart port. Relying solely on rural leisure tourism is not enough to drive its sustainable economic development. The Netherlands is the world's second largest agricultural technology country, providing innovative green technologies through leading manufacturing companies in the region, such as Signify's (formerly Philips Lighting) professional plant lighting technology, to help establish greenhouse complexes on farms in the region and improve the quality and yield of crops.

After years of development, the Eindhoven "Brainort" metropolitan area has become one of the global intelligent manufacturing regions, achieving sustainable development of modern industries and becoming an important part of the Netherlands' national innovation and development strategy.

- 2) Technological innovation helps the green transformation of the lighting industry

A. Technological innovation in the lighting industry

Light, along with air and water, constitutes the most fundamental element of human life. The earliest forms of lighting for humans were bonfires and torches, followed by candles and oil lamps. Humans obtained faint light in the dark through burning, which lasted for a long time.

At the end of the 19th century, the Industrial Revolution and the emergence of incandescent bulbs marked the birth of the modern lighting industry, and their soft lighting warmed households in the era of electrical lighting. At that time, electric lighting was a new technology that required innovative research and development to improve electrical safety and the lifespan of light bulbs.

In the latter half of the last century, energy-saving fluorescent lamps began to emerge, which are more energy-efficient, environmentally friendly, and have a longer lifespan than traditional light bulbs; After entering the era of LED lighting, compared with traditional light bulbs and fluorescent lamps, LED produces purer and brighter light, is more energy-efficient, and has a longer lifespan. Nowadays, with the development of new generation information technologies such as the Internet of Things, the era of connected lighting has arrived; At the same time, lighting technology is expanding its traditional lighting functions and striving for green and sustainable development.

It can be seen that the lighting industry is a manufacturing industry with a history of over a hundred years of development, but it started with new innovative technologies, and later achieved industry transformation and development based on multiple technological innovations. The driving force behind these technological innovations is the improvement of lighting quality, as well as the new industrial revolution, green and sustainable development. Nowadays, lighting has transitioned from traditional manufacturing to connected lighting that integrates the Internet of Things and green technology, and continues to innovate and develop.

B. Signify (former Philips Lighting) leading green transformation of lighting industry

The innovative transformation and development of the lighting industry cannot be separated from the exemplary role of leading enterprises. As a global leader in lighting technology, Signify was founded under the name Philips in 1891 in Eindhoven, Netherlands. It began producing traditional light bulbs (Figure 6) and has been leading the world in breakthroughs and developments in lighting technology applications, constantly introducing meaningful innovations to create better working and living conditions for people.

Figure 6: lighting bulb in 1892

Signify (formerly Philips Lighting) leads the transformation of the lighting industry from traditional lighting to LED lighting, providing high-quality and efficient lighting; Nowadays, based on the Internet of Things technology, it is comprehensively leading the transformation and development of the lighting industry towards connected lighting (Figure 7), bringing lighting from a single lighting function into the new digital age, providing a new lighting experience of "light beyond sight".

Figure 7: office connected lighting system in 2014

a. Innovation tradition

In the early days of the establishment of Signify (formerly Philips Lighting), lighting was a new technology that required significant research and development investment to improve lighting quality. Therefore, the first research laboratory was established to study and improve traditional light bulbs, which now seem simple lighting products, for decades.

The company's R&D emphasizes open innovation and establishes an international network with other industry research laboratories to achieve consensus on technological goals; At the end of the last century, with the advent of the knowledge economy era, active efforts were made to open up innovation. As mentioned in the previous international practice sharing section, the previously closed research park was opened to other high-tech manufacturing enterprises and institutions to share facilities and exchange knowledge, ultimately becoming the Eindhoven High-tech Campus today. This park promotes the sustainable development of modern manufacturing industry through multi-party joint innovation mode. Currently, more than 300 enterprises and institutions have settled in, gathering more than 10000 high-tech talents. It has been rated as the "Smartest Industrial Park".

At the same time, the company attaches great importance to young people as the sustainable future of the manufacturing industry, and supports the alliance between the Dutch government, businesses, and education sector to stimulate young people's interest in science and technology. Activities such as seminars, internships, and lectures are organized, including a special "Girls' Day" project to enhance the interest of high school girls in research and technical careers.

b. Innovation for sustainable development

Signify (formerly Philips Lighting) leads the lighting industry in developing green innovative technology applications and actively addresses the world's most pressing challenges:

Climate change: Climate change is affecting every country and city. Strengthening international cooperation, jointly transitioning to a low-carbon economy, using more renewable energy, and improving energy efficiency, the company provides efficient LED lighting technology and develops clean energy solutions, such as solar lighting.

Circular economy: The traditional production and consumption mode of "acquisition, production, and disposal" has caused a lot of resource waste, while circular economy represents a redesign of the future, aiming to improve resource utilization efficiency and free economic growth from dependence on natural resource utilization. To this end, the company designs replaceable or recyclable components to extend the lifespan of lighting products, and 3D printing lighting fixtures with recyclable materials is a great application.

Food safety: The global population growth puts enormous pressure on food supply, and the production of food also generates corresponding environmental pollution. Therefore, the company innovatively uses professional plant lighting technology to improve crop yield and quality, reduce energy consumption and costs, and achieve sustainable agricultural development.

Health and well-being: Light is extremely important to us, just like air and water, it is an important regulator of our bodily rhythms and plays a crucial role in our physiology and emotions. The company innovatively applies human factors lighting design to improve visual comfort, enhance physical function, and improve health and well-being in both daily life scenarios and workplaces.

c. Leading for future of lighting industry sustainable development

Signify (formerly Philips Lighting) has set a five-year goal of achieving carbon neutral operations from 2016 to 2020 to minimize the impact of company activities on the environment and build a better world. With the unremitting pursuit of environmental management, the company has formulated and implemented various plans, and reported the progress of its work to the outside world through third-party audited financial forms. In September 2020, it achieved its carbon neutral operation goal in the global market.

In 2020, when achieving carbon neutrality in operations, Signify (formerly Philips Lighting) set new climate targets in its "better Life, Brighter World" 2025: Sustainable Development Plan for the Post Carbon Neutrality Era, promising to surpass carbon neutrality and double the speed of surpassing the Paris Agreement targets, with a focus on promoting carbon reduction actions across the entire value chain.

Based on successful emission reduction experience in the lighting industry and practical application of innovative lighting technologies, Signify (formerly Philips Lighting) has launched

the "Green Switch Program" globally, calling on all industries to join the low-carbon transformation action and launch practical and feasible action goals and plans. In 2022, based on China's dual carbon development strategy, a white paper titled "Promoting China's' Dual Carbon 'Development Path - Practice and Vision of the Lighting Industry" was released in China, proposing that the sustainable development of the lighting industry should focus on five key areas: urban and rural construction, clean energy, green travel, circular economy, and green agriculture, to help China's industrial structure and production and lifestyle undergo comprehensive and in-depth systemic changes.

In 2024, Signify (formerly Philips Lighting) publicly disclosed its greenhouse gas (equivalent carbon dioxide) emissions data across the entire value chain (including Scope 1, 2, and 3) and included it in its 2023 financial report, obtaining a reasonable assurance audit opinion from a third-party auditing firm (SBTi); On this basis, a new 2040 net zero emission target is proposed, committing to reducing absolute greenhouse gas emissions across the entire value chain by 90% compared to 2019 by 2040 without using carbon credits, achieving net zero emissions across the entire value chain.

In response to the goal of net zero emissions across the entire value chain by 2040, Signify (Philips) has launched a climate transition plan called "Net Zero 2040" and has committed to auditing and reporting on the progress of the plan in its annual financial report. This plan covers multiple cross business and cross value chain actions, including incentivizing suppliers to commit to using renewable energy, adopting new energy logistics transportation fleets, and further promoting the most core factors of emission reduction in the lighting industry in recent years - high-efficiency LED lighting technology and intelligent interconnected lighting control systems.

In 2024, the company, in collaboration with Climate Group and other partners, launched the "Renovation Revolution" initiative for the construction industry, aiming to increase building renovation rates, promote the application of green and intelligent technologies, and take a crucial step towards achieving global sustainable development. In China, in collaboration with climate organizations, we have released a white paper titled "From Energy Consumers to Low Carbon Pioneers - Connected Lighting Empowering Building Energy Efficiency and Carbon Reduction". Taking this initiative as a starting point and lighting as a practical case, we call on relevant industry partners to join the sustainable development transformation of the building industry.

From achieving its own carbon neutrality operational goals to its action plan for net zero emissions across the entire value chain, Signify (formerly Philips Lighting) has led the sustainable development of the industry and beyond with innovative lighting technology, setting a benchmark for ESG practices. In the process of achieving "Net Zero 2040", the company will continue to increase investment in climate action and further improve the energy efficiency of lighting products;

Collaborate closely with end-users, enterprises, and related institutions to provide more efficient, low-carbon, and energy-saving LED lighting products for various industries and application fields; Join hands with partners and actively respond to the two key policies proposed by the International Energy Agency (IEA), namely "doubling global renewable energy capacity" and "doubling global energy efficiency improvement speed". The company will work together with partners from various industries to contribute to a sustainable future and create a cleaner and more sustainable economic model.

- 3) Conclusion

A. The multi-party joint innovation model helps promote sustainable development of industries.

The innovation policies and guidance mechanism of the Eindhoven municipal government in the Netherlands actively promote the sustainable development of the local high-tech manufacturing industry, facilitate the "multi-party joint innovation model" of government enterprise university, and form an open innovation ecosystem, ensuring that innovative technologies are implemented in a closed loop from demand, research and development, application, and promotion, promoting the sustainable development of the industry and enhancing its attractiveness to industrial factors

Firstly, in the Eindhoven High Tech Park, the "Three Party Joint Innovation Model" has joined the key element of the industrial open innovation ecosystem, continuously enhancing the park's attractiveness to global industrial elements such as excellent enterprises and R&D talents.

Secondly, in the city of Eindhoven, the "Three Party Joint Innovation Model" has expanded to a "Four Party Joint Innovation Model" composed of cities, enterprises, universities, and citizens, inspiring the enthusiasm and sense of belonging of the general public to participate in the construction of green smart cities, and promoting sustainable innovation in the manufacturing industry through the application of green intelligent technology in urban scenarios.

Once again, in the Eindhoven "Smart Port" metropolitan area, regional industrial collaboration will be introduced into the "Three Party Joint Innovation Model" to jointly achieve sustainable industrial development in the entire urban agglomeration.

B. Technological innovation and leading enterprises assist in the green transformation and development of the manufacturing industry.

The lighting industry has a development history of over a hundred years, and it is through continuous technological innovation that it is transforming from traditional manufacturing to intelligent and interconnected lighting by integrating modern information and green technology. In this process, the leading role of industry leaders is extremely important. As a global leader

in lighting technology, Signify (formerly Philips Lighting) has been adhering to a tradition of innovation for 133 years, continuously innovating the research and application of green intelligent lighting technology, and striving to unlock the extraordinary potential of lighting, creating a "shining life, a beautiful world"; At the same time, starting from ourselves, actively leading the entire lighting industry towards green and sustainable development and making our own contributions.

4. Suggestions on Measures for Green and Sustainable Development of Modern Manufacturing Industry in Chongqing

- 1) Build a city brand with industrial themes and cultivate a city culture that promotes manufacturing innovation.

A. Chongqing is a national historical and cultural city, the birthplace of Ba Yu culture, with a history of more than 3000 years. It was the earliest inland trading city to open a port in the late Qing Dynasty. The "Red Rock Spirit" is a precious spiritual wealth. At the same time, Chongqing is surrounded by mountains and rivers, known as the city with mountains and rivers.

Suggestion: promote Chongqing's pioneering and innovative urban spirit, and create a city image of "a city of mountains and waters, a beautiful place". Through innovative themed marketing activities, promote Chongqing's urban brand, enhance its urban influence nationwide and worldwide, and attract talent elements for sustainable development in the manufacturing industry.

B. Chongqing is one of China's old industrial bases, which has gone through important stages of industrial development such as embryonic stage of opening up ports for trade, basic cultivation period of a large number of enterprises relocating to Chongqing, consolidation and development period of a number of major projects relying on the national construction, and rapid development since its direct administration. Its numerous industrial historical buildings are valuable cultural heritage of the city.

Suggestion: transforming and reusing these industrial historical buildings, such as old factories scattered throughout Chongqing, to create historical landmarks and innovative communities of urban industrial culture, especially focusing on attracting young people representing the future of the manufacturing industry, cultivating a city cultural atmosphere that respects industrial traditions and emphasizes technological innovation, and better promoting the sustainable development of industries.

- 2) Innovative practice of the "multi-party joint innovation model" to promote the application of green innovation technologies in urban scenarios.

A. Chongqing is focusing on building a modern industrial system with advanced manufacturing as the backbone, deeply implementing major technological improvements and large-

scale equipment updates in the manufacturing industry, accelerating the upgrading of traditional industries, increasing major scientific and technological breakthroughs, and strengthening scientific and technological innovation and deep integration of industrial industries.

Suggestion: establish and practice a "multi-party cooperation and innovation model" to promote the green and sustainable development of Chongqing's manufacturing industry.

Relying on industrial parks, cities and other carriers, we will continue to cultivate a new mechanism based on the innovation ecosystem of the manufacturing industry chain: focusing on promoting the transformation and application of innovative technologies to cultivate the industry chain, with cross disciplinary open innovation platforms as the core, to form a collaborative green innovation ecosystem.

Industry leaders are crucial for the green transformation and development of the manufacturing industry: cultivating industry cluster leaders and attracting outstanding external enterprises to settle in, forming an innovation ecosystem composed of industry leaders, small and medium-sized high-tech enterprises, start-ups, research institutions, and service-oriented enterprises, and jointly contributing to the sustainable development of the industry.

Innovatively tap into the resource potential of Chongqing universities and research institutions: promote cooperation with enterprises to carry out green technology open innovation, and promote sustainable industrial development.

B. Cities (as well as industrial parks and urban agglomerations) are the carriers of manufacturing development and technological innovation, and also the living and working places of the vast number of citizens engaged in manufacturing development. As a super large city, Chongqing has rich and extensive innovative technology application scenarios for green and smart cities.

Suggestion: innovatively exploring innovative models for manufacturing industry to participate in urban construction, such as urban innovation laboratory projects, encouraging and promoting excellent manufacturing enterprises to apply innovative green intelligent technologies in urban scenarios; At the same time, we invite the general public to participate and jointly realize the closed-loop process practice of green intelligent technology from innovation to application. On the one hand, it helps to achieve green and sustainable development of the manufacturing industry and cultivate leading enterprises; At the same time, it also contributes to the green construction of Chongqing's smart city.

- 3) Promote the green and low-carbon transformation and development of Chongqing's modern manufacturing industry across the entire region.

Building a beautiful China is an important goal of comprehensively building a socialist modernized country and an important content of realizing the great rejuvenation of the Chinese nation and the Chinese Dream. Currently, China's economic and social development has entered a stage of accelerating green and low-carbon high-quality development.

Suggestion: guided by the goal of achieving carbon peak and carbon neutrality, establish green guidance for the development of Chongqing's modern manufacturing cluster system, accelerate the green transformation and development of Chongqing's manufacturing industry across the region, and assist in the healthy construction of the modern manufacturing cluster system.

Promote the deep integration of industrial digitization, intelligence, and greening, and accelerate the construction of a modern industrial system supported by the real economy.

Vigorously promote the upgrading of traditional industrial processes, technologies, and equipment to achieve green and low-carbon transformation.

Promote the upgrading and transformation of equipment in key industries, accelerate the promotion of energy consuming equipment with advanced energy efficiency and energy-saving levels, and implement energy-saving and carbon reduction reforms in different industries and fields.

Vigorously cultivate and develop a circular economy, support the greening of key industries, and promote the circular transformation of industrial parks.

Accelerate the formulation and revision of standards and specifications in key areas.

Actively encourage manufacturing enterprises to start from themselves and actively practice the green and sustainable development of the industry.

5. Conclusion

In this article, Signify (formerly Philips Lighting) shares its understanding of green and sustainable development in the manufacturing industry from a corporate perspective. It introduces the industrial innovation and sustainable development in Eindhoven of the Netherlands, where the company is located, as well as its international practice of leading the green transformation and development of the global lighting industry. Furthermore, it proposes innovative measures and suggestions for Chongqing to achieve green and sustainable development in modern manufacturing industry. It would be our great honor if this sharing helpful!

As mentioned earlier, the manufacturing industry and its enterprises achieve green and sustainable development through cities as carriers. Signify (formerly Philips Lighting) has been

continuously innovating technology with Eindhoven, the Netherlands as its center for 133 years, leading the global lighting industry's green transformation and development. Through innovative cooperation models, it actively participates in the green and sustainable development of the city where it is located.

Chongqing is a city with a long history, unique style, and distinct spirit. It has an industrial tradition and a foundation for the development of modern manufacturing industry. We firmly believe that by building a modern manufacturing system, Chongqing will achieve green and sustainable development in manufacturing industry. As a global leader in lighting technology, Signify (formerly Philips Lighting) hopes to devote to the great historical process of building a modern new Chongqing and make new contributions!

Keys to the green development of manufacturing industry

Ruling Zhang Blein
Chairman & CEO of Sodefinance

As a pillar of the national economy, manufacturing industry provides an indispensable material guarantee for the stable operation and healthy development of the economy and society. However, its rapid global development has caused or is still causing adverse impacts on the environment. Therefore, promoting the upgrading, advancing the intelligent and green evolution of the manufacturing industry can effectively reduce these negative impacts and achieve sustainable development goals.

In this article, SODEFINANCE will take its long-term partner Mersen as an example to show how Mersen, a manufacturer of high-tech products and a global expert in electrical power and advanced materials serving the high-tech industry, promotes the green development of the manufacturing industry through its products, knowhows and corporate social responsibility policies, and contributes to creating a world that cherishes resources and the environment more.

I.Impact of manufacturing on the environment

Manufacturing is not only an important part of the economy, but also an important driving force in promoting global development, S&T progress and social stability. From the late 18th century to the early 19th century, the rise of the Industrial Revolution marked the modernization of the manufacturing industry. The introduction of mechanized production significantly improved production efficiency, thereby meeting market demand on a large scale.

But as we all know, the development of manufacturing has many significant and adverse impacts on the environment, such as:

- Air pollution: Industrial emissions from certain manufacturing processes (such as carbon dioxide, nitrogen oxides, and sulfur oxides) can cause air pollution, affecting the health and quality of life of the residents nearby.

- Water consumption and pollution: The manufacturing industry requires a large amount of water for production and cooling processes. If not properly handled, wastewater discharge may contain harmful chemicals, causing water pollution and affecting the aquatic ecosystem and water supply security.

- Solid waste and hazardous waste: Solid waste and hazardous waste generated during the manufacturing process, such as waste materials and wastewater treatment residues, may pollute the soil and groundwater if not properly managed, and may even cause resource waste and health risks.

- Energy consumption and greenhouse gas emissions: The high demand for energy in the manufacturing industry leads to the combustion of large amounts of fossil fuels, releasing greenhouse gases (such as carbon dioxide), exacerbating global climate change and greenhouse effect problems.

II.Promoting green development of manufacturing through technology and products

As mentioned above, the manufacturing industry has a huge impact on the environment. With the increase of environmental awareness and the global tensions over energy supply, the manufacturing industry is gradually shifting towards green manufacturing and sustainable development. It has always been the goal advocated and actively strived for by Mersen to promote the green and sustainable development of the manufacturing industry through innovation on products and technologies.

1.Applications of advanced materials

Mersen develops and applies advanced materials to manufacture industrial equipment and components with high-performance.

For example, silicon carbide (SiC) semiconductors are increasingly becoming the first choice for the transition to higher efficiency, as they perform better and consume less energy than silicon (Si) semiconductors. They are used in electric vehicles, energy storage, wind power generation and solar power conversion systems. SiC are particularly important for accelerating the adoption of electric vehicles, as they can increase driving range and reduce battery charging time. The market for silicon carbide semiconductors has seen only limited expansion in recent years, but is expected to see very strong growth over the next three to four years, with annual growth of approximately 30% to 40%, in line with the development of electric vehicles and 5G telecommunications.

Mersen is a key player in the rise of silicon carbide semiconductors. Its expertise in providing the components needed to manufacture power semiconductors is almost unique. The isostatic graphite and insulators produced by Mersen ensure perfect control of the reaction at 2,400°C to form extremely high-quality silicon carbide.

2.Power transmission and protection

Regional development requires conversion and transmission systems that are increasingly powerful and efficient in order to distribute energy at the point of consumption and minimize losses. HVDC is a common technology that uses overhead transmission lines or submarine cables to transmit power from various sources (solar, wind) over long distances. The systems use converters to transform alternating current into direct current and vice versa.

As the major industrial supplier, Mersen provides products which help to optimize the efficiency of the converters (interconnection busbars, cooling devices, power capacitors) and ensure the electrical protection of installations (fuses). The Guangdong-Hong Kong-Macao Greater Bay Area has built the world's largest indoor back-to-back flexible direct current converter stations, significantly enhancing the regional power mutual assistance capabilities. Mersen supplies nearly 28,000 cooling plates to protect the power modules integrated in two high voltage flexible HVDC converter stations. The Group was chosen based on the flawless reliability assurances required for this type of equipment, which is used in particularly demanding environments and conditions. These new converter stations will ensure a secure supply of power to the Greater Bay Area, thus promoting the region’s economic and social development.

These devices not only improve the efficiency and safety of power transmission, but also promote the intelligent development of the power industry.

3.Utilization of renewable energy

Wind power, solar power and hydropower are currently the mainstream forms of renewable energy, which generated 3372GW of energy in 2022.

Wind power production is steadily increasing, thanks to the boom in onshore and offshore wind capacity. Mersen supplies power generation and distribution products, as well as products for the protection of equipment, and is recognized for its ability to provide innovative solutions to the wind power industry.

With production capacity reaching nearly 450 GW in 2023 and an annual growth rate of 15%-20%, the solar market continues to expand, with China accounting for more than 85% of overall manufacturing capacity. The challenge facing the industry right now is to continue developing new technologies aimed at improving solar cell efficiency. Mersen has promoted the emergence of this market with high-end graphite and insulation felts for producing silicon ingots, the raw material of solar cells.

Hydropower accounted for 37% of total renewable electricity generation at the end of 2022 and supplied up to 75% of demand in some countries like Brazil. While hydro is undoubtedly the most sustainable renewable energy source with facilities that can operate for up to 50 or even 100 years, dams require sophisticated technical solutions adapted to their specific operating conditions (humidity, oil vapors, dust). Mersen assists industry operators throughout the life cycle of the power plants by providing them with solutions dedicated to hydroelectric generators and services to optimize facility performance.

4.Technological cooperation and innovation

Mersen actively collaborates with partners in the manufacturing industry in technological innovation and R&D to deliver tailormade solution. If we take busbars, for example, each model is co-developed with the customer in order to produce a customized battery module. That's one of the reasons why it was recently chosen by Automotive Cells Company (ACC), the joint venture created by Stellantis, TotalEnergies/Saft and Mercedes-Benz, to manufacture “new generation” batteries and support vehicle development at Peugeot, DS, Opel and Fiat.

III.Corporate Social Responsibilities (CSR)

Manufacturing is an industry that concerns global development. The Paris Agreement[1], the Montreal Protocol[2] and the Stockholm Convention[3] are all important environmental conventions formulated by the international community for manufacturing and social development. They are committed to promoting sustainable development and environmental protection on a global scale, and play an important guiding role in the environmental management and sustainable development of the manufacturing industry.

When talking about the sustainable development of the manufacturing industry, we often focus on technological innovation and product upgrades, but ignore the company’s awareness of social responsibility and relative management. Here, we would like to share Mersen’s Corporate Social Responsibilities (CSR) policy. Being aware that its social and environmental impact must be constantly measured, evaluated and analyzed in order to be better managed, Mersen has established a cross-segment CSR policy for all its employees and adapted to all levels of the organization.

In March 2024, Mersen updated its new medium-term CSR targets (2027), which is an integral part of the Group’s strategy, aiming to develop the group’s business in a responsible and sustainable manner. The specific measures related to environmental protection include:

1.Responsible partner

- Improve social and environmental practices throughout the value chain

  • Maintain a minimum of 85% of external purchases with local suppliers

  • Less than 5% of suppliers with a CSR score of less than 25

2.Limit the environmental impact of Mersen’s sites

[1] Paris Agreement: a legally binding international treaty on climate change. Its overarching goal is to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.”

[2] Montreal Protocol: a global agreement to protect the stratospheric ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS).

[3] Stockholm Convention: an international treaty to protect human health and the environment from the potentially toxic POPs.

- Reduce GHG emission

In the manufacturing process of many of Mersen's products (especially graphite and felt products), the use of natural gas and electricity is a major source of greenhouse gas emissions. Therefore, as early as 2021, Mersen Group pledged to reduce the intensity of its greenhouse gas (GHG) emissions by 20% between 2018 and 2025 through the following work, which has been updated in the new roadmap:

• Reduce GHG emissions intensity by 35% (versus 2022)

• Increase the share of renewable electricity to 80%

- Recycle waste

In order to reduce the environmental impact of industrial sites, waste management has become an important environmental focus of the Group.

• Increase the share of waste recycled to 80%

- Lower water consumption

Water is an essential resource for the Earth. Water consumed by Mersen is primarily for cooling equipment used in heating processes and ensuring water quality before disposal. Discharge is strictly controlled to avoid any risk of contamination. By setting targets to reduce water consumption, Mersen contributes to the sustainable management of water resources.

• Lower water consumption intensity by 15% (versus 2022)

• Draw up a formal water conservation plan for all sites exposed to water stress

China has many high-quality manufacturing companies that spare no effort in product upgrading and technological innovation. However, achieving success like Mersen in continuously exploring and expanding in the fields over 130 years is also inseparable from its efforts to build up a responsible enterprise. Only by focusing on products and technology on one hand and corporate social responsibility on the other hand can we truly establish an excellent corporate image in the global market and enhance our competitiveness.

IV.Conclusion

The manufacturing industry not only provides a large number of material products and services, but also has an important impact on economic development, technological and social progress, and globalization. Although the manufacturing industry faces environmental and resource

challenges, it has been playing a key role in improving the quality of human life and promoting social development. The green development of the manufacturing industry is not only a necessary measure to cope with environmental challenges, but also an important way to achieve sustainable development.

In this article, we use Mersen's products and technologies to demonstrate the bright prospects of promoting the high-end, intelligent and green development of the manufacturing industry. At the same time, Mersen's corporate social responsibility policy also emphasizes what proactive actions a company could take in environmental protection and resource management. From reducing greenhouse gas emissions to increasing waste recycling, these measures not only meet the requirements of international environmental conventions, but also provide valuable experience and demonstrations for the green transformation of the global manufacturing industry.

From the "Action Plan for Enhancing High-Quality Development of Manufacturing in the New Era and New Journey (2023-2027)", we learn that Chongqing has launched "33618"[Focus on building three major leading industrial clusters of intelligent networked new energy vehicles, new generation electronic information manufacturing, and advanced materials; upgrade and build three pillar industrial clusters of intelligent equipment and intelligent manufacturing, food and agricultural product processing, and software information services; innovate and build six characteristic and advantageous industrial clusters of new display, high-end motorcycles, light alloy materials, light textile, biomedicine, new energy and new energy storage; cultivate and expand 18 "new star" industrial clusters (including six future industrial clusters such as satellite Internet, biomanufacturing, life sciences, metaverse, cutting-edge new materials, and future energy, and 12 high-growth industrial clusters such as power semiconductors and integrated circuits, AI and robots, servers, smart homes, sensors and instruments, intelligent manufacturing equipment, power equipment, agricultural machinery equipment, fibers and composite materials, synthetic materials, modern Chinese medicine, and medical devices).] modern manufacturing cluster scheme, and the high-quality development of the city's manufacturing sector has continued to consolidate. Facing the challenging goals of the global sustainable development, we call on Chongqing's manufacturing companies to actively fulfill their social responsibilities while continuously upgrading products and innovating technologies, to realize a win-win situation for economic development and environmental protection by promoting the intelligent and green development of industries and technologies.

Advancing High-Quality Development of Modern Producer Services Industry

Y.K. Pang
Chairman of Hong Kong for Jardine Matheson Limited and Senior Advisor to the Board

Executive Summary

● This 18th meeting of the Chongqing Mayor's International Advisory Board (CMIA 2024) comes at a crucial time for the global economy and a key point in China's further development and modernisation. The global and geopolitical context is complicated, but shifts in political economic power and influence and the application of new technologies offer opportunities.

● In July this year, the third plenary meeting of the 20th Central Committee of the Communist Party of China set out plans for comprehensively deepening reform and opening up. We believe this offers opportunities for business development, unifying markets, a boost to consumption, and the further development of Chongqing's strategic position in the development of western and central China.

● Chongqing's economy has been growing solidly, across manufacturing, services and consumption. The "33618" plan for a modern manufacturing cluster system offers a powerful vision to drive the industries of the future.

● The new energy vehicles (NEV) sector has grown rapidly and is expanding beyond China's borders. The government is developing ambitious plans for modern producer services industries.

● The Jardine Matheson Group remains committed to its business in China over the long-term. Chongqing is a major part of the Group's operations in China. New business developments are building on retail and logistics strengths and consumer markets.

● We are looking for opportunities to apply technology further to new and traditional businesses, in line with the Chongqing government's goals for development and modernisation, and the promotion of modern producer services industries.

● Our business strength in core geographies of China and Southeast Asia are aligned with the deepening of ties between these regions, for example in electric vehicles.

● We welcome the opportunity this CMIA meeting provides to learn more about Chongqing's plans and opportunities, and to continue working together towards a prosperous future ahead.

Introduction

The 18th meeting of the Chongqing Mayor's International Advisory Board (CMIA 2024) comes at a crucial time for the global economy and a key point in China's further development and modernisation. We are currently witnessing a rise in geopolitical tensions and the prospects for the global economy remain uncertain. At the same time, there are opportunities arising from structural shifts in political and economic power from West to East, while new technologies and their applications are revolutionalising business practices and creating new economic opportunities. This "fourth industrial revolution" and its implications for smart development was the subject of the 13th CMIA in 2018, and China at a national level and Chongqing at a local level have been at the forefront of devising responses to the opportunities this presents.

The most significant policy statements for China this year came in the third plenary meeting of the 20th Central Committee of the Communist Party of China held in July. This set out plans for comprehensively deepening reform and opening up, and the opportunities that these present will require careful analysis by foreign companies in China. This meeting of the CMIA provides a good opportunity for us to understand how the Chongqing government sees the implications for Chongqing of this important plenary meeting in the wider national and international context.

Over the nearly two decades during which CMIA meetings have been held, Chongqing has played a growing role in China's development. Its geographical positioning, industrial base and consumer growth have made it an anchor in developing western and inland China. It has acted as one of the high points for opening up in inland China. The municipality connects to the Silk Road Economic Belt and 21st Century Maritime Silk Road under the Belt and Road Initiative, as well as to the Yangtze River Economic Belt and the New International Land-Sea Trade Corridor to China's southern coast (these were topics of the 10th CMIA in 2015). Chongqing played a prominent role in earlier pilot reforms, such as urban-rural integration. It is the only "international consumption centre city" in inland China (the topic of the 17th CMIA in 2022), and this is a key driver of our business development.

The Jardine Matheson Group has a long-term commitment to China and Chongqing and has participated in CMIAs since the early years. Jardines is one of only 10 non-Chinese Fortune 500 companies which realise 20 percent of their revenue from Chinese Mainland. Currently, we have total assets of around US$13 billion and employ over 80,000 people across China Mainland. We believe our range of businesses have synergies with latest development trends and plans in Chongqing and in China more widely, and with the growing economic ties between China and Southeast Asia, where Jardines is a growing player. This paper explores these themes in detail, concluding with some suggestions for further development.

The Third Plenum in Global Context

Over recent months, the focus of analysing China's trajectory has been the third plenary meeting of the 20th Central Committee of the Communist Party of China held in July (the "Third Plenum"). This meeting was much anticipated by the international business community, and we have paid close attention to the lengthy decision document released after the meeting and to the broad set of social and economic policy plans it sets out. We look forward to following these as they are implemented in detail.

The Third Plenum has a clear direction of travel, and a careful and steady approach to reform is welcome. Businesses hope for a consistent policy environment where possible, as well as one which allows improvements to be made. We welcome the persistence in progress towards further marketisation of the economy - the Third Plenum looks to offer this through the commitment to "leverage better the role of the market, foster a fairer and more dynamic market environment, and make resource allocation as efficient and productive as possible".

We have noted a number of other elements of the Third Plenum decision and related documents which we believe are especially relevant to the theme of this CMIA meeting and to Jardine Matheson Group's businesses in Chongqing.

First, a key focus of future development is the "fostering of new quality productive forces". We note that the decision emphasises that this should be done "in line with local conditions", and anticipate that particular features of this development path will be relevant to Chongqing. The specific economic sectors this relates to include artificial intelligence, aviation and aerospace, new energy vehicles, new materials, high-end manufacturing equipment, biomedicine, and quantum technology. Many of these are key parts of the Chongqing economy, and should drive economic growth and upgrading in the municipality over the coming years. But this policy goes wider, in its encouragement of the application of technology to sectors across the economy and the emphasis on integration of the digital and real economies. While the Jardine Matheson Group is not directly involved in most of these manufacturing sectors in China, the Group has already been committed to applying technologies to its existing businesses (see below for Display 3), and the economic growth promised by the development of new quality productive forces will spill over into the sectors where we are most active. There are synergies with Jardines' businesses in Southeast Asia.

A second set of features of the Third Plenum which we believe will be particularly relevant to Chongqing are the provisions on tax reform, strengthening the utility of territorial space planning,[1] furthering "new urbanisation", rural reforms and greater urban-rural integration, and unifying

[1] 强化国土空间规划基础作用

the national market by removing barriers, opening up competition, delivering the smooth flow of production factors, and improving the property rights system. Fiscal reforms which place more resources at the disposal of local governments, including through increased local tax collection and possible changes in the allocation mechanisms for consumption tax, will create opportunities for more flexible policy implementation at the sub-national level.

Optimising territorial spatial plans and unifying markets relate to themes of earlier CMIA discussions, particularly at the 15th and 16th CMIAs (2020 and 2021) around the development of the Chengdu-Chongqing Economic Zone, an initiative referenced again at the Third Plenum. The Third Plenum also called for deeper industrial collaboration between eastern, central and western regions of China such as the domestic relocation of relevant industries, further enhancing the openness of inland China, and developing China's strategic hinterland to ensure backup plans for key industries. These all promise opportunities for Chongqing to play an enhanced strategic role in national industrial strategy, and we look forward to learning more about the government's plans at this meeting of the CMIA.

Third, we expect an indirect boost to consumption from other measures put forward at the Third Plenum. An increase in the retirement age, presumably phased in over time, should stimulate domestic consumption, as well as help deal with the structural challenges of an aging workforce. Greater urban-rural integration, especially the building of a unified urban-rural market for construction land, further reforms to the hukou system, and the further reduction in market barriers between administrative areas can help businesses expand and provide better services to consumers. We note the State Council's statement after the Third Plenum about increasing the national urbanisation ratio to 70 percent by 2029, and the goal in Chongqing's 14th five-year plan to increase urbanisation from 69 percent to 73 percent. We expect further urbanisation in Chongqing will boost consumption and can help the property sector, an important driver of our businesses here.

Fourth, a feature of our approach to China has been long-term partnerships and the patient, steady development of our businesses. We note the Third Plenum injunction to "promote the development of patient capital"[2] as part of the regulation and development of financial investment mechanisms. Our approach to business strongly supports such long-term, strategic thinking, and we are always seeking to build long-term business relationships with outstanding Chinese enterprises.

The wider political and economic environment for companies has become more complicated, with access to certain global technologies more constrained than in the past. The Chinese government has responded by emphasising the importance of innovation and resilience, with results which demonstrate strength and adaptability in the Chinese manufacturing ecosystem. Finding the

[2] 耐心资本

optimal policy balance between resilience and openness will remain a challenge over the coming years. At the same time, the changing shape of globalisation and China's continued commitment to open economic exchange where possible offer opportunities for multinational business conglomerates such as the Jardine Matheson Group. Of particular interest are the growing economic and trade ties between China and Southeast Asia, which bring together two of the major markets in which we are active.

Chongqing: Modern Producer Services Industry

The structures of Chongqing's economy have left it less-directly exposed to these global trends than some other parts of China, though the indirect impacts of geopolitical and geo-economic competition are distributed across the Chinese economy and have implications for Chongqing too.

While overall levels of growth in the Chinese economy have declined over recent years, the headline GDP growth rate in national GDP of around 5 percent per annum remains healthy. Relative to many other parts of China's economy, Chongqing is outperforming, with projected annual municipal GDP growth at 6 percent. In 2023, Chongqing's GDP grew 6.1 percent to pass RMB3 trillion (approximately US$436 billion). Statistics for the first half of 2024 show GDP passing RMB1.51 trillion, with industrial value added up 8.6 percent (2.6 percentage points higher than the national average). There was a 2.6 percent increase in fixed-asset investment, and retail sales of consumer goods rose 3.9 percent to reach RMB768.5 billion (Chongqing's total social retail sales are over half of municipal GDP, more than that of the top ten cities in China, highlighting the city's consumer market strength). Exports were up 2.8 percent to RMB235.9 billion, while service sector growth was among the fastest in China, at 5.8 percent.[3] This builds on growth in the service sectors value added for 2023, up 5.9 percent to RMB1.64 trillion, accounting for 54.3 percent of Chongqing's GDP and 52.5 percent of its economic growth.

With Jardines' strong presence in both Hong Kong and Chongqing, we are pleased to see the steady growth in trade and investment ties between the two cities. In 2023, the trade volume exceeded RMB55 billion. There are 15 Chongqing companies listed in Hong Kong, with market capitalisation over HK$46 billion. The two cities have a government cooperation mechanism and legal services cooperation agreement. The latter should be able to support the further development of legal services in Chongqing (the goal for 2027 for this modern service sector is 20 law firms with over 100 staff and a total of 20,000 lawyers). Chongqing's Mingyue Lake International Intelligent Industry Science and Technology Innovation Base was jointly established by the Hong Kong University of Science and Technology and Chongqing Liangjiang New Area.[4]

[3] Data sourced from 数据来源： https://www.yicaiglobal.com/news/chongqing-is-a-dark-horse-among-chinas-top-powerhouses-first-half-data-prove

[4] https://sc.isd.gov.hk/TuniS/www.info.gov.hk/gia/general/202406/27/P2024062700324.htm

"33618" Modern Manufacturing Cluster System

Topic 2 of this year's CMIA relates these service industries to Chongqing's strategic plan for the development of a "33618" modern manufacturing cluster system, which offers a powerful vision to drive the industries of the future (see Display 1 for sectoral details).

Display 1: Chongqing's "33618" modern manufacturing cluster system[5]

- "3" one-trillion-yuan leading industry clusters: intelligently connected new energy vehicles, new-generation electronic information manufacturing, and advanced materials.
- "3" five-hundred-billion-yuan pillar industry clusters: intelligent equipment and intelligent manufacturing, food and agricultural product processing, and software information services.
- "6" one-hundred-billion-yuan industry clusters with special advantages: new displays, high-end motorcycles, light alloy materials, light textiles, biological medicine, new energy, and new energy storage.
- "18" rising star industry clusters - six future industry clusters and 12 high-growth industry clusters:
  - * 6 future industry clusters: satellite internet, biological manufacturing, life science, metaverse, frontier new materials, and future energy.
  - * 12 high-growth industry clusters: power semiconductors and integrated circuits, AI and robots, servers, smart homes, sensors and instrumentation, intelligent manufacturing equipment, power equipment, agricultural machinery, fiber and composite materials, synthetic materials, modern Chinese medicine and medical instruments.

In the first of these sectors, new energy vehicles (NEVs), Chongqing is clearly playing a leading role within the Chinese economy as the automotive sector shifts from traditional fuel vehicles to smart, network-connected NEVs. Production of NEVs in Chongqing has risen to more than one fifth of total vehicle output, reaching 500,000 out of a total of 2.32 million vehicles in 2023 (in 2023, Chongqing was the second-largest car producer in China, after Guangdong Province, but has outperformed Guangdong in the first half of 2024 to become the largest car producer in

[5] Sourced from briefing for CMIA and https://app.ichongqing.info/mixmedia/a/202402/20/WS65d418b2e4b075523e30a873.html

China). Ambitious targets have been set for further growth in the NEV sector to reach one million units annually by 2025 and as many as two million by 2027. Key players in the Chongqing sector include SERES (formerly Chongqing Sokon) and Chongqing Chang'An, and notable models like the SF5, AITO M5, M7, and M9 by SERES, as well as Deepal and Avatr by Chang'An, have gained prominence in China's NEV market. There is further potential for growth. Chang'An's sales of NEVs accounted for less than 20 percent of its total automotive sales in 2023, and there have been reports of measures to encourage this to grow.[6] The sector is also extending beyond China's borders. Vehicle exports from Chongqing in 2023 increased to RMB 33 billion (US$4.77 billion), a 51.9 percent yoy increase. SERES and Chang'An are expanding internationally, establishing NEV production bases in Indonesia and Thailand to cater to the Southeast Asian market, where the Jardine Matheson Group has strong networks in the automotive sector (we outline our development in NEVs in more detail in the next section of the paper).

Modern Producer Services Industries

Another key policy goal is the development of modern producer services industries. Preliminary calculations by the Municipal Bureau of Statistics show that the main industries of productive services added value of 687.3 billion yuan, contributing 25.6 percent to the city's economic growth and 22.8 percent of municipal GDP.[7]

Earlier this year, the Chongqing Municipal Development and Reform Commission sought opinions on the Chongqing Municipal Producer Service Industry High-Quality Development Action Plan (2024-2027).[8] This anticipates promoting specialization and high-end value chains, enhancing levels of digitalization, integration, greening, and internationalization, and supporting the modern industrial system and new quality productive forces. By 2027, the municipality aims to have 20 productive service industry clusters with a scale of RMB10 billion, and 100 leading enterprises in the productive service industry. Targets for 2027 include RMB55 billion in added value of scientific and technological research and technical services, establishment of industrial design parks and centres, growth in cultural and creative and industrial design-related corporate services (to over RMB300 billion), an industrial chain of the inspection and testing service industry of RMB100 billion, building high-end intelligence operation and maintenance service platforms, full-process engineering consulting companies, new general integration and general contracting chain leaders, and network platform factories. Significant growth is expected in online retail sales (to RMB270 billion), cross-border e-commerce, software and information service industry, data resource service industry, and the human resources service industry.

[6] See: https://www.caixinglobal.com/2024-08-07/in-depth-new-rules-set-to-give-state-owned-carmakers-an-ev-boost-102224269.html

[7] Source: Briefing for CMIA

[8] Available at https://fzggw.cq.gov.cn/hdjl/yjzq/202404/t20240426_13161703_wap.html (this document is the main source for the following paragraphs).

Of particular note, are environmental goals, with the aim to build 10 green sorting centres by 2027, a growth in recycling volume of scrapped cars and household appliances of 100 percent and 30 percent respectively compared with 2023, and average annual growth in the revenue of green service industries of 20 percent or more.

In finance, the goal is financial assets of RMB11 trillion, value added in the financial industry of RMB380 billion, and a share of municipal GDP of 9.5%. Financial leasing services are expected to grow 20 percent annually, and local securities firms will emerge.

These areas offer good prospects for synergy with businesses in Hong Kong, where Jardines has a strong presence. At the Chongqing Modern Producer Services Industry Promotion Conference in Hong Kong on 27 June 2024, Hong Kong's Financial Secretary, Paul Chan suggested three key areas for cooperation in field of modern productive services:[9]

- strengthen cross-border supply chain management cooperation;
- deepen cooperation in financial services;
- promote cooperation in scientific and technological innovation.

The growth in these sectors will have a range of mainly indirect implications for the Jardine Matheson Group. The next part of this paper gives an update on our business in Chongqing and the opportunities which we expect to arise from the latest policy developments at the national and municipal levels.

The Jardine Matheson Group in Chongqing

The Jardine Matheson Group oversees a portfolio of businesses which are leaders in their markets across our core geographies of China and Southeast Asia. It has 100 percent ownership of Jardine Pacific which holds a number of businesses operating across three main sections: engineering, consumer and transport services, 53.3 percent of Hongkong Land, 77.5 percent of DFI Retail, 85.3 percent of Mandarin Oriental, and 83.1 percent of Jardine Cycle & Carriage. Jardine Cycle & Carriage has a 50.1 percent interest in Astra.[10] The Group also has strategic investments of 21.2 percent in Zhongsheng Group and 21.4 percent in Yonghui Supermarkets through DFI. In 2023, the total turnover of the Jardine Matheson Group (including associates and joint ventures) reached US$109.8 billion with over 400,000 employees. Total assets were US$89.2 billion. Jardines ranked

[9] Source: https://sc.isd.gov.hk/TuniS/www.info.gov.hk/gia/general/202406/27/P2024062700324.htm.

[10] Figures at 31 January 2024, sourced from https://www.jardines.com/en/about-us/our-companies.

395th among the Fortune Global 500, and is one of only ten non-Chinese Fortune 500 companies that makes more than 20 percent of revenue from China.

Jardines has a long historical connection with Chongqing and returned to the city in the 1990s. Since then, it has become one of the largest foreign investors in the municipality. Operations range across retail sectors, real estate, automotive dealerships, and restaurants (details of the main businesses are indicated in Display 2). The Jardine Matheson (China) Limited Chongqing Representative Office was established in March 2012 (in addition to the offices in Beijing and Shanghai and the strong presence in Hong Kong). The Chongqing office covers businesses across Southwest and Central China (Chongqing Municipality and five provinces of Sichuan, Guizhou, Yunnan, Hubei, and Hunan). In 2023, total revenue of RMB23 billion (US$3.23 billion) was generated by our related businesses in Chongqing, with over 21,000 staff employed. Our contributions include approximately US$1.87 billion in Foreign Direct Investment (FDI) and around RMB18 billion in tax contributions.

Display 2: The Jardine Matheson Group in Chongqing

- **Hongkong Land (HKL)** has operated in Chongqing for over 20 years. Chongqing represents 57 percent of HKL's total developable Gross Floor Area (GFA) in the Chinese mainland, with 16 major residential and commercial projects. HKL's seven ongoing developments in the city primarily consist of residential properties with commercial components, including four commercial projects under "The Ring" series and one "CENTRAL" development. These projects are strategically located in prime city areas and have established a strong reputation in both residential and retail markets. In 2023, HKL secured third rank among all developers in Chongqing, while leading in average transacted unit price.
- **Yonghui Superstores** started business in Chongqing in 2004. It currently employs nearly 20,000 people and operates 148 stores. For 2023, Yonghui Chongqing ranked No.2 (No.1 is its home province of Fujian) among Yonghui’s 29 provincial companies. The sales of fresh food accounted for 35.9 percent of its total revenue, and the online business penetration was at 21.08 percent.
- **Zhongsheng Dealership** currently has seven dealerships in Chongqing, representing five brands (two Mercedes Benz, BMW, Audi, Lexus, two Toyota). Zhongsheng’s first collision and used car centre in Chongqing is due to open in November 2024.
- **Maxim’s** opened its first Shack Shake at the Chongqing MixC in June 2023.

As well as in China, the Jardine Matheson Group has a strong presence across southeast Asia. These networks mirror the development in Chongqing of industries with cross-border integration and the growing ties with southeast Asian economies, including through the New International Land-Sea Trade Corridor. Jardines' commitment to eco-friendly sustainability is strong across all of its businesses, including in the automotive sector.

Jardines' retail arm, DFI Retail Group, operates 10,600 outlets across 13 Asian countries, of which 5,600 are supermarkets and convenience stores. DFI has also been at the forefront of the digital transformation of services through its retail customer loyalty programme and omni-channel experiences. DFI has been building connections with Chongqing, and in spring 2024, Wellcome, Market Place and San Miu Supermarket Stores in Hong Kong and Macao began to sell oranges from Chongqing for the first time. The benefits of this arrangement come from Chongqing's location in the optimal terrestrial latitude for orange cultivation, which offers a supply for six months, from November to April. The strong development of Chongqing's logistics sector over many years means that it only takes about seven days from placing an order to delivery at DFI stores in Hong Kong. In March and April, 300 tons of Chongqing oranges were sold. DFI is exploring with the Chongqing supplier whether there are opportunities to supply other fruits. Chongqing and DFI Singapore have also established links for fresh supply. We hope that we can work together so that Chongqing agricultural products can enter new export markets.

The benefits of Jardines' networks across China and Southeast Asia were demonstrated in an agreement reached in March 2023 between Jardine Cycle & Carriage (Singapore) and Great Wall Motors (GWM) to distribute the GWM electric vehicle brand ORA in Singapore. This partnership develops our vision of green mobility solutions in collaboration with an important Chinese company (GWM – which has a production base in Chongqing's Yongchuan district – is a good example of a Chinese company which has successfully gone global). Singapore's development of a smart and connected mobility ecosystem allows the integration of EVs into the power grid and smart charging networks. Consumers benefit from lower costs and a better, quieter driving experience. For Jardine Cycle & Carriage, this further develops the portfolio of product offerings, building on the company's strength in automotive sales and after-sales operations. Jardine Cycle & Carriage is also the distributor of SAIC Maxus in Singapore.[11]

Other Jardine Matheson companies are making similar strides in the NEV sector. Zungfu is the distributor for BYD DENZA and smart in the Hong Kong market. Astra has an agreement with BYD to produce spare parts for the Indonesian market, where Astra is also focusing on providing quality and more affordable hybrid and battery electric vehicles suitable for customers' needs. In addition, Astra has invested in nickel mining, an important element for the new energy vehicle

[11] https://www.jardines.com/en/news-and-views/cycle-carriage-signs-distribution-agreement-great-wall-motor-bring-ora-exciting-new

industry. Through its subsidiary United Tractors, Astra acquired a 19.99% stake in Nickel Industries Limited and a 70% stake in PT Stargate Pasific Resources. Future nickel demand will be driven by growing demand for EV batteries.

Display 3: Applying technology to develop our businesses

In our paper for CMIA 2018, we noted that the Jardine Matheson Group's response to the challenge of the fourth industrial revolution puts the consumer experience at its heart. This involves leveraging data across businesses, and innovating in the automotive, retail and property development sectors:

- Zung Fu use of customer data to enhance after sales service, car sharing through WeChat.
- Mannings cross-border online-to-offline initiative, delivery platforms and scan and go; use of technology to track and understand customer profiles.
- HKL's smart construction site at Yorkville in Yubei, with technology used for air quality monitoring and facial recognition.
- Landmark Riverside Shopping Park use of facial recognition technology, and monitoring air conditioning levels for energy efficiency and environmental gains.

Some of the most innovative applications of technology can be seen in Hongkong Land's The Ring project. This is part of the Yorkville North development in Chongqing's Liangjiang New Area. The Ring showcases sustainability through its inclusion of a 7-storey, 42-meter tall indoor botanical garden. The goal is to combine urban living and nature in a new concept of a lifestyle retail shopping mall.

In early 2023, Hongkong Land launched its own Intelligent Building Management System. This seamlessly consolidates security, energy, environment, equipment and information management. It monitors operational data such as cooling stations, air conditioning, passenger flow sensors, and environmental parameters. The platform uses AI algorithms to provide intelligent control of the building's air conditioning equipment and optimize energy management. In 2023, the energy consumption in the communal areas of the mall was reduced by 11% y-o-y while in AI-controlled areas this was reduced by 28% compared to the same period in 2022.

In addition, the "Re-Ring Energy Station" project offers consumer rewards for taking sustainability-related actions such as bringing a re-usable cup or walking to the mall from their residence. This innovative low-carbon and environmentally-friendly programme demonstrates Hongkong Land's commitment to sustainability and to the application of new technologies.

Conclusion and recommendations

This 18th meeting of the Chongqing Mayor's International Advisory Board (CMIA 2024) comes at a crucial time for the global economy and a key point in China's further development and modernisation. The global and geopolitical context is complicated, but shifts in the global political economy and application of technology offer opportunities. The third plenary meeting of the 20th Central Committee of the Communist Party of China set out plans for comprehensively deepening reform and opening up which offer opportunities for business development, unifying markets, a boost to consumption, and the further development of Chongqing's strategic position in the development of western and central China.

Chongqing's economy has been growing solidly, across manufacturing, services and consumption. The "33618" plan for a modern manufacturing cluster system offers a powerful vision to drive the industries of the future. The new energy vehicles (NEV) sector has grown rapidly and is expanding beyond China's borders. The government is developing ambitious plans for modern producer services industries.

The Jardine Matheson Group remains committed to its business in China over the long-term. Chongqing is a major part of the Group's operations in China. New business developments are building on retail and logistics strengths and consumer markets. We are looking for opportunities to apply technology further to new and traditional businesses, in line with the Chongqing government's goals for development and modernisation, and the promotion of modern producer services industries. We are also building on growing economic ties between our core geographies of China and Southeast Asia.

To build on this further, we recommend that the Chongqing government consider the following measures:

- Take advantage of the direction set at the Third Plenum to promote market-oriented and business-friendly reforms.
- Further encourage the smooth flow of labour, goods, and investment in order to unify markets further, including across urban and rural areas.
- Incentivise the application of cutting-edge technologies to business development across sectors, including the modern producer services industries.
- Further invest in smart and sustainable ecosystems, including in transportation, retail and logistics.
- Continue to develop strong connectivity with Southeast Asia, including through logistics

development and shared practices and strengthening the New International Land-Sea Trade Corridor. The long-standing Chongqing-Singapore link can be used to help develop sustainable ecosystems in transport and other sectors.

- Continue its successful, proactive engagement with the international business community, including through annual meetings of the CMIA.

Chongqing: A Roadmap to Smart Manufacturing and Sustainable Development

Zhu Jinping
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Introduction

Chongqing, a major manufacturing hub in China, stands at the cusp of a significant transformation. The city is strategically focusing on intelligent manufacturing to create an "enhanced version" of its manufacturing landscape. By integrating next-generation information technologies, Chongqing aims to drive the digital transformation of its manufacturing sector, enhancing efficiency, productivity, and sustainability.

This paper explores the strategic importance of integrating advanced technologies and fostering collaboration among key stakeholders to enhance Chongqing's industrial competitiveness, upgrade technology level and drive economic growth. By examining best practices from international models such as Styricon Valley, Silicon Alps, and Silicon Saxony and highlighting the successful implementation of smart manufacturing at AT&S Chongqing, this paper provides a comprehensive roadmap for the city's journey toward becoming a leader in intelligent manufacturing.

Chapter 1: Building a Smart Manufacturing Ecosystem in Chongqing

Building a smart manufacturing ecosystem is essential for any city looking to advance its industrial development. It not only enhances competitiveness and drives economic growth but also encourages innovation, attracts global partnerships, supports sustainability, and builds resilience, all of which are critical for long-term success in the global market.

1.1 The benefits of smart manufacturing ecosystem participation

Advanced manufacturing technologies streamline processes, reduce waste, and optimize resource usage, leading to higher efficiency and productivity. This makes industries more competitive by lowering costs and increasing output. Additionally, a smart manufacturing ecosystem fosters innovation by integrating cutting-edge technologies, ensuring continuous technological advancement that is crucial for staying ahead in a highly competitive global market.

The use of advanced technologies also enables higher precision and better quality control, resulting in superior products. The flexibility of smart manufacturing systems allows for greater customization, catering to specific market needs and preferences. By adopting smart manufacturing,

Chongqing can position itself as a leader in modern manufacturing, attracting global businesses and partnerships, thereby boosting the city's reputation and competitiveness on the international stage.

Furthermore, a smart manufacturing ecosystem encourages collaboration between various stakeholders, including businesses, academia, and government. This collaboration leads to shared knowledge, resources, and innovations that benefit the entire industrial sector. Small and medium-sized enterprises (SMEs), which are vital for economic growth, also benefit from access to advanced technologies and resources, helping them compete with larger enterprises and contribute to the overall competitiveness of the region.

Finally, as countries worldwide focus on digital transformation and smart manufacturing, Chongqing's alignment with these trends ensures it remains relevant and competitive. This positioning enables the city to take advantage of international trade opportunities and partnerships.

1.2 Challenges and Strategies for Overcoming Obstacles in Ecosystem Development

Developing a smart manufacturing ecosystem in Chongqing presents significant challenges that must be addressed to ensure success. These challenges can hinder the ability of manufacturing organizations to connect with a broader network and advance their smart manufacturing initiatives. However, with strategic planning and the right interventions, these obstacles can be overcome, paving the way for a robust and competitive ecosystem.

Ecosystem Coordination: One of the primary challenges is the complexity of coordinating efforts across multiple stakeholders, including businesses, academic institutions, and government bodies. Effective coordination is crucial for aligning the diverse interests and activities of these entities to achieve common goals. To address this, the Chongqing government should appoint a “convener” from within the ecosystem—a key partner responsible for coordinating efforts across multiple vendors and stakeholders. This convener should be closely aligned with the government’s executive team or the smart factory champion driving the smart manufacturing strategy. By ensuring alignment of scope and timelines, this approach will facilitate smoother collaboration and more efficient implementation of initiatives. Europe's experience, as discussed in Chapter Two, provides valuable insights into how a coordinated approach can drive regional development and innovation.

Data Protection and Cybersecurity: As manufacturing becomes increasingly digital, protecting sensitive data, intellectual property, and operational integrity becomes paramount. Cybersecurity is a critical component in preventing cyberattacks, data breaches, and intellectual property theft, which could undermine the trust and competitiveness of the ecosystem. To overcome these risks, the Chongqing government must prioritize the development and implementation of robust cybersecurity measures across the ecosystem. This could involve establishing strict data protection protocols, investing in advanced cybersecurity technologies, and fostering a culture of security awareness

among all stakeholders. Ensuring that the ecosystem's digital infrastructure is secure will maintain stakeholder trust and protect the region's competitive advantage.

Talent Acquisition: One of the most significant challenges in building a smart manufacturing ecosystem is the acquisition of skilled talent. The rapid advancement of technologies such as AI, IoT, and robotics requires a workforce with specialized knowledge and skills. However, there is often a shortage of such talent, which can limit the effectiveness and speed of ecosystem development. To overcome this challenge, the Chongqing government should implement policies and initiatives aimed at attracting, developing, and retaining talent. This could include establishing specialized training programs in partnership with local universities and technical institutes, offering incentives for skilled professionals to relocate to Chongqing, and creating opportunities for continuous learning and professional development within the ecosystem. Additionally, the government could promote international collaboration and exchange programs to bring in expertise from other leading regions in smart manufacturing. By addressing the talent gap, the government can ensure that Chongqing has the human capital necessary to support and sustain its smart manufacturing ambitions.

1.3 Integrate key technologies for building smart manufacturing ecosystem

To successfully build a smart manufacturing ecosystem in Chongqing, it is essential to integrate several key technologies that serve as the backbone for innovation, efficiency, and competitiveness. These technologies not only enable the transformation of traditional manufacturing processes but also foster collaboration across the ecosystem, driving economic growth and positioning Chongqing as a leader in the global manufacturing landscape.

Internet of Things (IoT): The IoT is fundamental to creating a smart manufacturing ecosystem. By connecting machinery, sensors, and devices, IoT enables real-time monitoring, data collection, and communication across the production process. This interconnectedness allows for predictive maintenance, reducing downtime, and optimizing asset utilization. In Chongqing, the deployment of IoT can streamline operations, enhance productivity, and provide manufacturers with valuable insights that drive continuous improvement.

Artificial Intelligence (AI) and Machine Learning (ML): AI and ML are critical technologies for analyzing the vast amounts of data generated by IoT devices. These technologies enable manufacturers to identify patterns, predict outcomes, and make data-driven decisions that improve efficiency and quality. AI-driven automation can also enhance production processes, reduce human error, and enable greater customization. For Chongqing's manufacturing sector, AI and ML are indispensable for staying competitive in a rapidly evolving market.

5G Connectivity: The deployment of 5G networks is set to revolutionize smart manufacturing by providing ultra-fast, reliable, and low-latency connectivity. 5G enables real-time communication

between devices, supports the massive data transfer required for IoT, and enhances the capabilities of AI and robotics. In Chongqing, 5G connectivity enables the seamless integration of advanced technologies and supporting the rapid development of the smart manufacturing ecosystem.

AT&S's IC substrates play a critical role in supporting these key technologies. As the foundation for advanced semiconductor packages, IC substrates are essential for the high-performance computing, connectivity, and miniaturization required by technologies such as IoT, AI, and 5G. By enabling the efficient integration of multiple functions into compact semiconductor devices, AT&S's IC substrates enhance the performance and reliability of the electronics that power smart manufacturing systems.

By integrating these key technologies, Chongqing can build a robust smart manufacturing ecosystem that enhances industrial competitiveness, drives economic growth, and positions the city as a leader in the global manufacturing landscape. These technologies not only provide the foundation for innovation and efficiency but also enable collaboration and connectivity across the entire ecosystem, ensuring Chongqing's long-term success in the era of intelligent manufacturing.

Chapter 2: Government Roles and Responsibilities to Accelerate Ecosystem Adoption

The rapid advancement of intelligent manufacturing necessitates a strategic, coordinated effort to foster collaboration among local enterprises, academia, and foreign investors. The government plays a crucial role in this process, acting as a catalyst to promote public-private partnerships, encourage international cooperation, and support industry-academia collaboration. By learning from successful European clusters, Chongqing can build its own smart manufacturing ecosystem.

2.1 Insights from European Cluster Models

Examining successful clusters in Europe, such as Styricon Valley, Silicon Alps, and Silicon Saxony, reveals that fostering an ecosystem requires a holistic approach that integrates innovation, international collaboration, and strong ties between industry and academia. These clusters offer valuable lessons for Chongqing as it seeks to enhance its industrial landscape.

For example, Styricon Valley in southern Austria has become an innovation hub for microelectronics. International companies like ams-OSRAM, TDK Electronics, LAM Research, Intel, Infineon, and NXP have established branches for production and research alongside successful domestic companies such as AT&S.

In the Silicon Alps business cluster, companies are deeply integrated with the region’s top-tier research institutions, including Graz University of Technology, Montanuniversität Leoben, Alpen-

Adria-Universität Klagenfurt, FH Joanneum, and Fraunhofer Austria. The region also hosts Silicon Austria Labs, a world-class microelectronics research center, which, in collaboration with Upper Austria, has locations in Graz, Linz, and Villach.

Silicon Saxony in Germany serves as another prime example. With over 550 members, including manufacturers, research institutions, and public bodies, Silicon Saxony has created a self-sustaining network that not only focuses on current technological trends but also anticipates future needs in areas such as artificial intelligence, robotics, and sensor technology. This dynamic environment has strengthened the competitiveness of its members and positioned Saxony as a leader in high-tech industries.

These examples demonstrate how strategic clustering can propel a region to the forefront of technological innovation.

2.2 Lessons for Chongqing: Challenges and Strategies

One of the key strengths of these industry clusters is their emphasis on public-private partnerships. By bringing together industry leaders, research institutions, and government bodies, these clusters create platforms where resources, risks, and rewards are shared. This collaboration drives innovation, facilitates the development of new technologies, and enhances the competitiveness of the region's electronics and microelectronics sectors. Chongqing could catalyze the growth of its intelligent manufacturing sector by adopting a similar model that aligns the interests of the government, private companies, and academic institutions.

Another critical factor in the success of these clusters is their focus on international cooperation. By actively engaging with foreign companies and investors, these clusters introduce new technologies, expertise, and best practices, which in turn enhance their global competitiveness. This international collaboration not only boosts the region's visibility but also attracts further investment and partnership opportunities. For Chongqing, fostering international cooperation will be essential for gaining access to advanced technologies and global markets, which are crucial for maintaining competitiveness in the rapidly evolving field of intelligent manufacturing.

A third pillar of success is strong industry-academia collaboration. By partnering with academic institutions, these clusters ensure a continuous flow of skilled graduates ready to enter the workforce and contribute to a robust research and development environment. Collaborative projects between manufacturers and academic researchers lead to technological advancements and innovative solutions that drive the industry forward. Chongqing can replicate this approach by strengthening ties between its manufacturing sector and local universities, promoting research collaborations, and developing programs that prepare students for careers in intelligent manufacturing.

2.3 Moving Forward

Chongqing's journey toward becoming a leader in intelligent manufacturing will require a deliberate and well-coordinated effort. By learning from the experiences of European clusters like Styricon Valley, Silicon Alps, and Silicon Saxony, the Chongqing government can develop strategies to address challenges such as ecosystem coordination, data protection, skills development, and talent acquisition. These strategies will not only help overcome current obstacles but also position Chongqing as a dynamic and innovative hub for smart manufacturing on the global stage.

Chapter 3: AT&S - A Model for Smart Manufacturing

Chongqing stands as one of AT&S's most critical global production hubs. Since establishing its presence in the city in 2011, AT&S has developed state-of-the-art facilities for high-end IC substrates and PCB (printed circuit board) modules. These efforts align with the growing demand for high-performance computing modules and contribute significantly to the development of the local semiconductor ecosystem by nurturing innovative talent.

AT&S Chongqing serves as a benchmark for integrating intelligent technologies into manufacturing processes, enhancing efficiency, supporting large-scale production, and promoting sustainability. The company has spearheaded several key initiatives in this regard.

First, AT&S has introduced the MES (Manufacturing Execution System) to realize intelligent production processes across its factories. This system encompasses the entire product lifecycle, covering everything from product development to intelligent production and comprehensive management of manufacturing execution.

Moreover, AT&S has optimized its supply chain processes by facilitating seamless collaboration between customers, the company, and suppliers. The automatic interaction and integration between the SAP system and MES enable efficient coordination from orders to final products and from raw materials to delivery.

In terms of data management, AT&S employs advanced technologies such as data warehouses, Online Analytical Processing (OLAP) tools, data mining, artificial intelligence, and machine learning. These technologies enable effective integration of existing factory data, providing rapid and accurate decision-making support. This approach allows the factory to respond swiftly to market demands, reduce production cycles, improve product quality, and increase production capacity.

Lastly, but importantly, AT&S has implemented a Smart Energy Management system to monitor and optimize energy usage, reducing costs and minimizing environmental impact. This system includes the use of renewable energy sources and energy-efficient technologies. AT&S has also proposed that the Chongqing government establish a cross-city renewable energy trading

mechanism, connecting the city with regions rich in clean energy resources. This initiative could address the clean energy supply shortage in Chongqing and stimulate economic development in less developed areas, in line with the national "Great Western Development" strategy. It is essential for the government to fully open the renewable energy market to all industry participants, including both domestic and foreign companies, to diversify the clean energy options available and ensure competitive pricing.

Conclusion

The transformation of Chongqing into a hub of intelligent manufacturing and sustainable development requires a multi-faceted approach.

By leveraging cutting-edge technologies like IoT, AI, and 5G, and fostering collaboration between government, industry, and academia, Chongqing can position itself as a global leader in intelligent manufacturing.

Drawing on insights from the European industry Clusters and the pioneering efforts of AT&S, this paper underscores the critical steps needed to overcome challenges and build a robust, competitive, and sustainable manufacturing ecosystem. Through strategic planning, strong partnerships, and an unwavering commitment to innovation, Chongqing can realize its vision of becoming a premier hub for smart manufacturing on the global stage.

Creating advanced industrial clusters in Chongqing through the digitalization and green transformation of manufacturing, powered by sustainable energy

James Zhao
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Abstract

This paper aims to share insights into how digitalization and green transformation can act as critical new drivers of change for Chongqing's manufacturing sector and enable the city to achieve its vision of building a system of modern industrial clusters, powered by sustainable energy.

In particular, these insights are focused upon further illuminating how it will be key to leverage the systemic efficiency and circularity delivered by dynamic industrial clusters which benefits co-located companies, local communities, the energy system, and the wider economy.

As a special case reference, we have highlighted Hitachi Energy's state-of-the-art transformers factory in Liangjiang New Area, which was relocated with the strong support of the local and the municipal government. Addressing the fast-growing demand for electrifying the evolving grid in the region through innovative and digital manufacturing, the new facility has transformed itself into a modern intelligent factory with significantly improved production efficiency.

We conclude with recommendations that emphasize the importance of fully embracing digitalization and green transformation, working together across all stakeholder groups and sectors, continually opening the market and deepening knowledge exchanges, and building a dynamic global talent pool.

1.Harnessing the digitalization and green transformation of global manufacturing as new economic growth engines

Standing as powerful new engines of economic growth, the digitalization and green transformation of global manufacturing will play a critical role in helping the world address major challenges such as climate change, resource scarcity, and ageing workforces. What's more, they can also drive the expansion of global wealth production, delivering enormous benefits to people throughout societies around the globe. In addition, they can help countries and companies better navigate mounting uncertainties in the international environment's fast-changing geopolitical dynamics by enabling them to strengthen the resilience and security of supply chains. The disruptive impact of shocks from the Covid-19 pandemic and subsequent supply chain disruptions also highlighted vulnerabilities in the way that global production networks are organized, further

underscoring the urgent need to better secure and optimize them.

As supply chain disruptions, regulatory pressures, and intense global competition add to the volatility of the manufacturing business environment, digitalization enables industry players to build factories that are more sustainable, cost-effective, and resilient. Manufacturers, fueled by digital technologies, are now rapidly transforming their operations with solutions powered by the Internet of Things (IoT), data analytics, intelligent robotics, and artificial intelligence (AI). For instance, generative AI, where the technology is advancing at an accelerated pace, will bring about a new wave of digital transformation as it is extended into the industrial sphere, promising to deliver a new level of efficiency to organizations.

And in today's changing energy environment, large manufacturing and processing companies consume substantial amounts of energy, resulting in increased carbon emissions. With combating climate change being of paramount importance and one of the most pressing issues of our times, it is critical to help industrial manufacturers navigate the transition to cleaner energy sources and reduce their carbon footprint by integrating renewable energy generation, such as solar and wind power, into their energy mix. The world is now in a race to accelerate the transition to clean energy, and electricity will be the backbone of the entire energy system, with electrification creating unprecedented demand for power grid systems combined with digital solutions and services.

Looking ahead, the value of the global smart manufacturing industry is expected to more than double from US$310 billion in 2023 to US$745.1 billion by 2030, according to Fortune Business Insights.[1]Holding the largest market share in this industry, the Asia-Pacific region is also projected to be the fastest-growing region during the next decade. However, the transition to advanced manufacturing globally faces significant challenges, including the difficulty of companies adapting to rapid technological advancements and keeping up with the pace of innovation, the complexity of decarbonizing supply chains, and skills shortages, among others.

2.China's accelerating bid to define the leading edge of global manufacturing

As the largest trading nation, China is the world's manufacturing superpower, with its production exceeding that of the nine next largest manufacturers combined. The country has the largest and most complete industrial system worldwide – a well-developed ecosystem featuring a strong network of suppliers, manufacturers, and logistics companies. Notably, it has successfully maintained its position as the top global manufacturing hub for 14 consecutive years, according to the Ministry of Industry and Information Technology (MIIT), and today its manufacturing sector accounts for 31.7% of national GDP and 30% of the global total.[2] China is now well-positioned to remain the world's manufacturing powerhouse going forward, thanks to improved productivity,

[1] Smart manufacturing market size to rise $754.1 billion at CAGR 13.5% by 2030, Fortune Business Insights, July 19, 2023

[2] Policy promotes greening of manufacturing sector, China Daily, March 13, 2024

broad industrial clusters, and well-established infrastructure.

In recent years, there has been rapidly expanding support behind China's national drive to transform itself by 2035 into a powerhouse for advanced manufacturing, underpinned by smart and green industrial production. Advancing "new industrialization," which aims to upgrade traditional industries, cultivate strategic industries, and promote advanced manufacturing and digitalization, is viewed as a key pathway for elevating the Chinese economy's future growth prospects.[3] Since last year, the central leadership has also underscored the role of "new quality productive forces."[4] This new development philosophy aims to support the Chinese economy's transition away from its earlier growth models, facilitate its drive to climb up the value chain, add momentum behind its post-pandemic recovery, and strengthen its self-sufficiency and resilience amid an increasingly complicated and uncertain international environment.

Speeding up the green and digital transformation of the manufacturing sector will be critical to fostering "new quality productive forces." To do so, China has been rolling out a raft of policy measures to support its advanced-manufacturing drive. In 2024, for example, central authorities have issued a wide-ranging document focused on facilitating the green transformation of the country's manufacturing sector, a three-year blueprint to accelerate the development of a digital workforce, and an action plan to advance digitalization in manufacturing.[5]

Major progress has already been achieved through China's accelerating bid to build an internationally competitive and advanced manufacturing sector. For example, China has successfully launched many smart manufacturing pilot projects over the last three years, building 421 national-level demonstration factories along with over 10,000 provincial-level digital workshops and smart factories.[6] To date, the country has established 45 national advanced manufacturing clusters in the fields of next-generation IT, high-end equipment, and new materials and energy. And there has been explosive growth in the number of China's "lighthouse factories," a term referring to manufacturers that show leadership in using Fourth Industrial Revolution technologies.[7] China has now become the country with the highest number of "lighthouse factories," according to the WEF; by the end of 2023, the world had a total of 153 "lighthouse factories," with 40.52% of them located in China.

Moving ahead, backed by an ever-maturing policy framework, China can be expected to further define the leading edge of manufacturing in the years to come. In particular, it will continue

[3] Top-level Chinese meeting urges digital transformation of manufacturing sector as economy continues steady recovery, Global Times, May 12, 2024

[4] Economic Watch: China's efforts to cultivate new quality productive forces to deliver global benefits, Xinhua, June 24, 2024

[5] Policy promotes greening of manufacturing sector, China Daily, March 13, 2024; Action plan to increase supply of digital talent, China Daily, April 17, 2024; China speeds up digital transformation of manufacturing sector, Xinhua, May 13, 2024

[6] China's manufacturing goes intelligent with modern factories, CGTN, January 19, 2024

[7] Global Lighthouse Network, World Economic Forum; China holds majority of world's 'lighthouse factories,' China Daily, January 11, 2024

to leverage the benefits offered by manufacturing clusters in helping to maximize system value; the geographical concentration of industry players has already helped to significantly increase overall efficiency and productivity, delivering positive outcomes for the economy, local communities, the environment, and the energy system.

3.Chongqing's integral role in the broader national drive towards advanced manufacturing

As one of China's most important manufacturing hubs, Chongqing has an integral part to play in the broader national drive towards advanced manufacturing. This position is strengthened further by its strategic role in the Chengdu-Chongqing Economic Circle, a vast regional integration plan which aims to transform China's two southwestern megalopolises into a major new growth engine that helps to drive high-quality, sustainable development nationwide. Powered by the regional development strategy, the economic circle's GDP reached 8.2 trillion yuan (US$1.14 trillion) last year, outpacing the national average growth rate of 5.2% by expanding at 6.1%.[8]

Recent years have seen Chongqing lead the rise of China's southwestern region as a new economic growth hub. Amid the post-pandemic recovery, there has been very strong momentum behind Chongqing's economy. In 2023, Chongqing's GDP grew by 6.1%, reaching a record three trillion yuan (US$423 billion) for the first time in central and western China and making it only the fourth city in the country to top this figure. This momentum continued into Q1 2024, with GDP rising by 6.2%.[9]

As a key driver of its economic success, Chongqing has led the rapid development of its high-end manufacturing sector, supporting its emergence as a major hub for technological industries. In its current development plan for the next five to 15 years, the city has embraced an innovation-driven strategy and is set to become an advanced manufacturing juggernaut as its traditional industrial base expands and becomes increasingly digitalized.[10] A wide range of factors have been facilitating the transition for Chongqing's manufacturing sector towards high-end, smart, and green practices. These include the city's accelerated development of modern manufacturing clusters, longstanding policy efforts to build an attractive investment environment for both domestic and foreign enterprises, increasingly close industrial collaborations within the Chengdu-Chongqing Economic Circle, and deepening exchanges with members of the Association of Southeast Asian Nations (ASEAN), such as Chongqing Liangjiang New Area's new partnership with Singapore to create a model park for international cooperation on technological innovation.[11]

[8] Chengdu-Chongqing Economic Circle's GDP topped US$1.1 trillion last year, Yicai Global, March 5, 2024

[9] W. China more popular among investors, China Daily, May 24, 2024

[10] Chongqing set to become advanced manufacturing powerhouse, CGTN, October 20, 2021

[11] 'Seeing is believing,' Chongqing Mayor welcomes visit to experience city's charm, iChongqing, June 5, 2024; Chongqing and Singapore to join hands on sci-tech innovation model project, iChongqing, April 1, 2024

Additionally, Chongqing's success in developing advanced transportation and logistics networks has been particularly important, especially by leveraging its status as a key hub for the Belt and Road Initiative (BRI), such as China's first-ever freight train route to Europe and connections to Southeast Asia via the New International Land-Sea Trade Corridor.[12] The city's ongoing push to further enhance its connectivity with other regions will continue to yield further gains, such as the planned opening of the country's largest high-speed railway station in Chongqing in 2025.[13]

There are many indicators of the significant progress being made by Chongqing in its shift towards advanced manufacturing. By the end of last year, the city had built 144 intelligent factories and 958 digital workshops.[14] As a crucial hub for the production of new energy vehicles (NEVs), Chongqing's transition to NEVs has helped the city recover its leading position in auto production; in June, Chongqing reclaimed its title as China's largest auto manufacturing city, surpassing Guangzhou by producing 997,100 vehicles from January to May.[15] A recent international fair for trade and investment, held in Chongqing, also saw the signing of 124 manufacturing projects totaling 198.85 billion yuan (US$27.45 billion), testifying to the region's growing appeal to domestic and foreign investors.[16] And after being launched several years ago, BLOCK71 Chongqing, an industrial hub focused on expanding China-Singapore exchanges, has nurtured close to 30 high-tech firms.[17]

However, while Chongqing has made rapid advancements in the development of its manufacturing sector, it has faced power shortages due to dwindling hydropower output and surging household electricity demand that can occur in the summer due to extreme heat.[18] Regional electricity shortages have underscored the importance of further expanding access to sustainable energy that can help ensure Chongqing's industrial base avoids disruptions during its climb up the value chain.

To help overcome such challenges facing Chongqing as it moves to further elevate its industrial base, it will be critical to continue to leverage the systemic efficiency and circularity delivered by the advancement of dynamic manufacturing clusters. Doing so will require:

- Sustaining nearby communities with well-developed social infrastructure: While clustering major industry players within a geographic area can generate new jobs in underserved areas and support recruiting efforts for highly skilled workers, industrial parks need to be able to sustain

[12] What makes Chongqing a global hub for laptop production?, CGTN, September 18, 2023

[13] China's largest high-speed railway station set to open in 2025, iChongqing, March 29, 2024

[14] Chongqing's smart factories drive intelligent manufacturing boost, Xinhua, March 9, 2024

[15] Chongqing reclaims title as largest car manufacturing city, iChongqing, June 28, 2024

[16] W. China more popular among investors, China Daily, May 24, 2024

[17] Chongqing and Singapore to join hands on sci-tech innovation model project, iChongqing, April 1, 2024

[18] China's hydropower supply hit by reduced rainfall, reservoirs shortage: electricity council, Global Times, June 14, 2023

nearby communities to ensure they can not only attract but also retain their talent pools over the long run. It is vital to have a strong focus on continuing to build out the social infrastructure needed to support those communities, including schools, healthcare facilities, leisure areas, and public transport. For instance, easy access to quality health services and educational institutions supports the wellbeing of residents and their families, while the construction of a high-efficiency transport system can deliver premium commuting, providing affordable travel options for people.

- Taking advantage of the colocation of manufacturing plants to reduce waste: Waste reduction is part of the array of benefits that manufacturers can reap by locating within close proximity of one another. Enabling the circularity of industrial by-products and waste, manufacturing clusters create an environment where one company's by-product waste streams can be used by nearby companies as inputs, helping them to collectively promote resource efficiency and reduce waste and emissions.[19] Within that environment, it is important for companies to assess their own waste streams to identify which could be valuable inputs for other co-located businesses.

- Supporting power system resilience and flexibility by leveraging the colocation of industry: Industrial clusters are playing a critical role in the clean energy transition, with the colocation of different manufacturing processes creating opportunities for systemic efficiencies, electrification, demand optimization, and carbon capture, utilization, and storage (CCUS).[20] It is important for industry players that are physically in the same location to pursue shared infrastructure, with the emergence of cluster electrification enablers like microgrids, shared renewable energy generation and storage, and demand optimization. For example, shared battery energy storage systems (BESS) could be an option during times of dwindling hydro power. As the world transitions to more renewable energy sources, the global demand for BESS has continued to surge and is expected to grow more than 20% per year through 2030.[21] Hitachi Energy has been an innovative force in the BESS and microgrid space for more than 30 years, and our BESS, PQpluS™, helps electricity consumers by actively managing the timing and profile of their energy use.[22] Virtual power plants (VPPs) also offer an advanced digital solution that can help support more flexible and efficient power grids for industrial clusters. In the past two years, Hitachi Energy has supported China Southern Grid (CSG) and China Huaneng (Zhejiang) to set up VPPs to help increase the flexibility and stability of the power system by dispatching multiple user-side resources, the latter of which marks the first one in China that is integrated in the power dispatching system.[23]

[19] Achieving net-zero future with industrial clusters, Accenture, March 2021

[20] Industrial clusters are critical to getting to net-zero. Here's why, World Economic Forum, October 29, 2020

[21] 1H 2023 Energy Storage Market Outlook, BNEF, March 21, 2023

[22] Battery Energy Storage System PQpluS™, Hitachi Energy

[23] Hitachi Energy's innovative digital power plant solution gives secure power supply for China's megacity, Hitachi Energy, December 17, 2021; Hitachi Energy in China

- Deploying large-scale transport infrastructure: Providing scale, risk-sharing, and demand aggregation, geographic concentrations of co-located companies also play a pivotal role in catalyzing large-scale transport infrastructure.[24] For Chongqing to make further progress in the development of its advanced manufacturing, it will be necessary to ensure that the city's industrial clusters can always efficiently transport products out of the area by continually enhancing the modern transport infrastructure serving them, facilitating excellent connectivity with the rest of the world. To do so, roads, railways, airports, and ports must all be designed with exporting facilities in mind which can handle the flow of products moving in both directions.

4.Hitachi Energy's focus on helping to build a modern energy system that is fit for future

At Hitachi Energy, our mission is to "advance a sustainable energy future for all."[25] We believe electricity will become the backbone of the entire energy system. According to the International Energy Agency's (IEA) Net Zero by 2050 report, the energy sector will be dominated by renewables by mid-century and electricity will account for almost 50% of the total energy consumption, up from 20% today.[26] Clean energy generation, network infrastructure, and electrification of end-use sectors are crucial to decarbonization. To efficiently meet the changing needs of a growing population and limit climate change, large-scale volumes of variable energy generated from renewable sources need to be efficiently integrated into the world's energy system. The electrification of transportation, industry, and building sectors will continue to be ramped up to fulfill demand.

In China, the energy transition has accelerated dramatically following President Xi's ground-breaking announcement of the country's 2030/2060 decarbonization goals in September 2020, with a strong foundation having already been set. In 2023, China's renewable energy capacity surpassed that of thermal power for the first time to constitute more than half of the country's installed power generation capacity; renewable energy now accounts for about one-third of the country's total power consumption.[27] In addition, China's power-sector development plans include a major increase in inter-provincial electricity transmission capacity and numerous long-distance transmission lines from west to east.

And in Chongqing, there is gathering speed behind the emergence of a new energy system, a key building block for its sustainable future. Transitioning to a new energy system will be critical to elevating Chongqing up the value chain and enabling it to become an even more economically competitive and environmentally sustainable global city. Momentum is now building behind the drive to create a new energy system, backed by new projects and an increasingly robust

[24] How to harness the collaborative potential of industrial clusters, World Economic Forum, January 11, 2024

[25] Hitachi Energy advances a sustainable energy future for all, November 4, 2021

[26] Net Zero by 2050: A Roadmap for the Global Energy Sector, International Energy Agency, May 2021

[27] Working toward a greener China, Xinhua, December 28, 2023

policy framework – seen in the launch of Chongqing's carbon offset scheme three years ago, its cooperation with Sichuan to build a "hydrogen corridor" that will see around 1,000 hydrogen fuel-cell logistics vehicles going into service by 2025, and a new territorial spatial plan (2021-2035) that aims for Chongqing to become a global transport hub and a gateway to China's western regions by 2035, among many other steps and measures being taken.[28]

Hitachi Energy's most important role is to help ensure that we have a modern energy system that is fit for future, and our business is well-positioned to support Chongqing's decarbonization targets and drive towards advanced manufacturing. For our business, we have worked out the Sustainability 2030 plan to become a green company not just by ourselves but also by driving the sustainable development of the value chain.[29] This includes the goal of achieving carbon-neutrality in our own operations by 2030. To deliver a sustainable energy future for all, we are driving profitable and sustainable growth with the Hitachi Energy 2030 plan by continuously strengthening our core power grids business, doubling efforts on digital and services and expanding at the edge of the energy system, and investing in R&D and M&As to accelerate growth, while creating a partnering ecosystem across the value chain.[30] This will help enable the energy transition to scale up rapidly and ensure that each clean GW that we add to the energy system is balanced with an increase in grid capacity and flexibility to meet needs around security, reliability, and resilience. From a grid perspective, three key drivers of the energy transition will push forward the power system's ramp-up, namely power electronics, digitalization, and sustainable products.

With our order backlog having more than tripled to over US$30 billion due to surging global electricity demand, Hitachi Energy recently announced plans to invest an additional US$4.5 billion in manufacturing, engineering, digital, R&D, and partnerships by 2027, doubling the investments done in the last three years.[31] This complements our US$1.5 billion investment announced earlier this year to ramp up global transformer production. With the world in a race to transform energy systems, electrification is creating unprecedented demand for power grids systems combined with digital solutions and services. As the market leader, Hitachi Energy is responding with an unprecedented level of investment, people, and innovation to meet that demand.

5.New chapter for transformer factory in Chongqing highlights global commitment and valuable experiences

In Chongqing, Hitachi Energy's new state-of-the-art transformer factory in Chongqing underscores that commitment to continually expand our global investment and better serve local

[28] China's Chongqing launches carbon offset scheme, Carbon Pulse, September 16, 2021; Hydrogen-powered vehicles making SW China greener, Xinhua, March 24, 2024; Chongqing to become international transportation hub, China Daily, March 26, 2024

[29] Sustainability at Hitachi Energy

[30] Hitachi Energy 2030 Plan

[31] Hitachi Energy to invest additional $4.5 billion by 2027 to accelerate the clean energy transition, Hitachi Energy, June 7, 2024

markets and customers.[32] As the first joint venture we established in western China back in 1998, Hitachi Energy Chongqing Transformer Co., Ltd. has since emerged as one of Hitachi Energy's most advanced transformer R&D and manufacturing bases in the world after its growth journey spanning a quarter century. It is a sister factory to Hitachi Energy's flagship factory in Ludvika, Sweden, with frequent talent exchanges between the two facilities.

With its cutting-edge transformer solutions and extensive global experience, the company participated in many significant domestic and international projects, such as the Three Gorges hydro project, Changji-Guquan, the world's first ±1,100 kV UHVDC transmission link, the latest Longdong-Shandong ±800 kV UHVDC transmission project, and the world's largest single photovoltaic power plant, the Al Dhafra PV2 solar project in Abu Dhabi. Around 2,000 power transformers have been delivered out of the Chongqing factory to such key projects.

Amid China's evolving energy transition and path towards decarbonization, Hitachi Energy recently unveiled a new chapter for our Chongqing factory. In early 2023, the company relocated to Liangjiang New Area, transforming itself into a modern intelligent factory with significantly improved production efficiency. With the use of industrial automation and robotics, the manufacturing processes have now become faster and more precise. Energy management systems have been put in place to facilitate real-time acquisition, analysis, and the timely maintenance of equipment and production data, ensuring cost-effectiveness throughout the value chain. In line with the company's sustainability efforts, the modern factory has incorporated environmentally responsible measures to reduce the overall carbon footprint.

In particular, we were drawn to relocate by the incredibly welcoming business environment and supportive policies put in place by the management committee of the Liangjiang New Area, the first national-level opening-up and development area in inland China, as well as its huge success in gathering together first-class innovation resources. Thanks to the unwavering support from the partners and all involved stakeholders, the Chongqing factory has become a prominent example for Hitachi Energy to drive local innovation with global technology and lead high-quality development in the industry. With a focus on intelligent operations and continuous innovation in the new facility, Hitachi Energy will further deepen the local presence and continue to work with customers and partners to contribute to advancing a sustainable energy future in China and beyond.

Earlier this year, Hitachi Energy also announced our participation in a landmark new project that will significantly expand the supply of sustainable energy to Chongqing, highlighting our dedication to being "in Chongqing, for Chongqing." We will provide innovative products and

[32] Hitachi Energy inaugurates state-of-the-art transformers factory in China, Hitachi Energy, September 15, 2023

[33] Hitachi Energy supports Hami-Chongqing cross-region power transmission project, Hitachi Energy, February 21, 2024

technologies for the Hami-Chongqing ultra-high voltage direct current (UHVDC) transmission project built by State Grid Corporation of China.[33] Spanning 2,290 kilometers from Xinjiang to Chongqing, the project will promote energy security and carbon neutrality, helping to accelerate the efficient use of clean energy in Xinjiang and optimize Chongqing's energy supply.[34]

Notably, the project features a huge proportion of green electricity, with wind and solar power accounting for more than half of all the electricity transmitted to Chongqing. Upon completion, it will be able to meet the needs of an estimated one-quarter of Chongqing's electricity consumption. The project exemplifies how Hitachi Energy is working closely with our customers and partners to promote the delivery of clean energy and contribute to Chongqing's sustainable development through collaboration and innovation. In China, Hitachi Energy is involved in about 50 HVDC transmission projects, among which UHVDC projects account for about half.

6.Conclusion

As new drivers of change for Chongqing's manufacturing sector, digitalization and green transformation will empower the city to build upon its strong competitive advantages, ensuring that it thrives and succeeds not only in China's rapidly changing economic landscape but in the wider global economy as well. In the years ahead, there will be enormous opportunities for Chongqing to further strengthen its positioning as a frontrunner in China's national drive to advance the development of smart and green manufacturing – and establishing a dynamic clean energy system will be the foundation for Chongqing to do so.

The right technologies, partnerships and talent will be critical to driving the digitalization and green transformation of manufacturing in Chongqing, strengthening the resilience of its supply chains, and ultimately securing its position as a global hub for world-class advanced production powered by clean energy. We offer the following recommendations for Chongqing to achieve its goal of building a system of modern industrial clusters:

- Fully embrace digitalization and green transformation: Chongqing should continue to focus on new technology options and how digitalization can accelerate the clean energy transition and support manufacturing businesses to move further up the value chain. For instance, the city can leverage the colocation of manufacturing plants to support power system resilience and flexibility by deploying technology options like BESS and VPPs.

- Work together across all stakeholder groups and sectors: The deepening of circular partnerships will be vital to help create a partnership ecosystem that allows Chongqing to leverage the entire

[34] New power transmission project to further promote green development in Xinjiang, CGTN, August 11, 2023

value chain to deliver the scale and speed needed to guide the energy transition and support the city's emergence as an advanced global manufacturing powerhouse. Within industrial clusters, for example, it will be important to leverage synergies between cluster partners and processes, such as by identifying opportunities for collaborations to use waste productively.

- Continually open the market and deepen knowledge exchanges: Chongqing should press ahead with its longstanding commitment to open the market even wider to all investors and leading technology providers and continually take steps to enhance what is already a hugely supportive and welcoming local business climate. In addition, it can further deepen exchanges with other key manufacturing cities and regions in China and the world, supporting two-way flows of cutting-edge technologies, knowledge, and best practices.

- Build a dynamic global talent pool: Sustaining the communities around industrial clusters with well-developed social infrastructure will be vital to building and retaining a dynamic global talent pool in Chongqing. It will be key to continually strengthen collaborations between educational institutions, universities, and companies and endeavor to support the influx of talent at all levels – from university graduates to professionals and experts. Reskilling should also be a priority due to high demand for people to join Chongqing's manufacturing transition and the new energy systems powering it. And the healthy, longstanding exchanges between Hitachi Energy's factories in Chongqing and Ludvika, Sweden exemplify how deepening people-to-people ties can deliver mutually beneficial outcomes and significantly elevate a company's global talent pool.

We hope that the above examples and recommendations provide actionable insights that can help support Chongqing's drive to build a system of modern manufacturing clusters and further reinforce its stature as a city leader in the wider national drive towards new industrialization.

Initiatives for Advancing High-Quality Development of Modern Producer Services Industry of SMBC Group

Sumitomo Mitsui Financial Group (SMFG)

1.Preamble

Chongqing is the only city in west-central China directly administered by the central government, with an area of 82,400km2 and a permanent population of 32 million. It is the node of the Silk Road Economic Zone connecting the 21 century Maritime Silk Road and the Yangtze River Economic Zone and serves as an anchor for large-scale western development, playing a unique and key role in China's regional development and opening-up endeavors. The geographical advantage of Chongqing City is outstanding. Westward, Chongqing City established the China-Europe Railway Express (Chongqing-Xinjiang-Europe Railway) ahead of the rest of the country. Eastward, Chongqing City constructed the Yangtze River Golden Shipping Route to connect the world's largest inland waterway economic corridor that connects the Yangtze River with the sea. Southward, Chongqing City is promoting the construction of the New International Land-Sea Trade Corridor (ILSTC), realizing a strategic connect point of "One Road" and "One Belt" inland districts. In addition, northward, regular freight railway of the "Chongqing-Manzhouli-Russia" have been established, and they are connected to the China-Mongolia-Russia Economic Corridor River Terminal, showing their geographical advantage. This unique geographical advantage has kept Chongqing's economic development in good shape.

In June 2023, a conference was held in Chongqing to propel high-quality development in manufacturing in order to respond to the key directive: "Accelerate the journey towards becoming a manufacturing powerhouse" issued by the 20th National Congress of the Communist Party of China. It distinctly proposed the formation of the "3+3+6+18" modern manufacturing cluster system. The scheme is dedicated to creating three one trillion yuan level dominant industry clusters, namely, intelligent network-linked new energy vehicles, next-generation electronic information manufacturing, and advanced materials. It also aims to upgrade and establish three 500 billion level pillar industry clusters involving intelligent equipment and manufacturing, food and agricultural product processing, and software information services. Additionally, it plans to innovate and construct six 100 billion yuan level specialized advantage industry clusters in areas such as new display technology, high-end motorcycles, light alloy materials, light textiles, biomedicine, new energy, and innovative energy storage. It also intends to nurture and strengthen 18 "rising star" industry clusters, including satellite internet, power semiconductors, and integrated circuits. In this

paper, as Chongqing City is fostering the “3+3+6+18” system of modern manufacturing clusters, we would like to share SMBC Group's efforts on the issues and challenges of developing a high-quality modern productivity service industry and contribute to the further development of Chongqing City.

Figure 1: Concrete details of the “3+3+6+18” system of modern manufacturing clusters in Chongqing

2.Challenges Facing Chongqing

Producer services are services that provide assurance services to maintain continuity in the industrial production process, promote the advancement of industrial technology, upgrade industry, and improve production efficiency. It was proposed by the American economist H. Greenfield in 1966. Producer services are an extension of upstream and downstream production activities and include professional services, information and brokerage services, financial and insurance services, and trade-related services. The content and extension of these policies are constantly changing in accordance with economic and social development. In its "11th 5 Year Plan" China announced in 2006, it was stipulated that the development of the producer services industry would greatly develop the modern logistics industry by giving priority to the development of the transportation industry, as well as the orderly development of the financial services industry, the active development of the information services industry, and the normative development of the commercial services industry. The “12th 5 Year Plan" China announced in 2011 calls for deepening the specialized division of labor, accelerating innovation in service products and service models, promoting the

integration of productivity services and advanced manufacturing, and accelerating the development of productivity services. Normatively improving the business services industry by developing the financial services industry in an orderly manner, greatly developing the modern logistics industry, and developing/strengthening the high-tech services industry is clearly stated in the "12th 5 Year Plan". The "Guidance Opinion on Accelerating the Development of the Productivity Service Industry and Promoting the Adjustment and Advancement of the Industrial Structure" issued by the State Council in 2014 clarifies that China's productivity service industry at the current stage will focus on R&D design, third-party logistics, finance leasing, information technology services, energy conservation and environmental protection services, inspection, inspection and certification, e-commerce, commercial consulting, service outsourcing, after-sales service, personnel services, and brand building.

As stated in the topic proposal for the 18th CMIA conference, in order to develop high-quality modern producer services industry, it is necessary to set the development direction to empower the "3+3+6+18" manufacturing industry, fostering the extension of productive service industry towards specialization and the high-end of the value chain. Chongqing must aim to enhance quality, digitization, integration, greening, and internationalization to construct a new system of productive service industry that is high-quality, efficiently organized, and integrated. This would provide robust support for the swift construction of a modern industrial system and the nurturing of new productive forces.

Therefore, the challenges facing Chongqing include, but are not limited to: "expediting the digital transformation of service industry enterprises," "enhancing and refining functional service support," "improving the caliber and efficacy of productive financial services," and "encouraging the eco-friendly transformation of the service industry."

3.SMBC Group's Initiatives

SMBC Group is taking the following initiatives in Japan to address some of the issues mentioned in "2. Challenges facing Chongqing."

3.1 SMBC Group's initiative to: "Expedite the digital transformation of service industryenterprises"- "PlariTown" a digital platform for businesses.

"PlariTown," a digital platform launched to support the digital transformation of SME customers, accumulates examples of digital usage by various companies and shares knowledge with digital service partners, enabling the collection of digital-related information (from current events to various reports), the introduction of solutions and customer feedback regarding those solutions, etc. It also provides free digital consultation services to customers who have collected information and are considering the implementation of their own digital systems. These services offer suggestions on

how to use digital systems in accordance with the issues customers are facing.

3.2 SMBC Group's initiative to: "Enhance and refine functional service support"-"SMBC CLOUDSIGN," an electronic contract service.

"SMBC CLOUDSIGN," established jointly with Bengo4.com,Inc. in October 2019, provides an online service for concluding and storing contracts. The fact that it is actually used by SMBC Group, a financial institution with high security standards, has led to the trust of customers, and it has been widely adopted by companies, including local financial institutions, and local governments. In addition, the service eliminates the need for contract stamp fees; reduces costs related to the printing, binding, mailing, and storage of contracts; and reduces labor costs. Furthermore, since contracts are stored as electronic documents, it makes it easy to centrally manage and retrieve contracts and enables workers who handle contracts to work remotely.

3.3 SMBC Group's initiative to: "Improve the caliber and efficacy of productive financial services"- "Future X (mirai cross) ," a startup ecosystem platform.

Through the Incubation Acceleration Program which SMBC Group launched in 2015, we have been working to identify and support promising startups in the early seed stage. On the other hand, we believe that the formation and expansion of a startup ecosystem in which various players from industry, government, academia, and financial institutions are able to work together is necessary to further support startups in more advanced stages. To further accelerate these efforts, SMBC established "Future X (mirai cross), " a startup ecosystem platform funded by industry, government, academia, and financial institutions in collaboration with SMBC Venture Capital Co., Ltd. and SMBC Nikko Securities Inc. in August 2021.

"Future X (mirai cross) " has three main programs.

The first is the Incubation Acceleration Program. The Program supports those that want to commercialize their ideas and technologies and startups in the early seed stage. In cooperation with sponsoring partners such as the national government, local governments, and universities, we invite applications from all over Japan and provide training and mentoring opportunities (for approximately 3 months) for startups that have passed a document screening process on issues such as fundraising, team building, and branding. During the Program and the pitch contest held by the final judging panel, various companies and investors are connected. Through such efforts we support the realization of collaborations.

The second is a program that supports collaborations between advanced startups and established companies. In addition to identifying the challenges and needs of established companies and introducing startups based on them, Mirai Works Inc., which co-operates "Future X (mirai cross)," assigns a dedicated concierge to support the direction of collaborations, consideration and

preparation of co-creation plans, and coordination of internal consensus with the aim of realizing business creation. In FY2023, we conducted approximately 200 matches between startups and established companies to realize capital and business alliances, proof-of-concept experiments, and service introductions.

The third is the holding of seminars and events, which are held about once every 2 months concerning numerous themes in various regions. Most recently, we held an open innovation event focusing on startups in Kyoto in cooperation with Kyoto City and other sponsoring partners, as well as a pitch event for startups that are expected to utilize DX (Digital Transformation)in order to improve operational efficiency and eliminate labor shortages in the areas of real estate, construction, and logistics. The event also uses online communication and provides opportunities for participants to communicate and network with each other.

Since FY2022, SMBC Group has been participating in various programs to realize open innovation and collaboration with startups. We will continue to contribute to the improvement of the quality of financial services by cooperating with Group companies and external partners to support startups that are trying to solve social issues and grow together to create new industries.

3.4 SMBC Group's initiative to: "Encourage the eco-friendly transformation of the service industry"-"Sustana," a tool for calculating greenhouse gas emissions

"Sustana" is a cloud service developed by SMBC which was released in May 2022. As of October 2023, more than 1,300 customers have used the service which enables companies to manage a range of tasks using cloud technology, from calculating their greenhouse gas emissions as the first step toward decarbonization, to planning and implementing greenhouse gas (GHG) reduction measures. Sustana is not limited to the service industry and supports various customers in promoting green model change. The use of "Sustana" is very simple. By registering corporate activity data for the company and the supply chain necessary for calculating GHG emissions, such as electricity usage, on the website, "Sustana" can automatically calculate the emissions, monitor and analyze the emissions, and smoothly start formulating a reduction plan, thereby contributing to operational efficiency for customers.

In January 2023, we launched "Alli for Green," a service that supports the collection of data necessary to calculate GHG emissions in collaboration with Allganize. Allganize's outstanding natural language processing capabilities enable Allganize to extract and digitize the information necessary to calculate GHG from invoices and reports that customers receive on paper and PDF. For companies with a large number of offices, this service is especially effective in enabling them to significantly reduce the man-hours involved in the visual verification and posting of information by automating the process of compiling invoice information.

4.Conclusion

In this paper, based on “Topic 2: Advancing High-Quality Development of Modern Producer Services Industry” selected by Sumitomo Mitsui Financial Group, we introduced examples of our initiatives related to developing the producer services industry and their backgrounds based on our experience. Sumitomo Mitsui Banking Corporation, a subsidiary of SMFG, has been steadily expanding its business network in China since entering the country in 1982, and has been providing a wide range of financial services to local companies. Given the importance of the rapidly growing city of Chongqing, we have been striving to provide high-quality products and services by leveraging our strengths as a global financial group and as the only Japanese bank in Chongqing since opening our representative office in 1996. We will continue to support the growth of local companies. While developing the “3+3+6+18” system of modern manufacturing clusters in Chongqing, we will make the most of the unique strengths of SMBC Group to contribute to the financial sector.

Promoting Green Manufacturing in the Manufacturing Sector for Developing New Quality Productive Forces

ISUZU

I. The Importance of New Quality Productive Forces in Manufacturing

In September 2023, President Xi Jinping first put forward the concept of new quality productive forces, pointing out that it is necessary to integrate scientific and technological innovation resources, lead the development of strategic emerging industries such as new energy, new materials, advanced manufacturing, electronic information, etc., and actively cultivate the future industries to accelerate the formation of new quality productive forces and enhance the new engine of development.

1.Definition of new quality productive forces

Productive forces was originally an economic concept that has always referred to the quantitative expansion and qualitative improvement of factors of production, including physical assets such as capital and labor, to bring about an increase in the productivity of the economy as a whole. In contrast, the role of new quality productive forces is to guide the economy away from the traditional economic growth model and towards economic growth characterized by the "three highs" of high technology, high efficiency, and high quality.[1] From the perspective of the manufacturing sector, it means that the entire life cycle of a product, from development to manufacturing, sales and recycling, requires more advanced technology and innovation to promote smart manufacturing. In addition, new quality productive forces needs to take into account the impact of economic growth on resources and the environment. For a long time, China has continued to engage in resource- and energy-intensive production activities for the sake of rapid economic development, especially in the manufacturing sector, which has placed a heavy burden on the environment, and therefore there is an urgent need to promote green manufacturing in the manufacturing sector as well.

2.The significance of promoting new quality productive forces in manufacturing

- **1)The new dynamics of economic growth**

The definition of new quality productive forces shows that the development of new quality productive forces lies in the development of forward-looking emerging industries with significant

[1] *Research Institute of Economy, Trade and Industry (RIETI) (Jul. 2024). China's Development of "New Quality Productive Forces" - The Key to the Integration of Advanced Technology and Industry*

strategic, leading, disruptive and uncertainty driven by cutting-edge technologies, specifically including six new fields such as future manufacturing, future materials and future energy. These six fields are all closely related to the manufacturing sector, which indicates that promoting the development of new quality productive forces in the manufacturing sector will make an important contribution to realizing the goal of high-quality economic development.

- **2)Responding to domestic changes and social issues**

With the decline in the domestic birth rate and the arrival of an aging society, labor shortage is becoming a major social problem. In the manufacturing sector, traditional labor-intensive production has reached its limits in terms of both qualitative and quantitative growth, and there is an urgent need to adopt advanced technologies, accelerate the development of smart manufacturing, and shift to higher labor productivity production methods to break away from dependence on labor. In addition, in order to comply with the global trend of carbon neutrality, China's environmental and energy issues, which have been sacrificed in the past in pursuit of high-speed growth, have been emphasized year by year, and the greening of energy has become more urgent. The promotion of new quality productive forces development in the manufacturing sector, especially the development of smart manufacturing and green manufacturing, is expected to help solve these social problems.

- **3)Responding to changes in the global environment**

The forward-looking emerging industries that are the focus of new quality productive forces include ten innovative and iconic products such as humanoid robots, quantum computers, and advanced and efficient aerospace equipment. In response to turbulent changes in the global environment, such as the decoupling of the U.S. and China, if China can lead to the improvement of new quality productive forces in these areas, it is likely that China will be free from the constraints of other countries, and will be able to utilize own technologies to promote the development of intelligence, and blaze the path of “self-reliant and self-strengthened” economic growth.

II.Current Status and Issues of the Development of New Quality Productive Forces in Manufacturing.

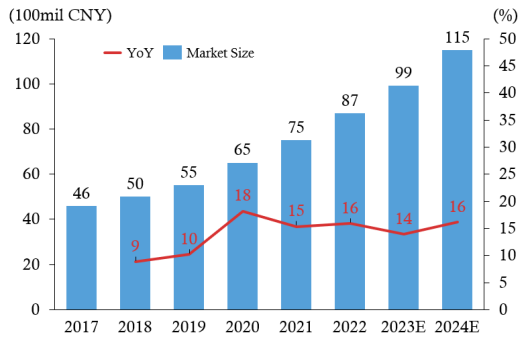
- **Current status**

* 1)Smart manufacturing has achieved initial success

China's manufacturing sector is becoming more intelligent and sophisticated in the process of shifting from quantitative expansion to qualitative improvement, and has made some remarkable achievements. Take industrial robots, including transportation robots, welding robots and processing robots, which are representative products of smart manufacturing, as an example. In recent years, with the development of related technologies and the progress of domestic production, the market

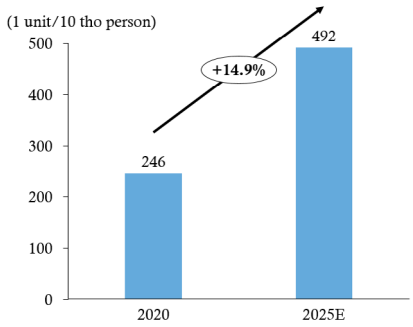
size of industrial robots and their penetration rate in the industrial field have shown continuous growth. Over the past five years, the market size of industrial robots has grown at a CAGR of more than 15% and is expected to continue to grow. The penetration rate of industrial robots in the industry is also increasing, which is expected to grow at a CAGR of 14.9% from 2020 to 2025. Currently, China has become the world's largest producer and seller of industrial robots, with a complete supply chain from core components to robot bodies even to system integration.[2]

Figure 1 Market Size of Industrial Robots in China



Source: Sealand Securities Report[3]

Figure 2 Penetration Rate of Industrial Robots in China



Source: Great Wall Guorui Securities Report[4]

* 2)Green manufacturing still has a long way to go

Since 2000, the Chinese government has been promoting decarbonization under the "30·60" national strategy. From the perspective of the manufacturing sector, decarbonization measures mainly include shifting to a renewable energy-led energy mix and actively promoting carbon footprint tracking and management, both of which still have a long way to go compared to the ultimate goal advocated by the state.

In terms of promoting renewable energy, benefiting from a series of initiatives taken by the state, including the official implementation of the Green Electricity Certificate (GEC) system from 2017, by the end of 2020, China's renewable energy power generating capacity has reached 42.5% of the total power generating capacity, and the total utilization of renewable energy in 2020 has reached 13.6% of the total primary energy consumption.[5] In addition, the national 14th Five-Year Plan introduced the Renewable Energy Development Plan, which quantifies the targets to be achieved by 2025 including the total amount of renewable energy, power generation, consumption

[2] *Eastmoney.com (Apr. 2024). Import Substitution Rate exceeds 50% for the First Time - Industrial Robot Import* and Export Situation Reversed

[3] *Sealand Securities Research Institute (August.2023). Global Intelligent Manufacturing Leader Building AI+ Terminal Manufacturing Platform*

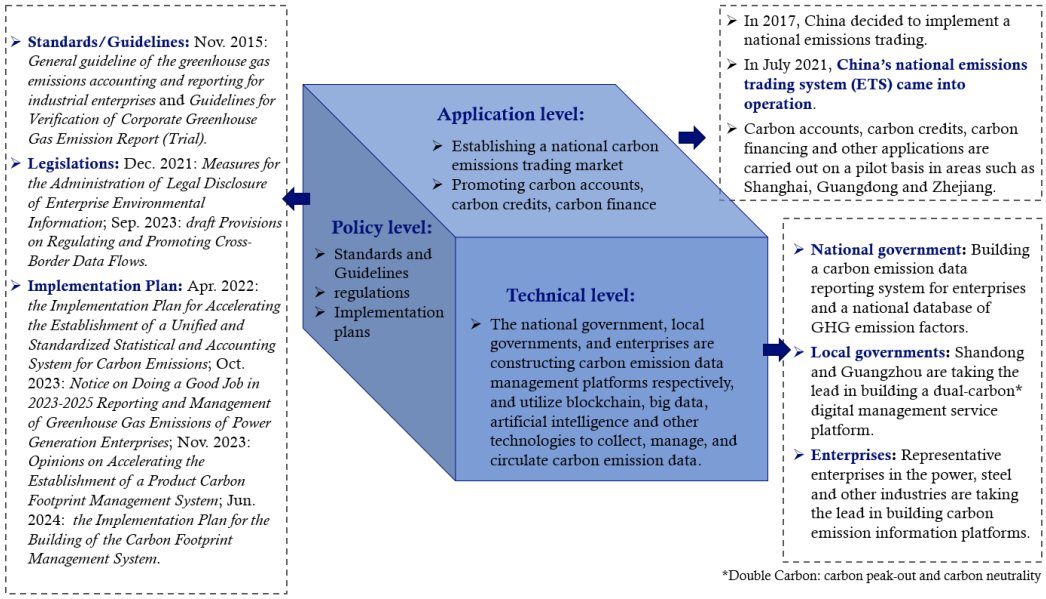
[4] *TE Zhiku (2023). China Industrial Robot Application and Development Trend Research Report 2023*

[5] *National Development and Reform Commission of China and other Departments (Oct. 2021). Renewable Energy Development Plan for the 14th Five-Year Plan*

and non-electricity utilization. Although these targets are more specific and stringent than ever, it is undeniable that it will still take many years to realize the goal of new energy structure dominated by renewable energy.

In terms of carbon dioxide emission tracking and management, the state is gradually promoting to establish an overall release mechanism for carbon dioxide emission data from three perspectives: policy level, technical level and application level. On the policy side, in recent years, improvements have gradually begun to be made, from the formulation of relevant standards and guidelines to the legislations and implementation plans. Recently, the state has also announced that it aims to establish a preliminary unified national system for managing carbon footprints by 2027.[6] At the technical level, various entities, including the national government, local governments and enterprises, are each building carbon dioxide emission data management platforms and exploring the use of technologies such as blockchain, big data and artificial intelligence for the collection, governance and circulation of carbon dioxide emission data. At the application level, the state has begun efforts to utilize the carbon dioxide emissions trading system (ETS), carbon credits and other means to guide the steady reduction of carbon dioxide emissions. However, these developments are still at an early stage, and there is still a long way to go to achieve zero carbon dioxide emissions.

Figure 3 Measures to Facilitate the Flow of Carbon Dioxide Emissions Data in China



Source: Summarized and compiled based on Nomura Research Institute and China Academy of Information and Communications Technology (Dec. 2023). Study on Promoting Social Transformation through Digital Technology in Japan and China (2023)

[6] Ministry of Ecology and Environment of China and other Departmenrts (Jun 2024). the Implementation Plan for the Building of the Carbon Footprint Management System

- **1.Issues**

  * 1)Lack of product-based carbon footprint management system

It is undeniable that as far as the promotion of carbon footprint management system advocated by the state is concerned, there is a lack of concrete measures on how to fine-tune the specific rules and penetrate them into each region, city, and enterprise practically. Globally, the GHG Protocol[7] categorizes greenhouse gas (GHG) emissions into scope 1, 2 and 3 emissions, and specifies the data and calculation methods for each scope. Scope 1 refers to direct GHG emissions from enterprises, such as emissions from fuel combustion and industrial processes; scope 2 refers to emissions that a company causes indirectly and come from where the energy it purchases and uses is produced; scope 3 encompasses emissions that are not produced by the company itself and are not the result of activities from assets owned or controlled by them, but by those that it's indirectly responsible for up and down its supply chain. The sum of the three scopes is the total emissions of the whole supply chain.

In addition, the EU has taken the lead globally in adopting a decarbonization measure, the EU's Carbon Border Adjustment Mechanism (CBAM), which will be implemented in 2026 after a transitional period from October 1, 2023 to December 31, 2025. It requires importing companies to report scope 1, 2 and 3 emissions of GHG generated during the production of their products on a product-by-product basis and purchase CBAM certificates. Products imported from China will be also subject to CBAM with no exception. While the current CBAM coverage is limited to steel, aluminum, cement, fertilizers, chemicals (hydrogen) and electricity, the EU has plans to further expand the scope of products covered in the future.[8] In addition, while CBAM registration is carried out by importers, the data on GHG emissions are managed by producers, which means that in practice the burden on importers will be passed on to producers. Therefore, especially for Chinese companies involved in exporting to Europe or actively exploring overseas, the lack of a product carbon footprint measurement and management system that complies with these regulations will greatly affect their future business development.

However, despite China's establishment of a ETS and active promotion of carbon footprint tracking and management, only the power industry in the national ETS is currently able to meet a part of scope 1 and scope 2 measurement standards, while other industries lack scope 1, 2 and 3 management systems, and are far from realizing the goal of zero carbon dioxide emissions. In

[7] The GHG Protocol: an international standard for calculating and reporting greenhouse gas (GHG) emissions developed by the GHG Protocol Initiative, which provides policy research and technical assistance on global environmental and development issues. (Official Website: https://ghgprotocol.org/)

[8] Japan External Trade Organization (JETRO) (Aug. 2023). Preparing for the EU's Carbon Border Adjustment Mechanism (CBAM)

addition to company-based carbon footprint management and monitoring, if China cannot realize product-based carbon footprint management and data transfer, it is hard to talk about genuine green manufacturing, and it may even become a stumbling block for enterprises to go overseas.

* 2)Data linkage of domestic carbon dioxide emissions still limited to a few enterprises and industries

At present, some domestic governmental organizations and large enterprises have already started to carry out carbon dioxide emission data interoperability and successfully conducted empirical experiments, except for other industries and regions where there are not many examples of large-scale operations or government-driven horizontal deployment.

For example, the China Academy of Information and Communications Technology (CAICT) provides a Carbon data Reliable Circulation (CRC) based on the Xinghuo BIF[9] platform, which is constructed using blockchain technology to realize the secure distribution of carbon dioxide emission data throughout the supply chain. Aimed at Chinese enterprises engaged in export trade to Europe, the platform uses technologies such as blockchain, decentralized identity (DID) and verifiable credentials (VCs) to ensure the reliable circulation of carbon footprint data throughout the supply chain, which has been verified across borders. This initiative enables data circulation with guaranteed reliability and data accuracy, thus making it easy for companies to comply with CBAM-related requirements. Some large enterprises, including Siemens (China), are the first users of the CRC, but it has not yet been possible to reach small and medium-sized enterprises, and a large-scale rollout has not yet begun.

In addition, in October 2023, Carbon Balance Technology, in collaboration with the China Textile Import and Export Chamber, jointly launched the International Carbon Disclosure Platform for Textile and Apparel.[10] The platform adopts blockchain, IoT, big data and artificial intelligence technologies to ensure the security of carbon dioxide emission of upstream and downstream products, and realizes the collection and disclosure of the data in the whole textile and apparel industry on the product basis. The platform also focuses on improving reliability by verifying the accuracy and traceability of data through third-party organizations, and 18 enterprises in the industry have joined as the first batch of advocates. The platform can be regarded as a positive exploration of product-based carbon footprint visualization for specific industries. However, it is undeniable that the platform still faces challenges such as a limited number of participating enterprises and products, and inconsistent data disclosure standards. In addition, inconsistent in the scope of data disclosure is

[9] BIF: Abbreviation for Blockchain Infrastructure & Facility.

[10] International Carbon Disclosure Platform for Textile and Apparel Official Website: *https://www.icdp-ta.com/*

also one of a challenges as some products on the platform disclose data on carbon dioxide emissions from raw materials to the production process, while others disclose data on the entire supply chain from raw materials to production, transportation and disposal.

* 3)Not yet starting negotiation with other countries at the governmental level on exploration of cross-border rules for carbon dioxide emissions data and the establishment of data mutual recognition mechanisms

Some regional governments are exploring data cross-border mitigation on a trial basis, but have not yet achieved widespread deployment. Thus, the establishment of data mutual recognition mechanisms with other countries is hard to be formally pushed forward because there are no unified standards for carbon dioxide emission data collection and disclosure in China.

In terms of data cross-border, the state has liberalized relevant policies since 2023, and is actively mapping out interconnections with global data infrastructures. In addition, a part of multinational enterprises have also realized cross-border carbon dioxide emission data by proactively participating in overseas data initiatives or platforms. For example, Huawei participated in Gaia-X, an autonomous decentralized inter-company data collaboration mechanism developed in Europe and Germany.[11] However, these rely heavily on companies' own resources and planning, and not all companies are in a position to learn from them.

In terms of cross-border data mutual recognition with other countries, it has not yet been formally explored at the government level. So far, China has been developing its own set of dual carbon rules in line with its own national conditions and status, such as actively promoting GEC, carbon credits, and ETS. However, green certificates obtained under this system are often not in line with foreign countries and cannot be directly certified abroad. For example, the Carbon Disclosure Project (CDP), a globally recognized voluntary global reporting framework for enterprises to disclose environmental information to investors and other stakeholders, defines specific accounting methods and calculation formulas for Scope 1, 2 and 3 emissions. However, the data in the emissions reports required by China's national ETS cannot be directly used for CDP disclosure. This discrepancy means that enterprises engaged in exporting or expanding overseas need to recalculate their carbon dioxide emissions every time, leading to tedious practical maneuvers, and is one of the factors that may hinder their pace of overseas expansion. Therefore, there is an urgent need for the government to be proactive and establish cooperation with other countries at the government level on cross-border data and mutual recognition mechanisms related to green manufacturing.

[11] *Ministry of Commerce of China (Dec. 2020). Minister for Economic Affairs and Climate Action: More than 100 Companies to Participate in EU's Gaia-X Cloud Project*

Figure 4 Comparison between CDP and China National ETS

		CDP	China National ETS
Industries Covered		All industries	**Limited to the power industry so far and will be gradually expanded to other industries in the future.** (Part of the regions are exploring expansion to other industries on a pilot basis)
Scope 1		• Verify more than 70% of scope 1 and 2 • As the CDP aims to let companies to provide an overview of GHG emissions, only aggregate data (mainly total scope 1 emissions) are required to be reported • Scope 1 emissions (tCO2e) = Fuel Consumption x Emission Factor	• In order to capture emission rights in more detail, the national ETS requires **specific emission factors such as Carbon Content (tC/GJ), Lower Heating Value**
Scope 2	**Location-based Method**	• Included • Scope 2 emissions (tCO2e) = Electricity purchases and Consumption x Emission Factor for Each Region	• Included • Scope 2 emissions (tCO2e) = Electricity Purchases and Consumption x **Nationally Harmonized Emission Factor**
	Market-based Method	• Included	• **Not included**
Scope 3		• Included	• **Not included**
Protocol/ Main Provisions		GHG Protocol	*Guidelines for Accounting and Reporting Greenhouse Gas Emissions for Electric Power Generating Facilities*

Source: Japan External Trade Organization (JETRO) Shanghai Office (Mar. 2023). Research on Initiatives and Methods for Decarbonization in China[12]

Green Manufacturing Related Countermeasures and Overseas Initiatives

1.Countermeasures related to green manufacturing

- **Establish product-based carbon footprint data visualization, data collection and standardization mechanisms**

On the basis of ensuring consistency with the construction goals and guidelines of the carbon footprint management system required by the state, it is necessary to specify the measurement criteria, scope and methods of carbon dioxide emission tracking, and clarify the data collection methods and reporting standards. In the process of standardization and implementation, priority can be given to the segments of the manufacturing sector that have relatively high demand for foreign trade and overseas expanding, have the need to respond to the carbon reduction and decarbonization policies of other countries, and have high carbon dioxide emissions.

- **Considering and strengthening mutual recognition of carbon dioxide emission tracking data with other countries**

[12] JETRO Shanghai Office (Mar. 2023). *Reseach on Initiatives and Methods for of Decarbonization in China*

Currently, some pilot free trade zones (FTZs) have established their own cross-border data transfer management lists, namely Negative Lists, which is a list of data that will be subject to certain compliance requirements to be exported. For cross-border data outside the Negative Lists, they are exempted from declaring the data security assessment, passing a personal information protection certification, and entering into a standard contract for the cross-border transfer of personal information. We believe that it is necessary to take advantage of this kind of policy to establish a mechanism to strengthen the circulation and mutual recognition of carbon dioxide emissions tracking data with other countries. Specifically, at first, a PoC can be conducted among enterprises in the two countries to promote the opening up of data throughout the supply chain, with participating enterprises taking the lead. Secondly, establish reliable data linkage mechanisms in specific industries in both countries and verify their reliability and feasibility. Finally, expand it to other industries and third countries, and accelerate the establishment of more bilateral and multilateral carbon dioxide emission data standards and mutual certification in more industries.

2.Overseas Initiatives

The EU, a leading region in dual-carbon measures, is stepping up the development of various regulations related to greenhouse gas emissions throughout the supply chain and expects to implement them in recent years. Countries across the globe, including Japan, are responding and trying adapting to this.

- **Relevant initiatives in Japan**

Japan has been working on the visualization of supply-chain-wide carbon dioxide emissions data, the scope and standards of measurement, specific measures on data collection and reporting methods, and data linkage and mutual recognition with other countries at both the technical and policy levels.

At the technical level, benefitting from the promotion of the government subsidy system, in terms of emission data visualization, Japan's major IT companies have released supply chain-wide greenhouse gas emission tracking and accounting systems. Meanwhile, the Ministry of Economy, Trade and Industry (METI), the Ministry of the Environment (MOE), and local governments in Japan provide renewable energy subsidies, energy conservation subsidies, carbon reduction and GX-related subsidies to companies that implement and use these systems, which shows the high degree of governmental importance.

In terms of data linkage, the Japanese government is also actively constructing and promoting data spaces and exploring cross-business, cross-industry and cross-border data linkage models through industry-university-research cooperation. The two major data spaces currently being promoted are DATA-EX, which went live in December 2020, led by the non-profit organization

Data Society Advancement Committee (DSA), and Ouranos Ecosystem, which is launched in April 2023, led by the METI and the Information Technology Promotion Agency (IPA).

At the policy level, Japan has been promoting the visualization of carbon dioxide emissions data across the supply chain, starting with listed companies that are relatively active globally. For example, Tokyo Stock Exchange (TSE) requires GHG emissions disclosure rules for companies listed on its prime market[13] Under the guidance of the Financial Services Agency of Japan (FSA), TSE has first recommended that around 1,650 prime market listed companies disclose their corporate-wide scope 3 emissions from April 2022[14], and then from February 2024 it has begun exploring a formal requirement for all prime market listed companies to disclose their GHG emissions in line with international standards[15] This will make scope 3 accounting a task that should be promoted by large corporations, not only their own carbon dioxide emissions, but also those of upstream and downstream corporations, including their suppliers and their transportation processes, so that inter-company data can be compared horizontally through a unified standard, thus promoting the acceleration of the process of carbon reduction and decarbonization by the corporations. FSA has explicitly requested that target companies disclose sustainability information in their annual reports, and that the disclosure standard should follow the draft standard[16], which is positioned as the Japanese version of the IFRS sustainability disclosure standard, issued by the Sustainability Standards Board of Japan (SSBJ)[17]. The draft standard defines the scope of carbon dioxide emissions to be disclosed and specifies the relevant companies to be covered, measurement standards and methods, reporting standards and timeframes, and so on. It is noteworthy that in exploring and drafting the standard, Japan not only considered existing relevant laws and regulations and industry practices in the country, such as the relationship with the Act on Promotion of Global Warming Countermeasures and the treatment of cross-industry indicators (risk and opportunity, capital investment, and internal carbon pricing), but also emphasized whether to create a Japanese-only standard or to comply with international standards and how to deal with issues such as the SASB standard[18]. As a result, the draft standard has become a disclosure standard for overseas investors and companies with international trade and overseas business needs, based on international standards and taking into account the ease of data transfer and mutual recognition with other countries.

[13] M TSE prime market: One of the segments of the TSE, which is for companies focusing on constructive dialogue with global investors. This market has the most stringent initial listing criteria and continued listing criteria among all segments in TSE.

[14] Nikkei XTECH (Jan.2024). Prepare by *2025, IT is essential for calculating scope 3 GHG emissions*

[15] Nihon Keizai Shimbun (Feb. 2024) *Disclosure of Emission Volumes to be Mandatory for TSE Prime Companies, Considered by FSA*

[16] SSBJ (Mar. 2024), The SSBJ issues Exposure Drafts of Sustainability Disclosure Standards to be applied in Japan

[17] SSBJ was established in July 2022 under the Financial Accounting Standards Foundation (FASF) as a mirror organization of the International Sustainability Standards Board (ISSB), whose members include the Japanese Institute of Certified Public Accountants (JICPA), officials from corporations and financial institutions, and university professors to promote the preparation of the standards to be applied in Japan.

[18] SASB Standard: one of the ESG disclosure standards issued by SASB (Sustainability Accounting Standards Board) since 2018.

Japan has also begun discussions at the governmental level on data linkages with the EU, and in May 2022 launched the EU-Japan Digital Partnership. Led by the Digital Agency, the Ministry of Internal Affairs and Communications (MIC) and METI on the Japanese side, and by the Directorate-General for Communications Networks, Content and Technology of European Commission on the EU side, the aim is to explore ways to address common priorities in the digital field between Japan and the EU, with cooperation on digital innovations, the free flow of data and data governance in the field of carbon neutrality cited as one of the key issues. At the second meeting held in April 2024, the two sides have agreed to actively promote mutual recognition and interoperability of data collaboration infrastructures between the two countries.[19] Specifically, it was noted that cooperation will continue to promote interoperability among Common European data spaces and Japan data spaces, including DATA-EX and the Ouranos Ecosystem, involving their respective industry associations on both sides.

- **Initiatives by Isuzu**

As a core company in the commercial vehicle supply chain, Isuzu is working to strengthen carbon reduction and decarbonization throughout the supply chain by linking data through Ouranos Ecosystem, and is making efforts to visualize carbon dioxide emission data through co-creation with upstream and downstream companies.

For upstream companies, Isuzu utilizes the Green Procurement Guide, which have been in formulated by Isuzu since 2002, to encourage suppliers to strengthen their decarbonization activities. The Guide require suppliers to obtain ISO14001 certification or other relevant environmental management system certifications, such as EcoAction 21[20], EcoSTAGE[21], and KES[22], in order to encourage suppliers to continuously strengthen their decarbonization processes. At the same time, Isuzu, as a core company on the supply chain, is also making effort to visualize the carbon dioxide emissions of upstream companies by requesting suppliers to cooperate in providing carbon dioxide emissions data on a voluntary basis through the CDP Supply Chain Program[23] in which Isuzu participates.

[19] Digital Agency of Japan (May 2024). *Second Meeting of the Japan-EU Digital Partnership Council Held*

[20] EcoAction 21: Japan's own environmental management system, developed by the MOE. It is based on ISO14001 and is known as the "Small and Medium-sized Enterprises (SMEs) version of ISO14001. At the audit phase, it requires company's environmental management objectives and the results of its environmental management programs and initiatives, and evaluates the company's total carbon emissions program and performance. (Official Website: https://www.ea21.jp/)

[21] EcoSTAGE: Developed by the EcoSTAGE Association, it is a management system for SMEs based on ISO14001, to strengthen management with a focus on improving the environment. (Official Website: https://www.ecostage.org/)

[22] KES: An environmental management system developed by KES Environment, a Kyoto-based NPO. It is developed for SMEs and all other businesses to encourage their participation in environmental improvement activities. (Official Website: https://www.keskyoto.org/index.html)

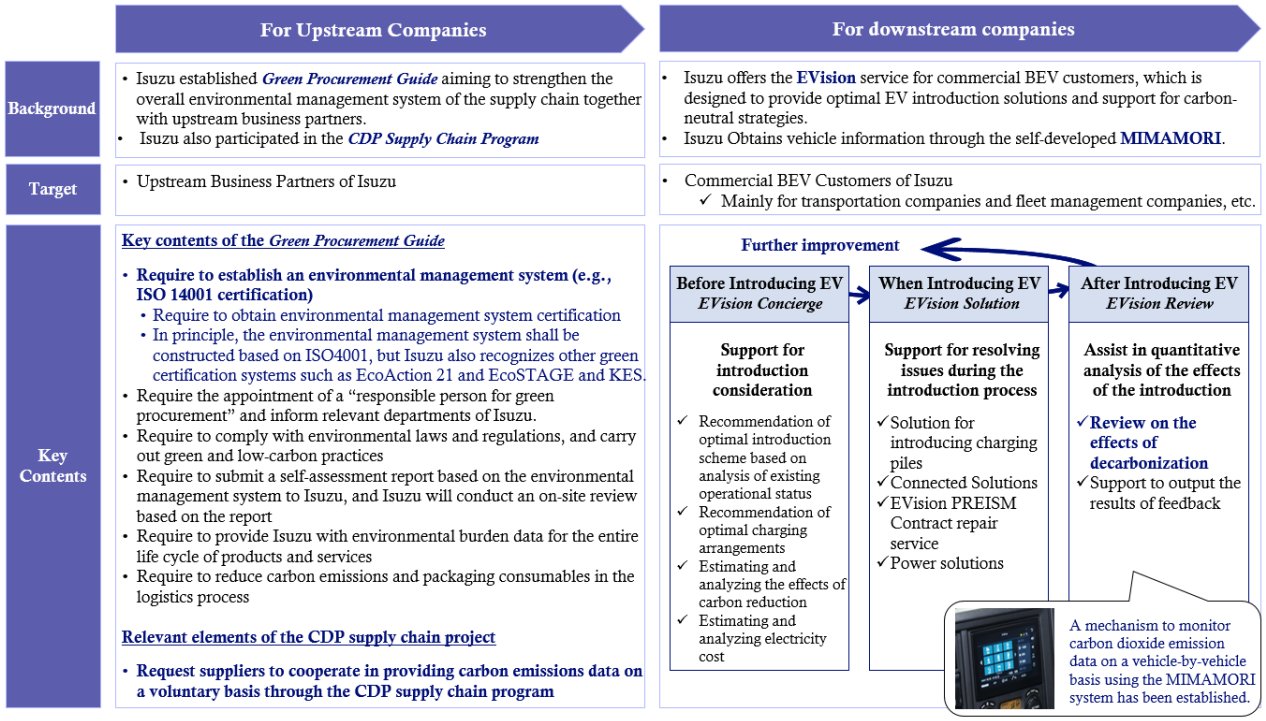
[23] CDP Supply Chain Program: A program of the Carbon Disclosure Project (CDP), a UK-based NGO, that calculates and requires companies to disclose emissions from their entire supply chain (Official Website: https://www.cdp.net/en).

For downstream companies, Isuzu has been offering its battery electric commercial vehicle (commercial BEV) customers an EVision total solution since March 2023 to support them achieve their carbon neutrality goals.[24] The solution is designed to help customers visualize their carbon dioxide emissions at various stages before and after the introduction of commercial BEVs. Before a customer adopts commercial BEVs, Isuzu will conduct the simulation after the introduction of BEVs and visualize the effect of EV operation by comparing and analyzing the cost and carbon reduction effect for each operating route and each operating vehicle based on full understanding of the customer's current operating conditions. After a customer adopts commercial BEVs, although no carbon is emitted during BEV operation, the amount of carbon emitted varies depending on the type of electricity used to charge the BEV, so Isuzu provides the optimal charging plan after fully considering the type of electricity used by the customer, the operating conditions, and the charging schedule, so that it can calculate data on the amount of carbon emitted during the charging phase that takes into account the charging phase. In this way, Isuzu can not only visualize the effect of carbon reduction, but also guide further carbon reduction measures, thereby creating a virtuous cycle of carbon reduction and decarbonization throughout the supply chain. Isuzu has also established a mechanism to monitor carbon dioxide emission data on a vehicle-by-vehicle basis using the MIMAMORI system, which is installed in all new Isuzu vehicles for remote access to vehicle data.

Thus, the co-creation model by upstream and downstream companies is one of the keys to Isuzu's ability to continue to effectively enhance decarbonization and carbon dioxide emission visualization throughout the supply chain. Another key is the Japanese government-led Ouranos Ecosystem, in which the government promotes cross-company data visualization through industry associations by leveraging the use of Ouranos Ecosystem by companies, including Isuzu, and by linking data. At the same time, as mentioned above, the government is also exploring the mutual recognition of the Ouranos Ecosystem with the EU data space. This means that if companies are able to connect their carbon footprint data to the Ouranos Ecosystem, they will be able to easily comply with EU policies in the future, which has the advantage of facilitating companies' response to EU policies, and this advantage also provides an incentive for companies in the supply chain to actively participate in the Ouranos Ecosystem.

[24] *Isuzu Motors (Jul.2023). Isuzu Develops the Total Solution Program "Evision" Helping customers solve issues for commercial BEV introduction and achieve decarbonization*

Figure 5 Isuzu's Initiatives on Decarbonization Enhancement



Source: Summarized and compiled based on Green Procurement Guide and EVision, etc. of Isuzu Motors

Suggestions for Chongqing

Chongqing is at the forefront of inland cities in terms of policy advantages, location advantages and industrial advantages. In terms of policy, Chongqing has the first FTZ in inland area, which makes it easy to enjoy numerous policy advantages, and has also been designated as a test area for various new policies. In terms of location, Chongqing is the node along the "Belt and Road" route and the Yangtze River Economic Belt, as well as the frontier and the strategic pivot for the Large-scale Development of the Western Region, with geographic advantages as a logistics hub in China and Europe, and sufficient hydropower stations in the vicinity. In terms of industry, Chongqing's manufacturing sector is relatively concentrated and has been focusing on the development of advanced manufacturing in recent years.

In order to better realize the product-based carbon footprint tracking and management of the manufacturing sector, and to help manufacturing enterprises respond more easily to the policies of other countries when exporting and going overseas, we suggest: (1) promoting the visualization and interoperability of the carbon footprint data system in a pilot region, as well as pilot and trial implementation of the cross-border and international mutual recognition of the data, (2) setting up a unified platform for carbon dioxide emissions and constructing a system of rules for connecting

the platform with the data of the enterprises, (3) providing policy support to enhance co-creation of enterprises in supply chain-wide carbon footprint tracking.

1.Promoting the visualization and interoperability of the carbon footprint data system in a pilot region, as well as pilot and trial implementation of the cross-border and international mutual recognition of the data

Based on the above discussion, from the perspective of complying with foreign policies, promoting carbon footprint data visualization and interoperability system as well as cross-border and international mutual recognition of data is a very crucial step for enterprises that have the need of export and expanding overseas. Therefore, it is suggested that the government take the lead in promoting the construction of a system for the visualization and interoperability of carbon footprint data, as well as cross-border and international mutual recognition of data.

It is suggested to establish a zero-carbon park as a pilot project first. In the establishment of the park, it is desirable to make full use of Chongqing's policy, location and industrial advantages, as well as the excellent scientific research results in carbon footprint management from universities and research institutions in Sichuan and Chongqing, and to establish it in the Chongqing FTZ, selecting higher-priority industries to be stationed in the park first, and carrying out a pilot project in the FTZ, where data cross-border policies are relatively lax. If it is possible to create a national demonstration zone, it will also help to set up an advanced case on a nationwide scale. Furthermore, it is desirable to start promoting the construction of pilot parks with other countries at the conceptualization stage of the parks when it is created, especially in terms of accounting, management and reporting principles of carbon emission data with full consideration of common international practices, so as to facilitate future convergence with the international community and thus rapidly promote the interoperability and international mutual recognition of carbon emission data. After the mechanisms and policies within the zero-carbon park have been fully verified, it will be easier to spread for the whole city or other industries.

2.Setting up a unified platform for carbon dioxide emissions and constructing a system of rules for connecting the platform with the data of the enterprises

It is easy to see from the initiatives in Japan that in order to realize the visualization of carbon dioxide emission data of the whole supply chain, it is not only necessary for the government to take the lead in setting up demonstration cases and establishing and improving relevant policies, but also crucial for the government to provide guidance at the technical level. Thus, we suggest that the Chongqing government take the lead in establishing a platform for sharing and interoperating carbon dioxide emissions data across enterprises, industries, and even across borders in the future. The government can then encourage enterprises to link their systems to the platform, which will make it easier to visualize and interoperate with carbon dioxide emissions data in practice.

Specifically, it is recommended that the Chongqing government take the lead in the project in the form of industry-university-research cooperation by acting as a bridge between the state and enterprises in the phases of architectural design, research and development, PoC, implementation, and dissemination. This facilitates the construction of a system architecture that is in line with national policies and guidelines, and has a high degree of feasibility and practicality for enterprises. For example, in the design phase, forums can be held to listen to the opinions of experts from industry and academia, system developers and enterprise associations, etc., and then conduct thorough discussions. In the development and PoC stage, small-scale empirical experiments can be carried out in high-priority industries first, so as to find out the problems and the improvement solutions in the practical application of enterprises. In the implementation and promotion phase, the government's influence and impetus can be utilized to encourage rapid promotion by the industry in a top-down approach. We believe that through government-led promotion, we can effectively build a platform that takes into account the national guidelines and the realities of the industry and enterprises, and successfully realize data interoperability with enterprise systems.

3.Providing policy support to enhance co-creation of enterprises in supply chain-wide carbon footprint tracking

As mentioned above, from overseas experience, co-creation within the industry is one of the keys to the successful promotion of supply chain carbon visualization and data interoperability, so we suggest that the Chongqing government provide policy support to strengthen the promotion of co-creation among enterprises.

If co-creation is only led by the core enterprises in the supply chain, the speed of promotion will be very slow. Moreover, the promotion of supply chain co-creation requires the collaboration of many enterprises, including SMEs in the supply chain. However, SMEs participating in co-creation on their own will face huge challenges in terms of cost and human resources. Therefore, we suggest that the government start with a pilot project focusing on core supply chain enterprises, and provide appropriate policy support for enterprise co-creation projects on carbon footprint tracking, and then gradually expand it to all enterprises in the city. In this process, it is suggested that support can be geared particularly towards SMEs in solving or advancing the problems they face in co-creation. For example, supporting enterprises to cultivate and introduce talents in the field of carbon footprint tracking co-creation, establishing a scheme of subsidies to promote enterprises co-creation, providing subsidies for the enterprises that develop and introduce the systems required for co-creation, etc.

We believe that if Chongqing can take the lead in promoting the above initiatives and creating a national-level demonstration zone, which promotes the visualization and interoperability system of carbon footprint data as well as cross-border and international mutual recognition of data, establish a unified carbon emission data platform, and promote co-creation among enterprises in

carbon footprints tracking throughout the whole supply chain, it will further promote the greening and globalization of China's manufacturing sector and thus enhance Chongqing's brand power and influence. We hope our suggestions will contribute to Chongqing’s decarbonization, and sincerely look forward to Chongqing further improving its manufacturing competitiveness, deepening the level of opening up to the world, and enhancing new quality productive forces.

Forging Irreplaceable 'Chongqing Competitiveness' through Intelligent and Green Initiatives

SIEMENS

1. Booming Technology Innovation Drives the Industrial Convergence as the New Norm

The current era is witnessing an unprecedented level of global technological innovation, with a new wave of technological revolutions and industrial transformations reshaping the global innovation landscape and economic structure. New-generation information technologies, including artificial intelligence, quantum information, mobile communications, the Internet of Things, and blockchain, are experiencing rapid breakthroughs and applications. These developments are giving rise to disruptive technologies and fostering a new wave of industries, business formats, and models that are transforming traditional modes of production and lifestyles. The rapid advancement of advanced manufacturing technologies, which integrate robotics, digitization and new materials, is driving a transformation of manufacturing towards greater intelligence, sustainability and integration, with significant developments occurring across various sectors. The technological revolution and industrial transformation present a wealth of opportunities, while also posing new challenges.

A total of 151 countries have set carbon neutrality targets and formulated corresponding policies and action plans, representing 92% of global GDP, 89% of the population, and 88% of emissions. Achieving carbon neutrality requires global systemic change, with the development of low-carbon technologies and industrial transformation across sectors creating new opportunities and driving economic growth.

The ongoing optimization of industrial intelligence, sustainability and integration will drive a shift in the global division of labor, with digital resources fostering collaborative innovation and efficiency gains. The return of manufacturing industries from developed countries will challenge the low-cost manufacturing advantages of developing countries. From a political and economic standpoint, the traditional pursuit of efficiency in industrial layout is evolving. The global industrial chain and supply chain are moving towards regionalization, localization, diversification, digitalization and other directions to accelerate the adjustment. The application of industrial meta-universe, artificial intelligence and other cutting-edge technologies is transforming the basis of competitive advantages among countries and the added value of different industrial segments, intensifying global high-end manufacturing competition.

Against the backdrop of cross-fertilization in various fields and accelerated innovation in organizations and models, there is also an urgent need for the government to adjust the traditional ways of industrial governance. The advent of new technologies has expanded the scope of industrial development, with more innovations occurring at the crossroads of existing industries. These innovations are driven by vast, real-time, and multifaceted data, which is becoming a crucial production factor. Consequently, the government must shift its approach to industrial development. Instead of focusing on supporting established and predictable industries, it should explore new frontiers, encourage cross-fertilization and innovation, and invest in developing new sources of productivity.

2. With Strong Manufacturing Fundamentals, There is Still Potential for Further Growth in the Scale of Industrial and Leading Enterprises

Chongqing is a traditional manufacturing base with a complete range of industrial categories, including prominent advantageous industries such as automotive and electronics. There is a concentration of well-known manufacturers such as Chang' An, Ceres, and Hewlett-Packard. The favorable industrial foundation and policy support have facilitated the rapid development of the new energy vehicle industry. In the first half of 2024, Chongqing produced 1.214 million units of automobiles, ranking first among Chinese cities in this sector. The export value of laptop computers, mobile phones and automobiles reached 77.8 billion, 21.35 billion and 20.01 billion yuan, respectively, representing a year-on-year increase of 4.7%, 35.8% and 34.9%. All the growth rates are higher than the corresponding national figures.

Chongqing's strategic location at the intersection of the Belt and Road Initiative and the Yangtze River Economic Belt offers convenient conditions for foreign trade. As the first "five-type" national logistics hub city in China, Chongqing not only holds a pivotal position in the domestic logistics system but also deeply integrates into global industrial, supply, and value chains through initiatives like the China-Europe Railway Express and the International Land-Sea Trade Corridor.

Amid the global trend of green and decarbonization, Chongqing, as the last line of defense for the ecological barrier upstream of the Yangtze River, faces both challenges and opportunities in promoting economic transformation towards green development. Exploring a green technology-driven path for industrial energy conservation and carbon reduction can not only enhance Chongqing's international competitiveness in manufacturing but also provide valuable experiences for other regions.

Chongqing's solid manufacturing roots and convenient logistics corridors have provided a robust foundation for the development of a modern industrial system. Along with the new opportunities of the new era, there are also challenges for future development. In 2023, Chongqing's value added of the secondary industry stood at 1.17 trillion yuan, ranking second in

the country, right after Shenzhen. However, in terms of revenue data for the regulated industry, Chongqing ranked sixth in the country with 2.68 trillion yuan, with a notable gap from the top three cities: Shenzhen (4.85 trillion yuan), Shanghai (4.5 trillion yuan) and Suzhou (4.43 trillion yuan). Presently, there is no local Chongqing enterprise on the list of the world's top 500 leading enterprises. And few Chongqing manufacturers and brands are with international influence, so the competitiveness of local enterprises has yet to be further improved.

3. Suggestions for Chongqing to Build a Modern Manufacturing Cluster System

3.1 Leveraging Industrial Software to Accelerate the Application and Promotion of Cutting-edge Technologies such as Metaverse and Artificial Intelligence, Enhancing Quality and Efficiency of Enterprises

In the context of the global digital transformation, technologies such as the meta-universe and artificial intelligence have brought about unprecedented opportunities for enterprises to leapfrog their development. They are changing how people work and live, and are transforming future business models. As technology, algorithms, resources and talent continue to evolve, these innovative technologies are also integrating with the manufacturing industry, relying on industrial software to penetrate various application fields and empower enterprises.

Based on the different product forms, uses, and characteristics, industrial software can be classified into four main categories: R&D and design, production control, information management, and embedded software. It permeates the entire enterprise value chain, from R&D to design, production, and operations, driving the optimization of manufacturing management processes, transforming production models and relationships, and enhancing total factor productivity. Thus, it is deemed the "brain of industry, foundation of smart manufacturing, and key to industrial upgrading." As a vital branch of the Metaverse, Industrial Metaverse integrates the physical and digital worlds, encompassing the mapping and simulation of highly complex systems like machines and factories, providing optimal solutions to real-world challenges and propelling industries into a new era of digitalization and intellectualization. Vigorously developing high-end industrial software incorporating cutting-edge technologies like the Metaverse and AI will significantly boost enterprise productivity, reduce R&D and manufacturing costs, and optimize resource utilization, thereby offering an effective path for Chongqing to enhance its manufacturing competitiveness.

Digital Twin, a critical technology supporting the Industrial Metaverse, can be viewed as a “virtual replica” of a physical entity. By leveraging industrial software to create digital twin models of products and factories, enterprises can simulate and emulate the entire business process, from design and R&D to production and maintenance. This simulation technology enables engineers to rapidly iterate design schemes in a virtual space, assess product performance and manufacturing costs in real-time and accurately, and promptly identify and address issues at an early stage.

It can not only reduce the trial-and-error costs associated with traditional R&D processes but also accelerate the transition from concept to product, enabling innovation to reach markets and customers more swiftly.

With a 30-year history in digital twin research and application, Siemens has widely deployed the core technology of digital-physical integration within its own operations and among external clients, supporting various industries such as automotive, renewable energy, fast-moving consumer goods, and biopharmaceuticals in achieving digital breakthroughs. For instance, in June 2022, Siemens collaborated on the development of BMW's factory in Debrecen, Hungary, optimizing production line layouts and logistics routes through digital twin technology, with an anticipated commissioning in 2025. In April 2023, Siemens and FREYR (a Norwegian lithium-ion battery manufacturing startup) jointly unveiled a digital model of FREYR's battery factory at the Hannover Messe, showcasing the potential of digital twin technology in advancing manufacturing capabilities.

Case Study 1: Siemens Nanjing Plant Demonstrates the Full-Process Application of Digital Twin Technology

Siemens Numerical Control (Nanjing) Co., Ltd. (SNC) is Siemens' largest research and development (R&D) and manufacturing center outside of Germany in the field of motion control. In recent years, facing increasing market demand, the factory urgently needed to expand capacity, improve production efficiency, and enhance flexibility.

As Siemens' first natively digital plant globally, the newly constructed SNC facility, officially opened in June 2022, exemplifies the tremendous potential of Siemens' advanced digital enterprise concept centered on digital twin technology. Prior to actual construction, Siemens comprehensively applied digital technologies to create a digital twin of the factory in the virtual world, realizing digitization throughout the entire process, from needs analysis, planning and design, construction implementation, to production operations. During the virtual construction phase, Siemens leveraged digital twin technology covering factory needs analysis, layout design, production process simulation, and virtual commissioning to complete the virtual construction of the factory within the software system.

After the new factory went into operation, its capacity increased nearly twofold, production efficiency improved by 20%, flexible production capacity increased by 30%, product time-to-market shortened by nearly 20%, space utilization improved by 40%, and material flow efficiency enhanced by 50%. The new factory can simultaneously produce two vastly different categories of products – electronics and electric motor manufacturing – that differ significantly in raw materials, production equipment, and process flows.

Figure 1 Siemens Numerical Control (Nanjing) Co., Ltd. (SNC)

Siemens Numerical Control (Nanjing) Co., Ltd.'s (SNC) new factory was successfully elected as one of the "Top Ten Technological Advances in World Intelligent Manufacturing 2022."

The latest advances in artificial intelligence are propelling the industrial metaverse into a new era of innovation. Siemens' latest industrial software, Teamcenter X, is a cloud-based product lifecycle management (PLM) software that showcases the boundless potential of AI. Powered by NVIDIA's Omniverse technology, Teamcenter X enables engineering teams to create highly realistic digital twins in real-time, avoiding the waste and errors that can occur in traditional workflows.

Integrated with generative AI technology, Teamcenter X significantly accelerates the process of setting up and adjusting photorealistic rendering details, such as material definitions, lighting environments, and other ancillary scene assets. By contextualizing engineering data with realism, tasks that once took days can now be accomplished within a matter of hours. Beyond engineering teams, stakeholders such as sales, marketing, decision-makers, and customers can also benefit from insights and understanding of the real-world product appearance, enabling more informed and faster decision-making.

Case Study 2: Hyundai Heavy Industries Achieves Interactive R&D with the Latest Solutions Combining Industrial Metaverse and Artificial Intelligence

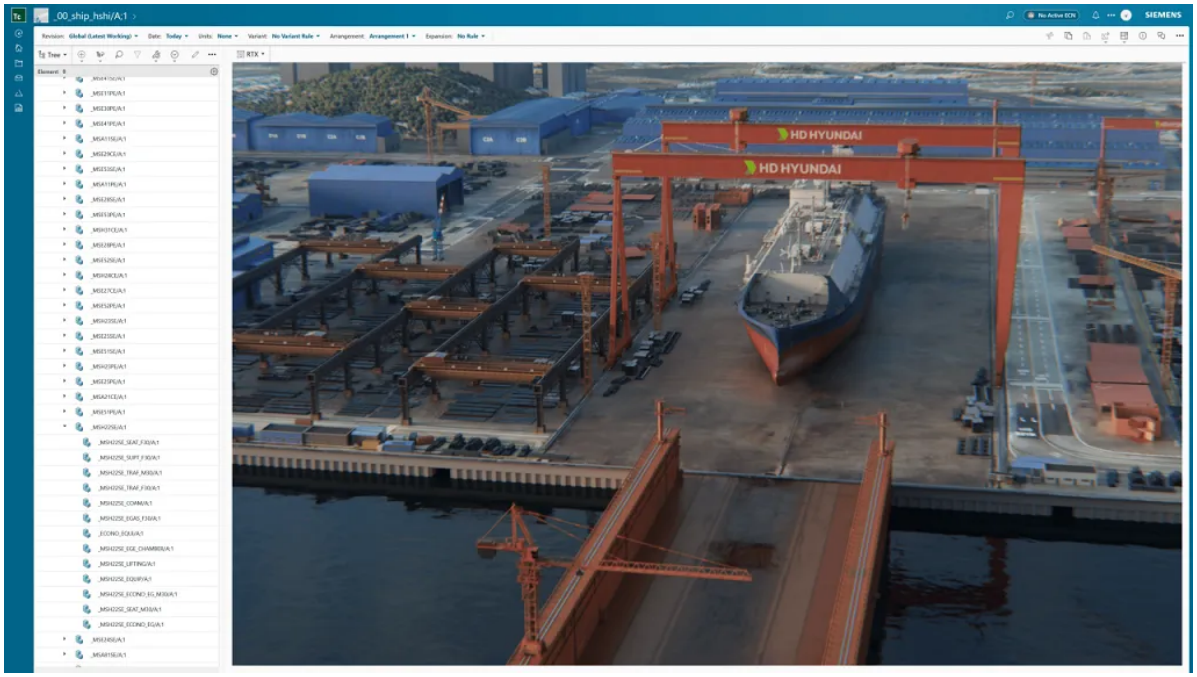


Figure 2 Example of HD Hyundai's Use of Generative Artificial Intelligence

Hyundai, a leader in the sustainable shipbuilding market, is continuously collaborating closely with world-class digital engineering enterprises such as Siemens to achieve its goal of establishing a “smart, autonomous shipyard” by 2030.

Focusing on the development of ammonia-powered and hydrogen-powered vessels, HD Hyundai faces immense complexity, with potential ships requiring the management of over 7 million discrete components. Leveraging Siemens' and NVIDIA's innovative AI solutions integrated within the Teamcenter X industrial software, HD Hyundai achieves unified and visual management of massive engineering datasets through real-time, highly realistic visualization technologies and interactive methods.

In this virtual yet highly realistic industrial metaverse, companies can construct a development environment nearly identical to the real world, enabling engineers to break free from the constraints of the physical world and freely explore various innovative possibilities. On top of this, the deep integration of artificial intelligence adds even more limitless potential.

The integrated development of new technologies such as the industrial metaverse, artificial intelligence, and edge computing will fundamentally transform the way manufacturing enterprises conceive, design, manufacture, and service products. **By racing ahead in cutting-**

edge technology and vigorously promoting the application of high-end industrial software, driving technological development through software and empowering industries, Chongqing's manufacturing sector will gain a leading technological advantage. Siemens suggests that Chongqing strengthen the integration and application of new technologies with manufacturing in the following three areas:

- Open up typical scenarios in Chongqing's modern manufacturing industry clusters to attract outstanding global technology service providers to carry out joint innovation and localized applications.
- Actively introduce outstanding enterprises in the fields of high-end industrial software, the metaverse, and artificial intelligence, screen and cultivate a group of local innovative technology service enterprises, and build bridges for them in terms of technology, funding, and markets to facilitate the clustering of the local ecosystem.
- Take the lead in establishing benchmark demonstration projects for leading enterprises in the three major industrial clusters of intelligent and connected new energy vehicles, next-generation electronic information manufacturing, and advanced materials, thereby leading the development of these industries.

3.2 Enhancing Carbon Footprint Management and Standardize Systems to Develop Green Leadership in Key Industries

Globally, a growing number of countries and regions are implementing stringent carbon emission control mechanisms, exemplified by policies such as the European Union's Carbon Border Adjustment Mechanism (EU CBAM) for carbon pricing, the Circular Economy Action Plan (CEAP) and the new Battery Regulation as part of the EU's circular economy strategy, and the United States' Clean Competition Act (US CCA). **Decarbonization has become a pivotal trend in global industrial development.** China has also issued numerous policies and implementation plans to advance this agenda. In May 2024, 15 departments including the Ministry of Ecology and Environment and the National Development and Reform Commission jointly issued the "Implementation Plan for Establishing a Carbon Footprint Management System," encouraging key industries and enterprises to establish digital management systems for product carbon footprints, conduct scientific accounting, and explore alignment with international standards.

As an inland comprehensive open hub, Chongqing, with the development of its "33618" modern manufacturing cluster system, has continually expanded its export scale, particularly in advantageous industries such as automobiles and electronics. Under the influence of international regulations and domestic policies, Chongqing's export-oriented enterprises are confronted with heightened carbon management requirements. To quantify carbon emissions at both the

organizational and product levels, establish circular economy systems, forge sustainable value chains, and enhance international competitiveness, Chongqing's enterprises must expedite their actions.

Statistics reveal that over 90% of industrial products' carbon emissions originate from supply chain processes. Therefore, achieving precise calculations of a product's carbon footprint throughout its entire lifecycle necessitates a comprehensive approach encompassing production, manufacturing, and the supply chain. Drawing on Siemens' research and practical experience, we identify several key barriers hindering corporate decarbonization efforts: poor data quality in carbon emission accounting, difficulties in acquiring carbon emission data from upstream and downstream partners in the value chain, limited coverage of third-party certifications, and doubts about the credibility of data reports. In response, we suggest that Chongqing considers introducing innovative solutions that integrate digital twins, blockchain, industrial edge computing, energy management, and domain expertise in manufacturing digitalization. By leveraging digital enablement and strategic deployment, Chongqing can precisely quantify carbon footprints across the entire supply chain for both products and organizations, thereby achieving efficient carbon reduction.

- ***Clarifying the "Carbon Portfolio" for Credible and Precise Carbon Footprint Accounting.*** Carbon data serves as the cornerstone for achieving carbon neutrality goals, necessitating authentic, reliable, and dynamic carbon footprint data. By maximizing the use of automation through technologies such as sensors, smart metering, and the Internet of Things (IoT), enterprises can integrate carbon emission management systems with their IT infrastructure for production and manufacturing execution. This integration, coupled with energy management and industrial edge computing, enhances data collection efficiency and accuracy.

- ***Enabling Credible Exchange and Traceability of Carbon Footprints Across the Value Chain.*** Digital solutions for corporate carbon management must facilitate efficient data interaction among enterprises, their upstream and downstream partners, and third-party verification agencies at the value chain level. Leveraging blockchain technology (e.g., Trusted Supply Chain Information Exchange and Sharing, TSX), which employs distributed ledger technology and cryptographic trust mechanisms, enables the verification of carbon footprint information submitted by suppliers for product components. This approach ensures the secure and reliable sharing of supply chain carbon footprint information while safeguarding business confidentiality. It enhances the authenticity, accuracy, and overall recognition of carbon-related data for export-oriented enterprises, fostering transparency and efficient collaboration across the value chain.

- ***Optimizing Emission Reduction Strategies with Digital Technologies.*** Based on precise carbon footprint calculations, enterprises must further analyze the data to identify key areas for

emission reduction within their production operations and supply chain processes. Employing digital twin technology, enterprises can virtually construct digital models of products, enabling real-time or near-real-time management throughout the product's lifecycle. Through multiple simulation scenarios using twin models, enterprises can monitor carbon emission trends, providing valuable insights for decarbonization roadmap planning and strategy formulation.

- ***As Chinese enterprises expand their operations abroad, it is crucial to not only monitor and report carbon emissions but also to align their product carbon footprint accounting standards, methods, and data with international best practices.*** This will help remove potential barriers to overseas expansion and ensure that Chinese enterprises can compete globally on sustainability.

Taking the automotive industry as an example, in June 2024, the Ministry of Industry and Information Technology released the "Key Points of Automotive Standardization Work for 2024," proposing to conduct research on the automotive dual-carbon standard system and clarifying the "systematic approach to advancing the development of standards in key areas such as intelligent and connected vehicles, new energy vehicles, automotive chips, and automotive dual-carbon.", As China's leading automotive city, Chongqing possesses absolute industrial conditions and scenario advantages to participate in the relevant work of automotive dual-carbon standards.

In light of international and domestic trends and the decarbonization needs of Chongqing's industrial clusters, Siemens suggests that Chongqing actively enhance its green competitiveness through the following three actions:

- Initiate the establishment of carbon footprint management systems in key export enterprises such as automotive and electronics, leveraging technologies like blockchain to achieve credible and precise calculations of product carbon footprints.

- The government supports the establishment of low-carbon eco-alliances in various industries, and organizes leading enterprises, eco-enterprises upstream and downstream of the industrial chain, and industry associations to work together to build carbon footprint standards that are in line with segmented industry sectors;

- Under the guidance of the government, promote communication and interaction between industry low-carbon eco-alliances and relevant domestic and international standardization committees and certification bodies, exploring transparent carbon footprint pathways that meet international standards.

By enhancing the normative and authoritative nature of carbon management in Chongqing's industrial clusters through standardization and internationalization, it can not only establish

benchmarks within the industry, driving the improvement of carbon management levels across the board, but also strengthen the leading position of Chongqing's advantageous industries such as automobiles and electronics nationally and internationally, thereby enhancing its global competitiveness.

Case Study 3: Siemens Aids Battery Enterprise Sunwoda in Green Overseas Expansion

With the acceleration of the global electrification process, the development, production, and utilization of batteries have become crucial for the EU's transition towards a climate-neutral economy. According to forecasts by the Global Battery Alliance (GBA), global battery demand is projected to increase 14 times by 2030, with the EU accounting for 17% of this total demand. However, amidst this market growth, the manufacturing, usage, and disposal of batteries face various resource and environmental challenges, underscoring the importance of battery sustainability, environmental protection, and high energy efficiency.

To address global climate change and promote green and low-carbon economic and social development, the EU revised the "New Battery Regulation" in 2022, requiring all rechargeable battery products to undergo carbon footprint certification that meets the requirements of the Product Environmental Footprint Category Rules (PEFCR). This poses new requirements for Chinese battery enterprises exporting to the EU.

Policy Overview

New EU Battery Regulation	
Legislative Process	The European Parliament adopted the EU New Battery Regulation on 14 June 2023, and the entire legislative process has now been completed.
Entry-into-force Time	Formally effective from August 17, 2023
Coverage Area	Suitable for all batteries entering the EU market, including portable batteries, SLI batteries, LMT batteries, electric vehicle batteries, and industrial batteries: • Regardless of their shape, size, weight, design, material composition, chemical composition, use or purpose • Whether produced in the EU or imported • Also applicable to batteries installed in or added to products, or specially designed for use in batteries installed in or added to products
The Impact on Chinese Overseas Enterprises	For Chinese overseas enterprises, exported battery products must meet the requirements of the EU New Battery Regulation and provide a carbon footprint (PCF) declaration and label before entering the EU market.

Figure 3 EU's New Battery Regulation

Siemens' SiGREEN platform foundation and carbon footprint ecosystem solution leverage innovative technologies such as blockchain, digital twins, energy management, and edge computing. Based on international standards for product carbon footprints like ISO 14067, it utilizes Siemens' digital expertise and know-how in manufacturing to precisely quantify the carbon footprint of products throughout the supply chain. SiGREEN also relies on the blockchain infrastructure established by "Spark Chain Network" to support peer-to-peer data communication, utilizing encryption keys to ensure authenticity and trustworthiness, thereby meeting enterprises' needs for supply chain confidentiality and data sovereignty. Enterprises can quickly identify high-emission processes based on reliable data, unlocking their decarbonization potential and effectively achieving industrial decarbonization goals.

Siemens has reached a dual-carbon collaboration agreement with Sunwoda, a renowned battery enterprise in Shenzhen. Based on Sunwoda's current battery production status, the two parties jointly selected a typical Sunwoda battery product. Leveraging Siemens' experience in analyzing and calculating product carbon footprints, they conducted data collection, modeling analysis, and piloted the process on the SiGREEN platform. Beyond meeting ISO 14067 standards, they explored an evolutionary path for future product carbon footprint transparency that complies with PEFCR and Battery Passport requirements. Furthermore, they actively discussed a battery passport management system based on Siemens' digital capabilities, providing platform services and decision support for battery enterprises' internationalization needs and decarbonization efforts. Additionally, SiGREEN offers one-stop overseas expansion services to meet carbon tariff and other requirements.

4. Conclusion

Given the backdrop of technological and industrial transformation and leveraging Chongqing's robust manufacturing foundation, we believe that to build the "33618" modern manufacturing cluster system, Chongqing should seize the opportunities of the era in both intelligence and green development. Firstly, rely on the application of high-end industrial software and the integrated use of cutting-edge technologies such as the Metaverse and artificial intelligence to enhance the quality and efficiency of industrial clusters and build technological competitiveness. Secondly, accelerate the pace of energy conservation and carbon reduction among enterprises, actively participate in the construction of carbon accounting standard systems for advantageous industries, explore international alignment, and build decarbonization competitiveness.

Bravely standing at the forefront of the times, Chongqing aims to become a significant national advanced manufacturing center, rooted in the western region and facing the world. The innovative development of intelligence and decarbonization will provide Chongqing with a competitive advantage in the industrial sector which is irreplaceable in global market.

Accelerate Digital Transformation to Achieve Green and Low-Carbon Development of Manufacturing

Schneider Electric

1. Background

We are currently experiencing a pivotal moment in which the mid-term objective of achieving carbon neutrality intersects with the immediate challenge of energy supply, catalyzing an ongoing technological and industrial revolution aimed at addressing climate change and energy constraints. Digital technology is instrumental in advancing the green and sustainable development of industries, emerging as a new competitive arena for numerous countries and regions on the global stage. In particular, the manufacturing sector, as a significant consumer of energy and resources, plays a crucial role in green and low-carbon development, which is essential for resource conservation, environmental protection, and the sustainable growth of the economy.

As the backbone of the real economy, the green development of the manufacturing is crucial for achieving green economic transformation and sustainable growth. The Ministry of Industry and Information Technology, along with six other ministries, has issued the "Guiding Opinions on Accelerating the Green Development of the Manufacturing Industry"[1] (hereinafter referred to as the "Guiding Opinions"). These measures include speeding up the green and low-carbon technological transformation of traditional industries, promoting the deep integration of green manufacturing with modern services, and establishing a green and low-carbon technological innovation system. The aim is to enhance the global competitive advantage of the manufacturing industry in both the industrial and supply chains. By 2030, green development in manufacturing should serve as a solid foundation for advancing a new type of industrialization, and by 2035, it should become the standard form of new industrialization.

Chongqing, a major industrial city in the southwest, takes manufacturing as the foundation of its city and the basis for its strength. In recent years, from building a national advanced manufacturing center to creating a "33618" modern manufacturing cluster system, Chongqing has been focusing on enhancing the core competitiveness of manufacturing and promoting continuous transformation and upgrading of local manufacturing.

Schneider Electric believes that against the backdrop of accelerating global digitalization, the restructuring of industrial and supply chains, and deepening international climate cooperation, Chongqing should speed up the extensive application of digital technology in the industrial sector to

[1] "Guiding Opinions of the Ministry of Industry and Information Technology and Other Seven Departments on Accelerating the Green Development of the Manufacturing Industry", https://www.miit.gov.cn/jgsj/jns/gzdt/art/2024/art_9fe98a60fb3546a8b3d11f0d70e00401.html

achieve green and low-carbon development of manufacturing.

2. Digital technologies enable green intelligent manufacturing and help the green and low-carbon transformation of manufacturing industry.

In the context of a global emphasis on energy efficiency and sustainable development, solely focusing on the production of energy, i.e. the supply side, is far from sufficient. We also need to address the demand side of the energy equation. Among the energy solutions aimed at achieving net-zero emissions by 2050, 50% pertain to the use of energy, which is driving an increasing demand for a green, low-carbon transformation in manufacturing. Yet, the progress in industry sector has been underwhelming. The report[2] shows that in 2022, the industrial sector's direct carbon emissions reached 9.0 Gt, making up a quarter of the global energy system's carbon footprint, of which,

- Heavy industries are responsible for 55% of the total greenhouse gas emissions from the sector. These emissions are often centralized in large industrial hubs, necessitating a focused deployment of key technologies such as waste heat recovery, electrification, hydrogen utilization, and carbon capture and storage.

- On the other hand, light industries contribute to 45% of the sector's emissions. They tend to be more dispersed and are predominantly small and medium-sized enterprises (SMEs) that frequently have to weigh sustainability against other business priorities. Nonetheless, the light industry holds significant potential for reducing energy consumption and enhancing operational efficiency.

The industry's green and low-carbon transition is lagging, largely due to the low adoption of large-scale smart manufacturing initiatives among manufacturers. In China, the majority of these enterprises remain in the nascent stages of intelligent transformation. According to the latest data from the public service platform[3] for smart manufacturing assessment, nearly half of the enterprises are at the level of smart manufacturing level 1 and below, while the proportion of enterprises reaching level 2 and level 3 is 28.34% and 14.71% respectively, and the proportion of enterprises at level 4 and above is less than 10%. This is far from enough to promote the transformation of production models, improve manufacturing levels, and release more efficiency space through intelligence, thereby empowering its green development.

Since the proposal of the dual-carbon goals, China has been steadily advancing relevant policies to resonate with the transformation of the era's momentum. The recently issued "Opinions of the CPC Central Committee and the State Council on Accelerating the Comprehensive Green

[2] IEA, Tracking Industry, https://www.iea.org/energy-system/industry

[3] https://www.c3mep.cn/dataBoard?subPlatformId=1

[4] "Opinions of the CPC Central Committee and the State Council on Accelerating the Comprehensive Green Transformation of Economic and Social Development", https://www.gov.cn/zhengce/202408/content_6967663.htm

Transformation of Economic and Social Development"[4] emphasizes "accelerating the collaborative transformation of digitalization and greening. Promote the deep integration of industrial digitalization, intelligence, and greening, and deepen the application of artificial intelligence, big data, cloud computing, industrial internet, and other digital technologies in the fields of power systems, industrial and agricultural production, transportation, construction, and operation, enabling digital technologies to enable green transformation."

In the field of manufacturing, promoting the deep integration of intelligence and green development through digital technologies to improve energy and operational efficiency not only helps to address energy and climate crises but also enhances the resilience and competitiveness of manufacturing enterprises in the future, thus achieving excellent operations.

2.1Emerging digital technologies significantly enhance smart manufacturing capabilities.

The digital revolution has created an entirely digital, highly interconnected and strongly intelligent world of digits, catalyzed the transformation and upgrading of the industrial system. Today, digital technologies, by optimizing the performance and processes of machine and manufacturing facilities, further improves the craftsmanship and boosts productivity and efficiency. Broad application of digital technologies in production is pivotal to the level of smart manufacturing.

2.2Optimizing machine and equipment efficiency

One of the key metrics manufacturers and industrial enterprises are increasingly looking at is Overall Equipment Efficiency (OEE). This metric measures the effectiveness of their equipment. OEE is an indicator of operational performance measuring the impact of equipment output or downtime on overall plant operations.

Digital connectivity of assets enables real-time collection and analysis of equipment data, including status, operational parameters, and fault information. This proactive approach to maintenance allows for the early detection of potential issues, reducing downtime and failure rates significantly, which in turn enhances equipment utilization and boosts production efficiency. Optimizing OEE helps manufacturers pinpoint bottlenecks in the production system, devise equipment optimization plans strategically, and maximize return on investment, thereby greatly increasing profitability.

Case study 1: At the factories of Schneider Electric in China, air compressors, a critical auxiliary facility, were identified as significant energy consumers after analyzing OEE and energy efficiency data. Swift action was taken by implementing an intelligent system that increased equipment efficiency by 8%. Utilizing logical control algorithms to analyze data and manage operating conditions efficiently, the factories transformed three air compressors into a unified

system. The annual electricity savings are equivalent to powering an electric vehicle for over 100,000 kilometers.

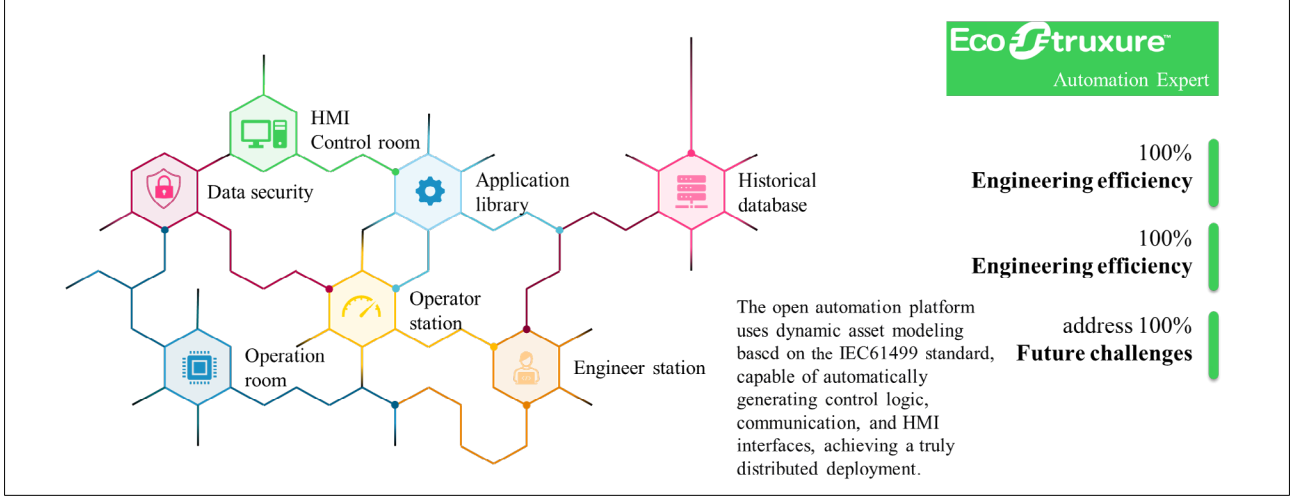
- 2.2.1Open automation for future industry

The holistic development of industrial enterprises lies on the digital management of the entire lifecycle of production equipment and infrastructure. Companies can gain comprehensive understanding of the facilities, processes, and energy assets, through applying digital twins and AI to the optimization of operation and asset management. As these digital connections become more robust, businesses are better positioned to boost efficiency and precisely target areas for resource enhancement and waste reduction, driving their transition to a greener model.

However, many enterprises often find it challenging to take the early stage in digitalization, as existing processes, equipment, and infrastructure were not designed with digital integration in mind, and most smart manufacturing projects are initially aimed at enhancing the operational efficiency of production assets. Therefore, it is crucial to connect all production and automation hardware in the factory -- even hardware from various vendors. Achieving seamless interoperability through open software-led automation standards assists organizations develope more efficient and productive approaches in data management, and facilitates the integration of operational technology (OT) and information technology (IT).

This is what Schneider Electric's EcoStruxure Open Automation platform aims to achieve (see Figure 1).

Figure 1: **Schneider Electric is shaping the future of industry to be open, efficient, resilient, sustainable, and people-centric through digitalization.**



A software-centric open automation platform, by decoupling software from hardware, breaks the limitations of existing systems, and addresses the portability, configurability, and interoperability of vendor applications, promoting "plug and play" in the field of industrial automation and facilitating digital transformation with ease.

Looking ahead, Schneider Electric's EcoStruxure open automation platform has three major advantages: 100% engineering efficiency and 100% operational effectiveness to address 100% challenges in future. The open automation platform uses dynamic asset modeling based on the IEC61499 standard, capable of automatically generating control logic, communication, and HMI interfaces, achieving a truly distributed deployment. It breaks away from closed traditional automation and defines automation control systems with software. As the core architecture for the next generation of industry, it truly achieves openness.

- 2.2.2Optimizing operational mode with artificial intelligence

These technologies help unleash the potential of artificial intelligence to further transform industrial operations today. The expansion of AI is no longer a topic for the future, it has already paved the way for cross-sector applications, improved every level of industrial operations, from manufacturing processes to data contextualization, for better decision-making by various methods:

- ***Improving operational efficiency:*** AI promises unprecedented optimization of manufacturing processes at both machinery and plant levels, e.g. leveraging machine learning (ML) algorithms and predictive models to facilitate anomaly detection and foster preventative maintenance practices. This proactive approach can increase equipment uptime, reduce unplanned downtime and significantly improve operational efficiency.

- ***Increasing value chain resilience:*** Leveraging AI into production planning process will improve customer demand forecasting and supplier management, and the resiliency of value chains will be strengthened. AI brings accuracy and reliability, reducing supply-demand gaps and potential production lags, therefore making industrial operations more resilient to market fluctuation.

- ***Industrial sustainability:*** AI, combined with the electrification and processes, enables more precise and controllable systems, and this facilitates flexibility in adapting production loads to the available energy mix, maximizing the use of renewable energies and reducing peak grid demand, which until now has been mainly fuelled by carbon-intensive power.

Case study 2: Another real-life example of a smart manufacturer comes from Schneider Electric’s customer, one of Asia’s biggest dairy companies, which has earned recognition from China’s Ministry of Industry and Information Technology for its digital transformation. The

energy management solution now in place has increased the company's operational efficiency by monitoring production lines in real-time. This system provides detailed updates on power usage, increasing overall energy efficiency by 19% and reducing operational costs by 5%. On the other hand, the process management system helped the company to plan production and make more accurate operational improvements with the detailed data it now has at hand. This information also allows historical data from different cost centers and product lines to be correlated to improve the use of lean manufacturing techniques.

In addition, in response to consumer demand for healthy products, the company applied digital traceability solutions to enable that operations are more agile, resilient, and responsible with more visibility and control over production. This helps ensure product quality and meet consumer demands to certify production chains and guarantee the origin of products, such as organic ingredients. Companies are increasingly turning to artificial intelligence to boost the efficiency of production tasks that are typically labor-intensive, especially within manufacturing processes that demand stringent environmental controls. AI systems are adept at real-time monitoring and management of critical environmental factors like temperature and humidity. This not only optimizes production yield but also reduces waste, enhancing the accuracy, speed, and responsiveness of food and beverage manufacturing.

- 2.2.3Driving efficiency with 5G applications

Advances in 5G connectivity, augmented reality (AR), and virtual reality (VR) are both making machines smarter and easier to operate within a manufacturing setup.

As consumers develop more customized and differentiated needs, industrial production needs to adapt to more diversified and small-batch production. Traditional fixed production lines face uneven loads and low return on investment, and may result in old production lines being eliminated as new projects and products are introduced. By integrating new 5G technology, fixed production lines can be modularized, and by introducing a configurable production management system, it is possible to produce different product models and quickly change under different production capacity loads. This significantly reduces the production line switching time, decreases the workshop area, increases production capacity, and eliminates the need to phase out or rebuild production lines.

Schneider Electric has conducted extensive research and practice in the industrial application scenarios of 5G. It is progressively implementing 5G multi-park private network solutions and the integration of 5G with VDI PAD technology in more than twenty smart factories and logistics centers across China. This integration significantly reduces both hardware and operational costs, leading to an asset-light approach.

In September 2023, Schneider Electric, together with the China Academy of Information and Communications Technology and China United Network Communications Group, jointly released the White Paper on "5G+PLC Deep Integration Solution." The white paper elaborates on the application of 5G+PLC in the discrete manufacturing industry, covering the planning, deployment, operation, and performance requirements of 5G networks throughout the entire lifecycle of production lines, along with detailed application explanations. It comprehensively demonstrates the profound changes brought by 5G to the manufacturing production mode.

2.3Building a green-smart manufacturing system for supply chain transformation

The emphasis on green development is gaining momentum among more businesses, and the construction and operation of future factories have evolved from focusing solely on "smart" to integrating both "smart" and "green" aspects. Research[5] indicates that "green development can stimulate the potential of intelligence, accelerating the smart upgrading and transformation of the manufacturing industry; while intelligent technologies promote the transition from energy-dependent production models to those driven by technological innovation, empowering the green, low-carbon development of advanced manufacturing." Integrating smart technology with green concepts is essential for the manufacturing sector to achieve green transformation and upgrade its processes.

2.4Building green smart factories

The core of manufacturing rivalry is the contest of production capabilities, with factories as key carriers, directly reflecting the manufacturing level and competitiveness of enterprises. The "Implementation Plan for Accelerating the Establishment of a Unified and Standardized Carbon Emission Statistics and Accounting System" issued by the National Development and Reform Commission proposes that the empowerment of energy conservation, emission reduction, and carbon reduction by digital technology has become an industry consensus[6]. The dual drive of digital and green technologies will inevitably become a trend for the sustainable development of future factories. The integration of green and intelligence is the mainstream of future factory construction and optimization. It is imperative for industrial enterprises to build green-smart factories by means of the digital technologies.

The Schneider Electric Institute of Business Value, in partnership with the International Economic and Technical Cooperation Center of the Ministry of Industry and Information Technology, has conducted a comprehensive survey engaging with 120 corporate executives through in-depth discussions and questionnaire assessments. This initiative aims to analyze the practices of

[5] "Green + Smart manufacturing: Empowering the High-Quality Development of Advanced Manufacturing" (Source: "People's Forum • Academic Frontier", September 2023 issue) , http://www.rmlt.com.cn/2023/1007/684391.shtml

[6] https://www.gov.cn/zhengce/zhengceku/2022-08/19/5706074/files/a924a706a96645f1a4eee8981e7da686.pdf

green and smart factory construction within the manufacturing sector from various perspectives. The report reveals that cost reduction and carbon emission reduction are the central objectives for many leading enterprises in building green and smart factories, with the ultimate goal of bolstering their core competencies and generating value for the business[7]. Specifically,

- First and foremost, 66% of the executives surveyed prioritize and acknowledge that the establishment of green and smart factories can lead to "reduced production and operational costs." Against the backdrop of slowing economic growth, there is a clear shift in corporate growth from energy-intensive and extensive management to a model that emphasizes refined, intelligent and high-quality growth, focusing more on internal expansion and seeking financial efficiency within the organization itself;

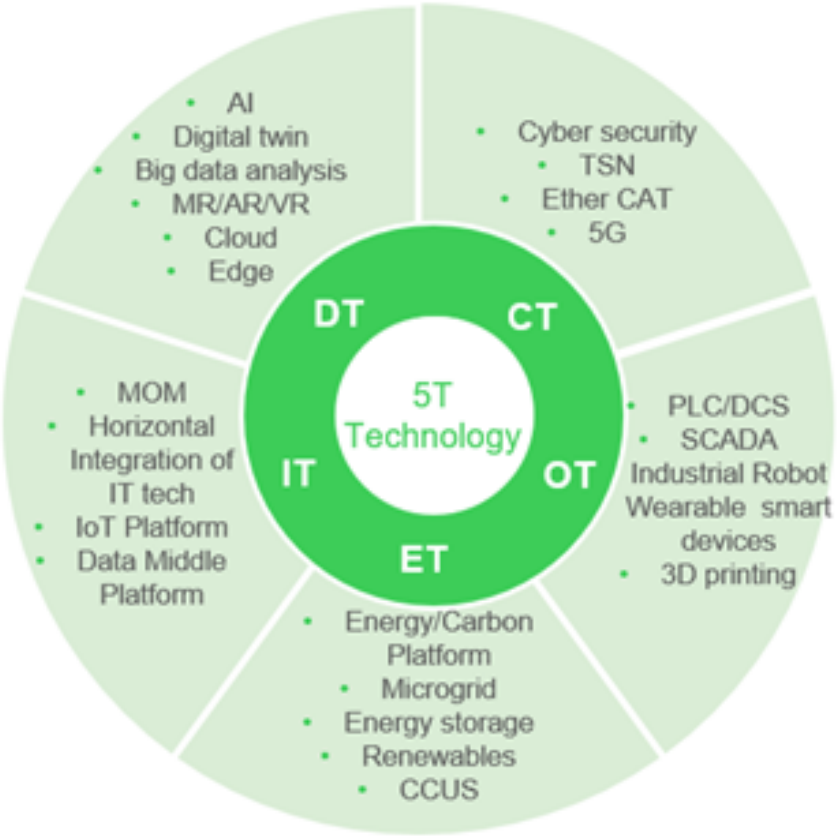
- Following closely, 46% of the executives agree on the shared vision of "enhancing energy efficiency and minimizing carbon emissions." In response to the nation's dual carbon goals and the upcoming carbon tariffs from the European Union, enterprises with strategic vision have already begun to integrate efficiency and carbon reduction into their factory construction and operational practices;

- Moreover, improving customer satisfaction (45%), ensuring reliable quality control systems (30%), and shortening product delivery times (24%) are identified as key business values that are directly linked to customer relations. This shows the necessity for a customer-centric approach tha meets customer needs effectively, which should be an integral part of the green and smart factory development strategy.

Drawing from years of practical experience, Schneider Electric identified five types of green smart manufacturing technologies, known as the 5T technology set (see Figure 2). Leveraging digital means to achieve the integration of 5T technologies will become a crucial cornerstone and direction for the future green and smart factories.

[7] "Digitization to build a green-smart factory - Executive insight into digitization enabling green-smart manufacturing 2023", Schneider Electric Institute of Business Value

Figure 2: 5T tech set in green smart manufacturing identified by Schneider Electric



5T technology include Communication Technology, Operation Technology, Energy Technology, Information Technology, and Digital Technology. Along with continuous innovation of the development and application of emerging technologies, there is a growing trend of integrating different technologies together. This integration refers to interaction and re-innovation of the 5T technologies strengthening the coupling relationship among these technologies The boundaries between these technologies are becoming less distinct, by which factories are able to apply in various ways to meet the requirements of modern green-smart manufacturing.

- 2.4.1Implementing circular economy in production

Digital transformation is also the key to helping businesses optimize material use, eliminate waste and extend asset life. With digital solutions, enterprises can utilize scarce resources more efficiently, expand the use of circular resources in product design, and implement business models that extend the use of materials.

Schneider Electric is actively adopting a circular economy model in production, incorporating

green design principles to enable its business growth and supply chain resilience. New approaches focusing on both its design and production for longer life or reuse of products have been tested throughout the entire value chain of the pilot projects, and are now being scaled up. For example, reversed logistics are also being used as part of innovative digital recycling programs for industrial customers that are underway in Schneider's production and distribution centers. Around 11,000 product references can now be sent to the centralized recycling centers for diagnosis, and, depending on their condition, then recycled, reused, dismantled, remanufactured, or refurbished. In France, these products are sold under the "Circular Certified" label that guarantees the same functionality and performance and ensures an updated warranty.

- 2.4.2Creating green smart supply chains

The essence of corporate competition extends beyond internal operations to the harmonious dynamics within the entire supply chain network. Supply chain efficiency and ecological impact directly influence corporate competitiveness, shifting the focus from conventional cost optimization to a broader spectrum that includes enterprise value, organizational resilience, and ecological synergy.

Firstly, the carbon footprint is not only present in the manufacturing processes of the company itself but throughout the entire value chain. Estimates by the Global Environment Information Research Center (CDP) show that, on average, the carbon emissions from supply chains are more than five times those of a company's direct emissions. To accelerate industrial carbon reduction, supply chain collaboration is the key.

Case study 3: For Schneider Electric, carbon emissions from its own factories represent merely 10% of its total supply chain emissions, with the remaining 90% emanating from upstream and downstream activities. Beyond achieving its own carbon neutrality and zero-carbon goals, Schneider Electric is propelling carbon reduction initiatives with partners throughout the supply chain. The company has harnessed digital technology to develop an end-to-end green supply chain that encompasses green design, procurement, production, delivery, and maintenance, thereby enhancing operational efficiency and sustainability. This has also set a benchmark for digital transformation, offering a reference for ecological partners and advancing the carbon reduction journey of the entire value chain. Recognized for its green supply chain initiatives, Schneider Electric has consistently ranked on Gartner's "Top 25 Global Supply Chains" list, securing the top position globally in 2023.

On the other side, the complexity and instability of the global economy are compelling supply chain transformations. The supply chain has evolved from a traditional linear "chain" structure to a complex "network" system. Any fluctuation at a node can trigger a cascading reaction across the entire network. Companies need to fully grasp the multifaceted situation of first-tier, second-

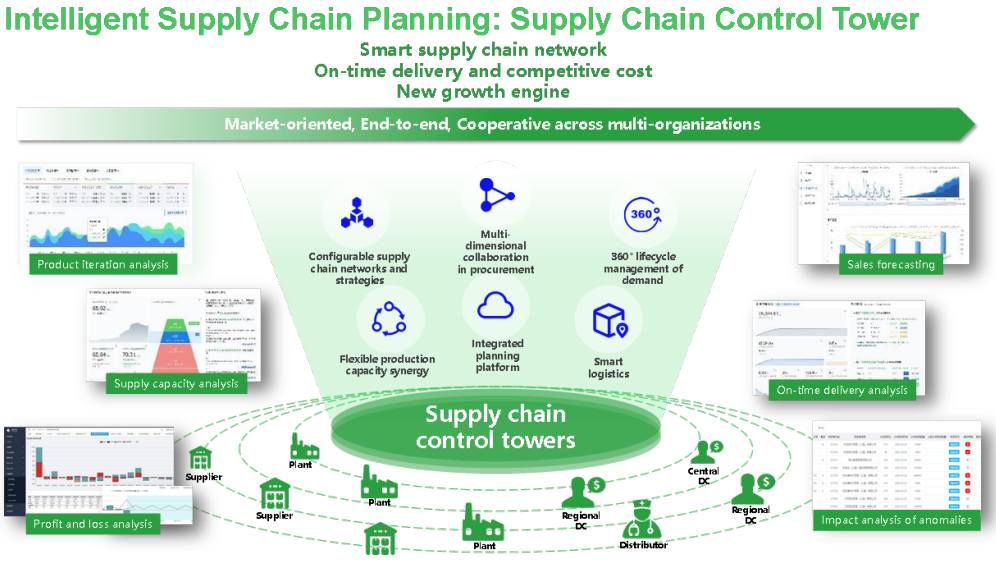
tier, and even deeper-level suppliers to ensure that they can quickly respond from end to end in the face of sudden crises. Digitalization, as a means, primarily enhances the visibility and information exchange of the supply chain, helping businesses better coordinate the work of each link, enabling intelligent decision-making to truly take effect, and achieving seamless docking and efficiency upgrades of the entire supply chain nodes.

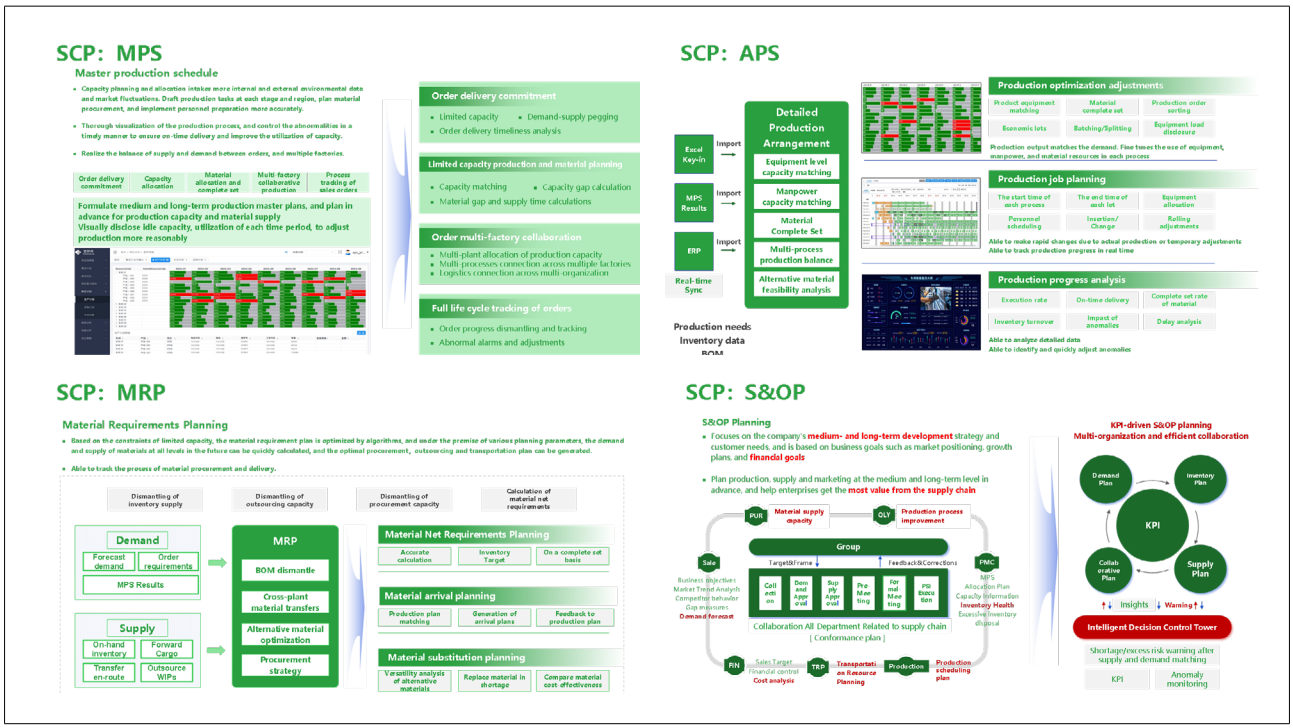
Schneider Electric's integrated smart supply chain "Planning and Scheduling" optimization system (see Figure 3), based on AI decision-making technologies such as operations research, reinforcement learning, and big data analysis, integrates AI optimization algorithms that learn from machines, providing enterprises with an "Industry + AI + OR" decision-making solution. It eliminates the boundaries between supply, production, sales, and other links, constructing a network interconnected by businesses, customers, suppliers, channel merchants, logistics providers, etc., to easily control every aspect of demand fluctuations, production scheduling, procurement optimization, and inventory management, helping manufacturing enterprises achieve comprehensive optimization of the supply chain.

2.5Enhancing full value chain performance

Scaling up green smart manufacturing depends on the speed and scale at which these advanced technologies are applied across the entire industrial system. Successful smart manufacturing enterprises must integrate the entire value chain from design, construction, operation to maintenance. The scope of their digital transformation should extend from their own factories to the entire end-to-end supply chain, including suppliers, customers, and other partners. Engaging all stakeholders in digitalization and green, low-carbon transformation will collectively build a green smart manufacturing system, thereby enhancing the performance of the entire value chain.

Figure 3. Schneider Electric integrated smart supply chain and scheduling optimization smart solution





- 2.5.1Optimizing production process from design to operations

The broad application of digital twin and industrial metaverse throughout the manufacturing lifecycle is instrumental in enabling manufacturing enterprises to better understand and optimize actual production processes, anticipate and resolve potential issues, thereby enhancing operational efficiency and achieving green and sustainable manufacturing.

- Digital twin technology creates precise digital models of physical objects, allowing their behavior and performance to be simulated in a virtual environment. This empowers machinery manufacturers to conduct virtual operational tests before actual production, thus enabling optimized decision-making, reducing costs, and shortening product time-to-market. For instance, BMW has utilized NVIDIA's Omniverse platform to achieve 3D design collaboration and real-time simulation across global factories, significantly improving production planning efficiency.[8]

- The industrial metaverse integrates technologies such as virtual reality, augmented reality, and blockchain, digitizing and virtualizing the real-world industrial ecosystem and connecting it to a virtual world. It simulates and replicates the physical environment, industrial equipment, production processes, and supply chains of the real world. This not only assists enterprises in optimizing product design and manufacturing processes in the digital realm but also leverages real-time data,

[8] https://baijiahao.baidu.com/s?id=1761038391512797336&wfr=spider&for=pc

sensor information, models, and algorithms for real-time monitoring, analysis, and optimization of industrial systems, enhancing production efficiency and reducing costs. For example, Foxconn has introduced MR/VR technology into the training process for new employees, shortening training time and improving proficiency while increasing labor efficiency.[9]

With AVEVA, Schneider's partner for industrial software, one single data repository can collect, store and manage data for operations, processes, assets, energy, and carbon intensity. This comprehensive toolbox can help manufacturers build their own enterprise metaverse.

Case study 4: Schneider Electric has developed a 3D model digital factory for Huali Group that accurately replicates the real factory at a 1:1 scale. It incorporates various engineering data, enabling end-to-end digitization from requirement analysis and planning to implementation and production operation. The virtual factory enables optimization in two aspects: asset optimization for early fault detection, efficient machinery operation, and energy balance, as well as value chain optimization. Models derived from digital twins can be utilized to simulate and continuously optimize issues involving the entire lifecycle, such as reducing employee workload and improving production efficiency.

- 2.5.2Data sharing in manufacturing ecosystem

In today's manufacturing industry, data sharing has become a key element of the ecosystem. By leveraging advanced data analysis and visualization tools for supply chain data sharing, companies can fully observe the entire manufacturing process and implement end-to-end collaboration from raw material suppliers to end users. This includes the ability to analyze historical data, whether from two months or two years ago, and visualizing it to grasp long-term trends and cyclical changes. Similarly, for geographically-dispersed data points, whether 1,000 feet or 1,000 miles away, users can monitor and analyze the data in real time, ensuring a clear understanding of every aspect of the production process.

This capability for data sharing and visualization enhances supply chain transparency, improves efficiency, and accelerates response speed. It enables businesses to quickly identify issues and opportunities, leading to more precise decision-making. For instance, by analyzing production data from different time points and locations, companies can optimize inventory management, reduce logistics costs, improve product quality, and respond to market changes. Moreover, data sharing fosters trust and collaboration between various links in the supply chain. Suppliers, manufacturers, distributors, and customers can share key information to jointly address challenges in

[9] "The Metaverse Enters the Factory" (Source: People's Data) https://baijiahao.baidu.com/s?id=1731418797531456251&wfr=spider&for=pc

the production process, providing vital support for achieving smarter, more flexible, and sustainable full value chain management.

Case study 5: Schneider Electric's shared MES (Manufacturing Execution System) is extended to the upstream supplier side, breaking down segmentation along the entire value stream. Through 5G networks, flexible management and allocation of supplier capacity can be achieved. Real-time monitoring and information sharing with suppliers are facilitated through remote device access. This enables a 48% reduction in material coordination time for suppliers, a 5% decrease in scrap rates for customized products, and a 50% reduction in design input.

3. Recommendations

In previous papers, Schneider Electric has proposed recommendations for the transformation and upgrading of Chongqing's manufacturing industry from corporate, supply chain, and industrial perspectives. These include promoting "enterprise smart transformation and cloud-platform adoption," "building a smart logistics system to enhance supply chain efficiency," "empowering the resilience of the industrial chain with digitalization," and "integrating technological innovation with digital transformation to accelerate the construction of a modern industrial system." We have observed that Chongqing has made significant progress in the smart transformation and upgrading of its manufacturing industry by organizing smart manufacturing diagnostic assessments, establishing smart factories and digital workshops, encouraging industrial enterprises to "embrace the cloud and platforms," launching the "Cloud Services Directory for Enterprises," and other initiatives.

Building on these initiatives, Chongqing can look ahead and, guided by the "Guiding Opinions," take further measures in line with the local manufacturing transformation. This includes enhancing supply-demand connectivity, capital and technological innovation, and talent cultivation. By doing so, Chongqing can fully leverage the role and value of digital technology in the smart and green transformation of manufacturing. This will accelerate the green and low-carbon transformation and development of the manufacturing industry, continuously enhancing the competitiveness of Chongqing's manufacturing sector.

3.1Strengthening government guidance and support for the green development 2.0 of manufacturing

The "Guiding Opinions" highlight the critical role of green factories in the green and low-carbon transformation of manufacturing. It calls for a three-tiered mechanism linking national, provincial, and city levels to cultivate green factories and promote green practices across industrial parks and supply chains.

Chongqing has implemented policies to establish green and smart factories, low/zero carbon parks, achieving breakthrough and successful replications. Despite these advances, the number of

recognized green factories and supply chains is modest relative to the city's industrial scale. More in-depth and mature measures could be adopted from "N" to "N+" to create an upgraded version of the green and low-carbon transformation of the manufacturing industry.

- 3.1.1Accelerating the low-carbon transition of the entire industrial sector

We recommend the city to establish clear objectives and strategies for the development of green smart manufacturing, specifying tasks, benchmarks, and operational mechanisms at every stage. This ensures effective implementation of all initiatives, striving for a higher standard of green, low-carbon growth within the industrial sector.

For instance:

- Governments can activate platforms, including industry associations and industrial parks to facilitate supply and demand matchmaking activities. This stimulates market engagement among businesses, assisting manufacturers and parks in promptly identifying suitable advanced technologies. They also ensure these entities earnestly advance the establishment of green smart factories.

- Select leading enterprises equipped to spearhead supplier decarbonization initiatives. To expedite green, low-carbon transitions across businesses, reply on industry associations and technology alliances to advocate for green manufacturing supply chains. Formulate action plans that leverage digital technology to enhance green supply chains, encouraging participation from all supply chain stakeholders for low-carbon advancement. The action plan should explicitly outline principles and practices for sustainable supply chain management, along with a roadmap for key elements:

* Green Design: Promote the creation of energy-efficient, low-carbon products that enhance resource recycling, eco-friendly and health-conscious. Implement lifecycle assessments for products, encompassing a range of environmental impact indicators, including the disclosure and verification of a product's carbon footprint throughout its lifecycle.

* Green Procurement: Intensify the green evaluation of third-party suppliers in line with green design and production objectives. Establish an entry mechanism for key suppliers, assisting them in setting carbon reduction goals through assessments of their carbon emission levels. This aims to foster environmentally responsible procurement practices and share exemplary approaches.

* Green Production: Embrace green production practices through lean manufacturing and smart technologies, enhancing efficiency via digitalization, and adopting a circular economy to conserve and efficiently utilize resources, significantly increasing the use of clean energy to boost efficiency and reduce emissions.

* Green Delivery: Employ eco-friendly and minimal packaging, substituting disposable plastics with biodegradable materials and recycled cardboard (including eco-friendly inks), and reinforce reuse and recycling initiatives. Advocate for green transportation methods, utilizing electric vehicles and optimizing routes with big data algorithms to minimize energy consumption.

Case study 6: Schneider Electric launched the Zero Carbon Project for suppliers in April 2021, aiming to encourage 1,000 suppliers in its supply chain, including 230 in China, to set carbon reduction targets. The project has deepened their understanding of sustainable development software and services and significantly reduces operational emissions. This initiative addresses Scope 3 carbon emissions, which are approximately 20 times the carbon emissions generated from Schneider Electric's direct operations or energy purchases (Scope 1 and 2).

Participating suppliers, which account for 70% of the upstream carbon footprint, have committed to halving their operational emissions by 2025. Chinese project member companies are categorized based on their carbon maturity to receive appropriate support, share best practices, and collaborate on digital community platforms. These suppliers have undergone training courses on carbon accounting, decarbonization tools, and energy management solutions. More than 20 on-site audits have been conducted, with detailed reports currently under review. These 1,000 suppliers correspond to millions of employees worldwide. Schneider Electric has also introduced assessments of labor practices related to wages, safety, working conditions, and educational support, aiming to increase the positive social impact of the entire supplier ecosystem.

- 3.1.2Creating diverse technology innovation and cooperation platforms

The key to low-carbon economic growth is industrial decarbonization. Companies prioritize regulatory compliance and cost saving, often using energy-saving measures and lean practices to cut emissions in the short term. However, achieving low-carbon transformation across industries entails a deep, systemic economic and social shift. This necessitates collaborative efforts and sustained dedication from various stakeholders. Governments could take the helm, fostering innovation in digital technologies that transcend industry borders, and scaling these across diverse applications to drive ongoing progress in industrial decarbonization.

- Chongqing's manufacturing industry has a complete range of categories and rich application scenarios, providing a good foundation for the integration of innovative technology and application scenarios. The government can encourage technology suppliers and service providers to form ecological alliances with enterprises in need of transformation, jointly create digital solutions for the difficulties and pain points in the manufacturing process of different subcategories, apply them in different scenarios, form a scale effect, and continuously iterate and update to ensure the advanced nature of the solutions.

- Enterprises often differ in their stages of development, which determines that there is no standard answer for the digital transformation plan of the manufacturing industry. It is necessary to customize corresponding strategies according to the specific characteristics and maturity of the enterprise, and deploy digital technology step by step through a "overall planning, step-by-step implementation", "diagnose before prescribing medicine, and quick small steps" approach, to provide continuous momentum for enterprises to improve quality, reduce costs, and increase efficiency. Therefore, Chongqing can also selectively create digital transformation innovation centers or public service platforms for key industries, encourage the incubation of localized technical solutions, to adapt to the industrial characteristics and needs of specific regions, and provide resources and empowerment for enterprises in the entire industry.

Case study 7: In 2018, Schneider Electric, leveraging its strategic cooperation framework with the Chongqing Municipal Government, partnered with a local enterprise in the Chongqing High-tech Zone to establish the Schneider Electric Green Smart Manufacturing (Chongqing) Innovation Center. Schneider Electric has integrated its global resources to support the center in providing customized solutions, software and hardware products, as well as operation and maintenance services for the green and smart transformation of manufacturing enterprises in Chongqing.

This initiative has bridged the gap between the technological innovation representing the international advanced level and traditional production enterprises respectively. The innovation center, combining Schneider Electric's advanced technology and services with a wealth of case accumulation, allows a wide range of local small and medium-sized traditional automotive, motorcycle, and electronics industry factories in Chongqing to have the most direct and efficient access to the world's advanced production management systems, technical equipment, information means, and business philosophy. By successfully building model enterprises, it enhances the willingness of small and medium-sized manufacturing enterprises to transform independently and effectively promotes more regional enterprises to accelerate the implementation of smart manufacturing and digital transformation (see Figure 4).

Figure 4: Schneider Electric Green Smart Manufacturing (Chongqing) Innovation Center

Since its launch in 2019, the Innovation Center has focused on digital and smart applications to transform the manufacturing sector, promoting Schneider Electric's green smart manufacturing solutions. It has hosted numerous lectures, welcomed international visitors, and offered free diagnostics to SMEs. The center has implemented projects for companies like Chongqing Golden Bridge Machinery, Chongqing Yu Xin Pingrui Electronics, and Chongqing Zhenbao Technology.

After the digitalization transformation, Chongqing Golden Bridge Machinery Manufacturing Co., Ltd. achieved a 40% increase in per capita efficiency, a 35% reduction in on-site labor, a 12% saving in space, and over a 70% decrease in work-in-progress on production lines. The company has since entered the new energy engine market and is now a supplier for new energy vehicles like BYD and Seres. The factory's success has been featured on the National Development and Reform Commission's website and reported by CCTV's "Focus Interview."

Chongqing Yu Xin Pingrui Electronic Co., Ltd. saw a 40% increase in output per unit area and a 5% improvement in per capita value after digital empowerment, with a 77% drop in maintenance inventory and a 26% reduction in production cycle times. The company's on-site work-in-progress decreased by over 46%, product delivery rates increased by 18%, customer complaints fell by 20%, quality loss ratio dropped by 33%, and customer satisfaction significantly improved. Yu Xin Pingrui went public on May 24, 2022, becoming a representative of high-quality development in Western (Chongqing) Science City.

Chongqing Zhenbao Technology Co., Ltd., through smart production line planning, has built an efficient smart factory integrating smart production, management, traceability, and supply chain, saving 30% on labor, increasing production cycle efficiency by 35%, improving equipment operation rates by 15%, and raising the first-pass yield rate by 15%. The company has secured a leading position in the semiconductor market.

- 3.1.3Leveraging the role of capital

In today's economy, capital is a critical element of innovation, and a vital function of capital markets is to reward innovation. Without capital engagement, innovation is hard to materialize. However, incubating technological innovation and then applying often face many challenges, such as high technological costs, substantial capital investment, long return cycles, and insufficient supportive policies. In the manufacturing sector, the promotion of green and low-carbon technology typically goes through three stages: R&D, pilot and demonstration, then large-scale promotion. Public funds focus more on early-stage R&D, while private capital looks more at mature technology applications. Yet, the transition from 'laboratory to market' remains relatively weak.[10] This requires the government to strengthen policy support and guidance, especially for state-owned capital to set an example in building “patient capital”.

[10] Officials from the National Development and Reform Commission answered reporters' questions about the "Implementation Plan for the Demonstration Project of Green and Low-Carbon Advanced Technologies."
https://www.gov.cn/zhengce/202308/content_6899563.htm

Currently, to encourage state-owned capital to participate in venture capital, the State Council and some local governments are working on establishing more comprehensive fault tolerance mechanisms and more scientifically sound assessment mechanisms. For instance, there are policies like the "17 Measures for Venture Capital," the "Guangdong Province Regulations on Science and Technology Innovation," and the "Several Opinions on Further Promoting the High-Quality Development of Shanghai's Venture Capital." Additionally, an increasing number of local governments are introducing policies to subsidize venture capital firms' investment risks, including cities like Shenzhen, Nantong, Hefei, Wuhan, Yangzhou, Wuxi, Chuzhou, and Xi'an. Chongqing can also adopt more proactive measures to leverage the enthusiasm of capital.

For example:

- Increase government industry fund in top-tier local enterprises, transitioning from being a Limited Partner (LP) to a General Partner (GP). This not only alleviates the current rigid exit and repurchase pressures faced by enterprises but also guides them to cultivate and master core digital technologies by participating in their operational decisions, accelerating the transformation process and creating the "Made in Chongqing" brand. At the same time, guide upstream and downstream enterprises in the supply chain to widely apply these technologies to promote the transformation and development of the entire value chain.

- Additionally, Chongqing could consider government-led investments, in collaboration with social capital through guiding or industry funds, to establish a batch of digital innovation centers or service platforms targeting key industrial sectors. Combined with more equitable and inclusive financial and industrial policies, this would encourage eligible manufacturing enterprises to co-create new technologies and solutions with innovation centers and support their application across the industry, gradually forming economies of scale.

These measures are not only conducive to the government's gradual exploration and creation of more industry-specific green and low-carbon development business models and policy environments but also facilitate the greater role of social capital in the venture capital field, especially in driving the formation of more long-term and patient capital, creating conditions for the green and low-carbon transformation of Chongqing's manufacturing industry.

3.2Empowering and cultivating digital talent

The specialized knowledge required for advanced digital technologies often exceeds the capabilities and resources of individual companies. Promoting open platforms, collaborative creation, and partnerships is crucial for encouraging more businesses to embrace digital transformation. Digitalization serves both as a pathway to cultivate talent and as a demand for skilled individuals. On the foundation of supporting the development of these multi-party

ecosystems, Chongqing should also place emphasis on attracting and developing digital talent. Particularly, given the significant proportion of SMEs in Chongqing, for those lacking investment or capacity to develop internal technologies, government-led cultivation and expansion of a digital workforce at various levels is essential. This effort empowers and prepares the industry for high-quality development and is a guarantee for the successful adaptation and utilization of new technologies by Chongqing's manufacturing enterprises.

- The digital transformation of industrial operations involves combining industry-specific expertise with digital technology. This process requires a versatile workforce that is not only willing to engage in manufacturing but also dares to innovate. The shift towards digitalization is profoundly altering the job market in manufacturing, and governments need to take further measures to attract and cluster digital talent. Additionally, governments and educational institutions have a responsibility to forge new paths for talent cultivation locally, investing in high-quality education and training programs to increase the effective supply of digital professionals.

- Furthermore, companies play a central role in implementing technology and nurturing talent. Collaborations between schools and businesses, in other words, integration of industry and education, are effective avenues in this process. For manufacturing enterprises undergoing transformation, efforts should focus on continuous improvement plans, with the workforce always at the heart of the transition. For instance, employing lean production techniques helps ensure that frontline operators drive operational performance improvements. Empowering workers with a sense of responsibility for product quality and consulting them on production process strategies can create a more versatile and self-sufficent workforce. Brief meetings and other shop floor processes allow team members to regularly share performance data during shifts, helping to identify opportunities and take actions for more efficient process operations. Therefore, Chongqing can guide colleges and vocational schools to cooperate with local manufacturing enterprises to establish talent cultivation bases. Jointly developing industry-relevant curricula, setting up laboratories, encouraging collaborative research and development, and facilitating technology transfer can provide practical scenarios. This approach fosters deep integration between education and industry, empowering the development of applied talents.

4. Conclusion

With multi-faceted approach thus forms Chongqing's comprehensive strategy to enhance the application of digital technologies. This strategy aims to accelerate the development of a modern, digital, smart, and green manufacturing system through policy optimization, technological innovation, capital support, and talent development, reflecting a new type of productive force. Schneider Electric stays enthused to share our technology and experience with Chongqing, helping to boost the city's manufacturing sector, drive high-quality industrial growth, and support urban sustainability.

Shaping the Future of Manufacturing with AI

Microsoft

Proposal to the 18th Chongqing Mayor's International Economic Advisory Council Meeting (CMIA)

In recent years, large language models and generative artificial intelligence (AI) have sparked a wave of innovation. AI has demonstrated capabilities that rival or even surpass human abilities. As AI moves from the lab to real-world applications, it is becoming more accessible to everyone, driving transformation and upgrades in manufacturing and across various industries.

According to an IDC report, 71% of enterprises and organizations worldwide interviewed are currently using AI tools, with another 22% planning to adopt AI technology within the next 12 months. For every dollar invested in AI technology, companies see an average return of $3.50, with an average payback period of 14 months. This investment effectively helps businesses and organizations unlock potential, improve efficiency, optimize workflows, and strengthen their capacity for innovation.

- **High-End, Intelligent Manufacturing:** Sectors such as electric vehicles and robotics, and smart devices like AI-driven PCs, smartphones, and mixed-reality headsets are set to reshape competitive landscapes and give rise to new market leaders.

- **Modern Productive Services:** This sector plays a pivotal role in supporting and optimizing the production activities of diverse market entities. A growing number of companies within the sector are integrating AI technology into their product strategies and production processes. By doing so, they can more efficiently and precisely respond to the evolving needs of manufacturing clients, offering solutions in areas such as demand forecasting, route optimization, and risk mitigation.

- **Finance:** The financial sector, which often involves extensive data analysis and reporting for market forecasts, risk assessments, financial statements, and investment advice, can greatly benefit from AI. AI enables analysts to automatically generate high-quality data analyses and reports, thereby increasing decision-making speed and accuracy.

- **Healthcare:** AI revolutionizes and improves the medical record process, saving doctors valuable time recording and analyzing patient conditions. In pharmaceutical research, AI

adds value to critical processes such as target identification, molecular simulation, property prediction, drug design, compound ranking, and synthesis pathway generation.

According to a survey of Microsoft Copilot users, 70% reported increased work efficiency, 68% noted an improvement in work quality, and 77% admitted they could not stop using Copilot once they tried it.

Beyond improving processes and efficiency, AI is impacting creativity. By automating routine tasks, AI allows researchers, product designers, and innovators to focus on the most valuable aspects of their work, significantly shortening the lifecycle from idea to final product. This boosts creative efficiency, inspires new forms of creative expression, and opens even broader future possibilities.

Microsoft's Latest AI Advances

Microsoft's mission is to "empower every person and every organization on the planet to achieve more." We are driving digital transformation and intelligent upgrades for businesses and organizations with our cutting-edge Azure Intelligent Cloud platform and Copilot. Microsoft is advancing AI adoption through three key efforts:

- **Empowering Core Products with Copilot:** We are integrating AI capabilities into Microsoft's core products through Copilot. This includes everything from the new Bing and Edge browser to Microsoft 365, Windows, Power BI, Microsoft Fabric, Dynamics 365, and Microsoft Security, empowering users across the board.

- **Expanding AI Capabilities with Copilot Stack:** The Copilot Stack extends the full stack capabilities of Copilot to customers, partners, and developers across entire industries. This end-to-end intelligent Copilot technology stack offers foundational AI infrastructure, core models, orchestration layers, and Copilot functionalities and plugins for enterprise applications. With Copilot Stack, enterprise customers and developers can create their own Copilots more easily, efficiently, and securely, leveraging their private data and customer relationships to quickly adopt and deploy AI capabilities, thereby enhancing operational efficiency.

- **Introducing the AI PC:** We have launched a new type of AI PC, moving beyond the traditional view of AI as an application, tool, or service. Instead, we integrate AI at the core, combining software and hardware resources to create a new kind of PC centered around AI.

At this year's Microsoft Build 2024 conference in May, we showcased over 50 AI features, many of which garnered significant industry attention. Microsoft has also forged deep partnerships with leading companies in manufacturing, productive services, and other sectors to apply and deploy AI technologies. For example, we partnered and collaborated with:

- **Audi:** We introduced Azure AI services, integrating the AI copilot into approximately 2 million vehicles.
- **NIO:** Through Microsoft Azure OpenAI, we infused the powerful intelligence of GPT into NIO's smart interaction system, NOMI, enabling it to handle more complex queries and offer a more personalized and intuitive user experience for NIO owners.
- **Bosch:** We leveraged generative AI to enhance vehicle convenience and travel safety, pushing the limits of autonomous driving training systems. Bosch and Microsoft co-developed a universal software platform to seamlessly connect vehicles with the cloud.
- **Joyson Electronics:** We enabled large-scale deployment of Microsoft Copilot services, empowering the company to tap into global business opportunities, improve efficiency, understand diverse demands and regional market differences, and accelerate technological integration.
- **EcarX:** We integrated Microsoft Azure OpenAI services and Azure cloud computing into EcarX solutions; co-developing and deploying innovative products and solutions, and seamlessly integrating cutting-edge large language models into an increasing number of vehicles worldwide.
- **Lenovo:** We co-developed an intelligent sales system, an upgrade of their global sales system that involved streamlining redundant business processes, strengthening team collaboration, and sharing data, effectively reducing costs and enhancing overall performance.
- **McDonald's China:** We explored next-generation intelligent technologies to empower employees, optimize processes, improve efficiency, and prompt continuous learning, setting new standards for digital transformation and intelligent innovation of the restaurant and retail industry.
- **OPPO.** We helped OPPO's new AI smartphones achieve more advanced and natural human-computer interaction leveraging Azure AI's powerful text-to-speech capabilities.

The world has entered a new AI+ era, where the speed of exploration, discovery, and innovation is accelerating across both the information technology industry and traditional manufacturing sectors.

Microsoft's Recommendations for Chongqing's AI-Driven Future

Looking ahead, Microsoft identifies three key areas of AI exploration and innovation:

- **AI for Science:** Using AI to advance scientific progress. As a reasoning engine, AI can assist

researchers in understanding vast amounts of data and eliminating many erroneous options in a short time. For example, with AI's help, Microsoft and its partners discovered a new material from 32 million candidates that significantly reduces lithium metal usage in batteries, in just 80 hours. Without AI, this work would have taken at least 20 years. AI is proving to be a crucial tool in accelerating scientific progress, from discovering new materials to speeding up research and development in fields such as chemistry and biomedicine.

- **Cognitive AI:** Enhancing AI's ability to assist humans with more complex and intelligent tasks, and even enabling collaboration between multiple AI agents to continually improve functionality and productivity. This means AI will become more sophisticated, handling more complex tasks and boosting human productivity.

- **Embodied AI:** Expanding AI's understanding and impact on the physical world, making the world a prompt for AI to drive interactions with physical hardware such as autonomous vehicles, robots, and mixed reality devices.

Chongqing has built a solid industrial foundation since the reform and opening up, becoming a leader in automotive production and the world's largest producer of laptops. Today, the city is focused on building a modern manufacturing hub centered around three leading trillion-dollar industries: smart connected new energy vehicles, next-generation electronic information manufacturing, and advanced materials. Chongqing is also pushing for AI technology innovation and manufacturing upgrades with new policies and initiatives such as:

- "Chongqing Action Plan for High-Quality Development of AI Industry Driven by Scenarios (2023-2025)," which outlines goals for smart manufacturing upgrades, key industry applications, major projects, and future scenarios like digital twin factories and AI-powered digital avatars.

- "Action Plan for High-Quality Development of Chongqing Manufacturing Industry in the New Era (2023-2027)," which aims to build a "33618" modern manufacturing cluster.

- "Implementation Plan for Promoting Large-Scale Equipment Updates and Technological Transformation in the Industrial Sector," which targets creating 400 digital workshops and 40 smart factories by 2027.

According to a recent Deloitte report, AI adoption in vertical industries will be led by companies ranging from startups to tech giants, with the electronics, automotive, and energy sectors seeing the biggest market size and growth. Based on these insights, Microsoft's recommendations for Chongqing are:

- **Policy and Research Support:** Develop policies to incentivize local universities, academic organizations, and research institutions to invest in "AI for Science." This includes exploring cutting-edge technologies that improve public welfare and address uncharted areas. A new paradigm for scientific exploration, "AI for Science" merges AI with computer science to deepen our understanding of the physical world, with the potential to revise existing physical laws, uncover new scientific principles, and create a self-sustaining cycle of scientific discovery and validation. The real-world impact of "AI for Science" is already clear. For example, there are an estimated 10^60 small molecule drug candidates and around 10^180 stable materials (approximately the square of the number of atoms in the known universe). More effective exploration of these vast spaces could lead to new discoveries such as better drugs, new battery materials, and new fuel cell electrodes for the hydrogen economy.

- **Support for Global Reach:** Provide robust support to empower local enterprises to seize AI-related opportunities and expand their global reach. Transitioning from a local to a global company involves overcoming challenges such as adapting to different service and product standards, understanding international users and their preferences, navigating regulations, and managing global after-sales systems. Companies must also integrate with local applications, deal with various financial and tax systems, address infrastructure needs in emerging markets, and handle complex global supply chains. This transition requires multilingual and multicultural collaboration, and the ability to manage massive amounts of data. As AI capabilities continue to evolve, a new ecosystem is emerging that helps enterprises accelerate their global growth. Microsoft offers comprehensive solutions that enable businesses to expand quickly in new markets. With Copilot, we support local partners in unlocking inherent cultural, linguistic, and localization barriers while boosting their professional standards, regulatory compliance, and operational efficiency for smooth and cost-effective cross-border expansion.

- **Cultivating Talent:** Foster a new generation of talent with the skills to thrive in the AI era. During our exploration of "AI for Science," Microsoft found professionals from various disciplines often lack understanding of AI, while AI experts may lack domain-specific knowledge. "AI for Science" is an interdisciplinary field that requires strong digital skills and literacy, and an enthusiasm for cross-disciplinary collaboration and exploration. Chongqing should encourage research organizations to adopt AI technology and focus on talent development. These organizations can offer relevant courses, organize training, and invite experts to serve as mentors, as well as provide the necessary computing power, software tools, and datasets to help researchers better master and apply AI technologies. Promoting cooperation and exchange between research institutions and leading industry enterprises will foster knowledge sharing and innovation, accelerating the widespread application of AI technology.

- **Promoting Green Development:** Drive the green transformation of the manufacturing sector by driving innovation at the intersection of technology, policy, humanities, law, and ethical oversight. Encourage industry participants to recognize the business value and growth potential created by sustainable practices. For example, global investments in energy efficiency technologies are expected to reach $60 billion by 2028, and strong actions to combat climate change could bring at least $26 trillion in economic benefits by 2030. Microsoft continues to invest in companies, funds, and projects committed to carbon neutrality, using advanced AI technologies to reduce carbon emissions and eliminate carbon footprints. We are eager to partner with local manufacturers in Chongqing and others to help achieve a sustainable future.

Today, Microsoft is investing greater resources in promoting AI innovation globally, strengthening cooperation with regional and industrial partners to build a low-carbon, productive, and sustainable future and address shared challenges.

Propel advancement through innovation productivity and collaborate for a healthy future

Merck

1. Abstract

Amid the accelerating pace of global economic transformation and technological advancement, new quality productivity has emerged as a key driver of industrial upgrades and regional economic growth. Chongqing, a pivotal economic center in Western China, is actively aligning with national development strategies, dedicating itself to advancing the high-quality development of its manufacturing sector. This is particularly evident in the establishment of modern manufacturing clusters and the pursuit of intelligent transformation. As a global leader in biomedical innovation, MSD China is committed to improving global health through innovative medicines and vaccines.

This report presents comprehensive and insightful recommendations to the Chongqing Municipal Government on fostering modern manufacturing clusters, intelligent advancements, and specifically, within the biomedical sector, emphasizing rare disease treatments, women's health, and screening & assistance programs for low-income women, all from the lens of new quality productivity.

2. Recommendations for Modern Manufacturing Cluster Development

2.1 Enhancing the Clustered Layout of the Biomedical Industry

Chongqing has demonstrated promising progress in biomedical development, yet further clustering is essential to amplify scale and synergy effects. MSD China proposes:

- Establishing a Biomedical Innovation Hub: Drawing inspiration from Boston's Biotech Cluster, Chongqing can capitalize on the research strengths of Chongqing University and Southwest University to create the "Chongqing Biomedical Innovation Valley," attracting both domestic and international biopharma enterprises to form a deeply integrated innovation ecosystem.
- Completing the Industrial Chain: Strengthen crucial links such as raw materials, formulations, and medical devices, fostering tight collaboration between upstream and downstream enterprises to ensure a seamless supply chain. Learning from Novo Nordisk's insulin production model in Denmark could optimize supply chain management.

- Promoting Cross-industry Integration: Encourage deep integration between biomedicine, smart equipment, electronics, and big data to enhance drug R&D, production, and distribution efficiencies through cutting-edge technologies. AI-driven drug screening and optimization can significantly reduce development cycles and costs.

2.2 Prioritizing Rare Disease Treatment

Rare disease treatment is a frontier in biomedicine and a critical indicator of national innovation capabilities. MSD China recommends Chongqing prioritize this area by:

- Establishing a Rare Disease Research Center: Modeled after the NIH's Rare Diseases Program, Chongqing should integrate global experts to conduct foundational and clinical research.
- Encouraging Innovative Drug R&D: Provide special funding and incentivize partnerships between enterprises and research institutions to expedite drug development. With over 300 million rare disease patients worldwide and less than 5% having effective treatments, this sector offers immense potential.
- Improving Healthcare Access: Advocate for the inclusion of rare disease drugs in national health insurance to alleviate patients' financial burdens and encourage commercial insurers to develop dedicated insurance products.

3. Recommendations for Intelligent Development

3.1 Advancing Smart Manufacturing and Digital Transformation

Smart manufacturing is vital for enhancing competitiveness. MSD China advises Chongqing to:

- Adopt Advanced Manufacturing Technologies: Encourage the implementation of continuous and smart manufacturing for heightened efficiency and quality.
- Establish Digital Management Platforms: Utilize big data and cloud computing to develop a comprehensive digital platform encompassing R&D, production, and sales. Analyze data to optimize processes and cut costs.
- Promote IT Applications in Biomedicine: Develop biomedical big data platforms, telemedicine services, and convenient online medical insurance services to elevate the industry's informatization level, akin to Mayo Clinic's model.
- Strengthen Cybersecurity and Data Protection: Establish robust information security systems to protect corporate data.

3.2 Enhancing Smart Logistics Systems

Smart logistics ensures stable biomedical supply chains. MSD China suggests:

- Building Intelligent Warehousing and Distribution Networks: Utilize IoT and RFID for automated warehouse management and efficient delivery networks, ensuring product safety and traceability.
- Optimizing Cold Chain Logistics: Establish rigorous cold chain systems for temperature-sensitive products to maintain quality during transport.
- Enhancing Supply Chain Collaboration: Facilitate information sharing and coordination to improve response times and flexibility.

4. Focus on Women's Health

On March 27th of this year, during a meeting with representatives from the American business community and strategic academia, General Secretary Xi Jinping emphasized the importance of Sino-US relations as a history of friendly exchanges written by the people. As this year marks the 45th anniversary of diplomatic relations between China and the United States, it is hoped that people from all sectors in both countries will strengthen communication and deepen practical cooperation. On the same day, Huang Xiaowei, Vice President of the All-China Women's Federation, met with the President of the US-China Business Council in Beijing. She highlighted women's health as a crucial aspect of public health and expressed anticipation for further exchanges and cooperation between China and the United States on free screening and assistance for cervical and breast cancer among low-income women. In this context, MSD proposes that Chongqing, while promoting the development of its biomedical industry, should prioritize women's health:

4.1 Strengthening Free Screening Mechanisms for Cervical and Breast Cancer Among Low-Income Women

- Establish Special Screening Funds: The government should create special funds for cervical and breast cancer screening among low-income women, ensuring adequate and sustainable funding. Funds should be sourced through multiple channels, including government subsidies and social donations, to provide free screening services.
- Expand Screening Coverage: Strengthen collaboration with grassroots medical institutions to extend screening services to communities and villages, ensuring all eligible low-income women can access these services. Utilize big data platforms to precisely identify target populations and improve screening efficiency.
- Enhance Screening Technology: Introduce advanced screening technologies and equipment, such as Liquid-Based Cytology Test (TCT) and Human Papillomavirus (HPV) testing, to

improve screening accuracy and sensitivity. Simultaneously, strengthen professional training and qualification certification for screening personnel to ensure high-quality screening.

4.2 Improving Assistance Systems for Cervical and Breast Cancer Among Low-Income Women

- Establish Green Channels for Assistance: For suspected or confirmed cases identified through screening, establish rapid referral and diagnosis mechanisms to ensure prompt further diagnosis and treatment. Provide medical assistance and rehabilitation guidance to confirmed low-income women to alleviate their financial burden.
- Launch Social Fundraising and Charitable Activities: Encourage all sectors to participate in health assistance efforts for low-income women, raising funds and materials through fundraising, free clinics, and other forms to provide greater support.
- Promote Insurance Mechanism Innovation: Explore partnerships with insurance companies to develop specialized health insurance products for low-income women, covering major diseases such as cervical and breast cancer. Simultaneously, advocate for the inclusion of related diseases in the medical insurance catalog to enhance the medical security of low-income women.

4.3 Strengthening Health Education and Promotion

- Conduct Health Education Activities: Regularly organize health education lectures and promotional activities targeting low-income women to raise awareness and understanding of cervical and breast cancer prevention and treatment, enhancing their health consciousness and self-protection abilities.
- Utilize New Media Platforms: Publish health information and screening assistance details through new media platforms like WeChat and Weibo to expand the reach and impact of promotional efforts. Establish an online consultation service platform to provide convenient health consultation services for women.

5. Conclusion and Outlook

In conclusion, from the perspective of the biomedical industry, MSD has provided comprehensive and insightful recommendations to the Chongqing Municipal Government on fostering modern manufacturing clusters, intelligent development, and prioritizing health screening and assistance for low-income women. We are confident that under the strong leadership of the Chongqing Municipal Government and with the collaborative efforts of all sectors, Chongqing's biomedical industry will embark on a brighter future, and the health security of low-income women will significantly improve. We eagerly anticipate partnering with the Chongqing Municipal Government and stakeholders from all sectors to contribute further to the advancement of global health.

Analysis Report on Green Development of the Pharmaceutical Industry

AstraZeneca

In light of the goal and current status of global carbon neutrality, as well as China's commitments and practices in this area, this report analyzes AstraZeneca's green actions as a case study. It thoroughly examines how the pharmaceutical industry can respond to and achieve both China's commitments and the global goal of carbon neutrality, and provides recommendations for advancing the green development of the pharmaceutical industry in Chongqing.

I. Goal and current status of global carbon neutrality

The goal of global carbon neutrality is to achieve net-zero greenhouse gas (GHG) emissions by reducing and offsetting emissions, thereby mitigating the impacts of climate change and global warming. Major economies in the world, represented by the European Union, the United States, and the United Kingdom, attach great importance to the overarching design of carbon neutrality. Given their respective stage of economic development, resource endowments, and technological and industrial foundations, they have developed systematic carbon neutrality policy frameworks that address goal setting, key sectors for emission reduction, technological innovation, and policy incentives.

(I) Goal of global carbon neutrality

- ***European Union.*** In December 2019, the European Commission formally proposed the European Green Deal, which aims to make Europe the world's first carbon-neutral continent by 2050 through the transition to clean energy and a circular economy, as part of efforts to halt climate change and promote the stable and sustainable development of the European economy. This is also the first time that the EU has clearly placed sustainable goals at the core of all decision-making.

- ***United States.*** In February 2021, the United States rejoined the Paris Agreement, and set a plan for net-zero emissions by 2050. This move signals that the US will also roll out a package of measures to reduce GHG emissions and accelerate the transition to clean energy.

- ***Other countries.*** Countries such as the United Kingdom, Sweden, Japan, and Canada have also established carbon neutrality goals, committing to achieve net-zero emissions in the coming decades. A series of policies and measures have already been adopted to achieve these goals.

(II) Current status of global carbon neutrality.

- ***Renewable energy technologies.*** More than 100 countries worldwide have developed renewable energy targets and supporting policies to reduce dependence on fossil fuels by promoting the use of renewable energies such as wind power and solar energy, thus lowering GHG emissions.

- ***Carbon capture,*** utilization, and storage (CCUS). CCUS, an emerging technology with the potential for large-scale CO2 emission reduction, involves processes such as the capture and transportation of CO2, and the reuse or safe storage of captured CO2. The US, EU, Japan, Germany, and other developed countries have introduced policies and measures to facilitate the commercial application of CCUS.

- ***Carbon sink construction.*** This involves forestry initiatives such as afforestation, reforestation, forest management, and reduced deforestation to absorb CO2. An increasing number of countries are quantifying forest targets and strengthening the construction of forest carbon sinks.

These specific targets are designed to address climate change, reduce GHG emissions, and achieve global carbon neutrality.

II. China's commitments and practices of carbon neutrality

Climate change is a common challenge for all mankind. China, a key participant, contributor, and leader in global ecological progress, has always placed a high regard for coping with climate change, steadfastly pursuing a path of ecological priority and green development. China has set the goals for reaching peak carbon dioxide emissions and achieving carbon neutrality, and has implemented a slew of measures to achieve these goals. At the general debate of the 75th Session of the United Nations General Assembly in September 2020, General Secretary Xi Jinping announced that China would scale up its Nationally Determined Contributions (NDCs) by adopting more vigorous policies and measures, strive to peak CO2 emissions before 2030, and achieve carbon neutrality before 2060.

Current practices of carbon neutrality in China include:

- ***Policy support.*** China has put in place the "1+N" policy framework for carbon dioxide peaking and carbon neutrality. "1" consists of two documents: Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy issued by the Communist Party of China Central Committee and the State Council and Action Plan for Carbon Dioxide Peaking Before 2030. "N" refers to implementation plans for key areas and industries and the related supporting guarantee plans.

- ***Technological innovation.*** At present, China's wind power and photovoltaic (PV) industries

have substantially enhanced their global competitiveness. The global market share of key components such as PV modules, wind-driven generators, and gearboxes account for over 70%, contributing positively to the global green energy transformation. To further support the realization of dual carbon goals, the Ministry of Science and Technology and eight relevant departments, jointly issued the Implementation Plan for Science and Technology Support for Carbon Dioxide Peaking and Carbon Neutrality (2022-2030), which puts forward sci-tech innovation actions and guarantee measures to support the realization of carbon dioxide peaking goal before 2030 and prepares technology R&D reserves for the realization of carbon neutrality goal before 2060.

- ***International cooperation.*** China has actively participated in international cooperation to combat climate change by sharing experiences and technologies related to carbon dioxide peaking and carbon neutrality with other countries and intensifying efforts to work with other countries in reducing global GHG emissions.

Overall, China has clearly defined its commitments to achieving carbon neutrality by 2060 and has adopted multiple policies and technological measures to achieve this goal. Carbon neutrality progress and renewable energy development, achieved by the Chinese government, will have a far-reaching impact on the global response to climate change.

III. Pharmaceutical industry and carbon neutrality

Climate change increases the risk of disease incidence, posing challenges to the capacity of the healthcare system to respond. The World Health Organization (WHO) considers it one of the most pressing global public health issues. Climate change, environmental pollution, and ecosystem degradation affect human health, including altering the transmission pattern and scope of infectious diseases, increasing incidences of non-infectious diseases such as heart disorder, apoplexy, lung cancer, and respiratory disorder, and raising disease risks for the elderly, children, and other vulnerable groups. Furthermore, it exacerbates medical inequalities in less developed countries or regions and weakens the capacity of the global health system to respond. On many occasions, the WHO has emphasized the relationship between climate change and health and has called for countries to take active actions in response to climate change to maintain global health and sustainable development. In addition, the healthcare sector is a significant source of global GHG emissions. Currently, the healthcare system generate approximately 2.4 billion tons of carbon dioxide globally, making up 4% to 5% of global GHG emissions, which come from all parts of the entire supply chain of the medical industry. To be specific, over 50% of these emissions are from supply chain, including the use of energy and heat in the manufacturing process of the pharmaceutical industry, production of chemical raw materials, agricultural product planting, and logistics; about 35% are from healthcare services, including energy consumption for the operation of buildings in hospitals and other medical institutions, transportation, and anesthesia gases; around 5% are from R&D; and approximately 10% are from patients, mainly including the use of products

by patients (e.g., propellants containing GHGs) and travel during the diagnosis and treatment process. Therefore, active climate action is crucial for improving health outcomes and enhancing the resilience of the healthcare system. All stakeholders in the healthcare system should join hands to promote the green transformation of the entire medical system.

It is clear that the pharmaceutical industry plays a vital role in carbon neutrality and proactive efforts should be made to reduce GHG emissions generated in its manufacturing process, supply chain, and product use.

- ***Energy utilization.*** Pharmaceutical companies can reduce energy consumption in their manufacturing process, use clean energy, and the efficiency of energy utilization efficiency to reduce GHG emissions.

- ***Manufacturing process innovation.*** By means of technological innovation and manufacturing process improvement, pharmaceutical companies can reduce their dependence on fossil fuels to lower GHG emissions.

- ***Supply chain management.*** Pharmaceutical companies can team up with supply chain partners to jointly reduce GHG emissions during transportation and logistics.

- ***Renewable energy.*** Renewable energies (e.g., solar energy, wind power, and renewable gas) can be used to supply some of the electricity and heat required for manufacturing.

- ***Carbon offsetting.*** Pharmaceutical companies can also offset their unavoidable GHG emissions by supporting carbon offsetting projects.

In terms of carbon neutrality, the impact of the pharmaceutical industry on climate change can be mitigated by increasing the proportion of clean energy, improving the efficiency of energy utilization , and supporting carbon offsetting projects. Such efforts will help the pharmaceutical industry contribute to sustainable development and make positive contributions to the goal of global carbon neutrality.

IV. AstraZeneca's green actions working towards carbon neutrality

As a global leading multinational biopharmaceutical company, AstraZeneca has always actively practiced corporate social responsibility with a firm commitment to sustainable development. AstraZeneca continues to advance the healthy development of people, society, and the planet from three aspects: environmental protection, access to healthcare, and giving back to society.

Regarding environmental protection, AstraZeneca has comprehensively mapped out and implemented in-depth decarbonization initiatives, with the "Ambition Zero Carbon" strategy raised in 2020, to align with the Paris Agreement's goal of limiting global warming to 1.5℃ The "Ambition

Zero Carbon" strategy aims to achieve net-zero GHG emissions by maximizing energy efficiency, using renewable energy, and investing in nature-based solutions. Guided by a science-based principle, this strategy features a GHG emission reduction roadmap, with the goal of reducing Scope 1 and 2 GHG emissions by 98% by 2026 from the 2015 baseline, halving Scope 3 GHG emissions from the 2019 baseline and becoming carbon negative by 2030, and reaching net-zero targets by 2045. In October 2021, AstraZeneca was one of the world's first seven companies to have net-zero targets certified by the Science Based Targets Initiative (SBTi).

AstraZeneca has been practicing the "Ambition Zero Carbon" strategy in China, actively promoting the implementation of sustainable development concepts in the country. Since entering China in 1993, AstraZeneca has always adhered to its original intention of being "patient-centric" and has been committed to becoming a trusted medical partner in China for over 30 years. After China proposed the "dual carbon" goals, AstraZeneca responded positively by taking a series of measures to promote energy saving and emission reduction, actively contributing to the decarbonization of the healthcare industry and integrating the concept of sustainable development throughout the entire value chain. As of 2023, we reduced GHG emissions from our own operations in China by over 70% from the 2015 baseline.

In China, AstraZeneca focuses on green manufacturing, green operations, green R&D, digital transformation, and green supply chain, thereby setting a benchmark for green development in multiple dimensions. Additionally, AstraZeneca China also works together with partners to promote the construction of a sustainable healthcare service system and is committed to jointly contributing to the net-zero and sustainable development of the pharmaceutical and medical industry. This year, AstraZeneca announced the upcoming "AZ Forest Initiative" to China, with $50 million to be invested in afforestation in China.

1. Green manufacturing

AstraZeneca is dedicated to transforming its three manufacturing and supply facilities in China into green and low-carbon facilities, with a plan to reduce GHG emissions from its operations by 98% by 2026 from the 2015 baseline.

The Wuxi supply facility has continuously advanced its transformation into a green facility, and vigorously pushed ahead with energy-saving renovation projects and the use of clean energy, aiming to achieve zero-carbon operations across multiple fields by 2026 and become the largest green facility with the widest product range in AstraZeneca's operations in the Asia-Pacific region. Currently, the Wuxi supply facility operates using 100% green electricity, with its GHG emissions in 2023 reduced by 55% from the 2015 baseline. In 2024, AstraZeneca entered into a ten-year renewable energy contract with China Resources Gas. The latter will cooperate with Everbright Environment in an innovative manner to provide biomethane and biomethane-based steam to the

Wuxi supply facility, facilitating green heating in the Wuxi manufacturing and supply facility. This project is expected to contribute to an up to 80% reduction of Scope 1 and 2 GHG emissions for AstraZeneca China.

Thoroughly putting the concept of green development into practice, the Taizhou supply facility has vigorously advanced various energy-saving renovation projects, undertaken energy-saving measures, installed solar photovoltaics, and purchased green electricity and green heat energy in response to the Green Lab Initiative. Currently, the Taizhou supply facility operates using 100% green electricity. In 2023, GHG emissions decreased by 96% and water consumption by 51% from the 2015 baseline.

The Qingdao supply facility has been designed and constructed with a commitment to sustainable development by adopting a range of internationally leading sustainable technology measures to reduce GHG emissions and conserve energy and water resources, and develop into a world-leading eco-friendly facility. Both the administration building and cafeteria has been designed and constructed in line with LEED Gold standards.

2. Green operations

In 2023, AstraZeneca established the customer-side energy management (CSEM) system and GHG emissions management platform for its commercial buildings. In 2024, the platform will further enhance the granularity of data management to strengthen and optimize GHG emissions management, thereby creating a green and smart park. AstraZeneca China's headquarters in Zhangjiang, Shanghai, operate using 100% green electricity through the installation of solar photovoltaics, energy storage systems, and direct green electricity procurement. In 2023, the Zhangjiang office area achieved a 93% reduction in GHG emissions and a 59% reduction in water consumption from the 2015 baseline. AstraZeneca China has continuously optimized its employee travel policy by encouraging the use of high-speed rail over air travel. In 2023, GHG emissions from employee travel were reduced by 78% from the 2015 baseline, which is equivalent to the amount of carbon dioxide absorbed by 2 million trees annually in comparison with that in 2019. The park has also continued to upgrade parking spaces for new energy vehicles to encourage employees to use new energy vehicles. By the end of 2023, over half of the parking spaces in the Zhangjiang park were designated for new energy vehicles. In addition, the Shanghai Zhangjiang park and each regional headquarters have collaborated on various initiatives such as energy saving and carbon reduction, reduction of disposable items, and garbage classification through Environmental Public Welfare Week, in an effort to integrate green concepts into employees' daily work and lives.

3. Green R&D

As an innovation-driven global biopharmaceutical company, AstraZeneca has incorporated its "Ambition Zero Carbon" throughout the entire business process from "laboratories to patients".

In its R&D efforts, AstraZeneca has actively explored paperless, online, and digital solutions to promote low-carbon laboratory operations. In 2023, the use of electronic submissions for drug applications resulted in a reduction of A4 paper use by 1.575 million sheets. Electronic Clinical Outcome Assessment (eCOA) was adopted for 100% of clinical projects with demand, and 98% of Trial Master Files (TMFs) were transitioned to electronic formats, significantly reducing paper consumption in the drug R&D process. Moreover, remote monitoring was conducted at eight study sites, and 60% of R&D meetings were held online, leading to a reduction in employee travel. Energy-saving initiatives have been introduced to lower operational energy consumption in laboratories, along with the rational allocation and optimization of experimental samples and reagents to minimize laboratory waste.

4. Digital transformation

AstraZeneca China has actively promoted online activities and knowledge dissemination to reduce GHG emissions from offline activities or meetings. AstraZeneca's digital marketing team has developed a suite of digital tools, including online meetings and e-learning, tailored to the clinical and academic needs of physicians. These tools are widely used to enhance the efficiency, convenience, reach, and environmental friendliness of physician education and academic exchanges. In 2023, 50% of meetings were held digitally, engaging over 1.6 million participants. Additionally, in 2023, the retail team delivered online academic training to more than 4,000 retail staff across 22 provinces nationwide. Meanwhile, the county team provided online academic exchanges for over 55,000 participants in county hospitals across 25 provinces nationwide. These efforts strengthened the communication with primary hospitals and enhanced the medical education for retail pharmacy staff.

5. Role model of industry cooperation

The Sustainable Markets Initiative (SMI), which was launched by His Majesty King Charles III, then the Prince of the United Kingdom, aims to unite all parties to jointly address climate change, protect biodiversity, and promote global sustainable development. Pascal Soriot, Global CEO of AstraZeneca, serves as Chair of the Health Systems Task Force of SMI's Global Council. This Task Force is dedicated to accelerating net-zero transition and build a sustainable healthcare system worldwide. AstraZeneca China has actively supported the preparation and establishment of the Health Working Group of SMI's China Council, and serves as a "co-chair" of the Working Group, which aims to accelerate the sustainable development of China's healthcare system and to exert a broader global impact. During the World Economic Forum in January 2024, AstraZeneca, in collaboration with four other multinational pharmaceutical companies - Lonza, Novartis, Novo Nordisk and Roche, entered into the industry's first multiparty renewable energy agreement with Envision Energy. This partnership aims to decarbonize electricity in their operations in China.

In May 2024, under the leadership of the China Chamber of International Commerce and with the active promotion of AstraZeneca, SMI's China Council successfully held a plenary meeting of the Health Systems Task Force and launched the Initiative on Green Energy Transformation of Pharmaceutical and Medical Industry Chain in Wuxi. AstraZeneca, together with 12 member companies and green energy partners, actively responds to this initiative by continuously accelerating the use of green energy and driving green upgrades in the supply chain, thereby demonstrating its leadership and firm commitment to green development and medical innovation. AstraZeneca will continue to leverage the SMI platform to promote collective actions and practical cooperation among companies in the pharmaceutical and medical industry chain in the areas of green supply chains, green diagnosis and treatment services, and green international trade.

6. Green supply chain

In addition to actively managing its own GHG emissions, AstraZeneca has also used its influence in the value chain to actively drive decarbonization efforts both upstream and downstream, achieving practical results. Given that Scope 3 (value chain) GHG emissions account for over 95% of total GHG emissions, in 2023, AstraZeneca China promoted the completion of the Carbon Disclosure Project (CDP) questionnaire, the participation in ESG assessment (EcoVadis), and the commitment to SBTi by more than 50 local suppliers through its "Sustainable Procurement Project". In 2024, AstraZeneca plans to further expand the coverage of the "Sustainable Procurement Project" among local suppliers to speed up the green transformation of the industry.

Having entered China for more than 30 years, AstraZeneca has always adhered to its original intention of being "patient-centric", continuously leveraged its advantages, actively promoted multi-party cooperation across countries, regions and industries, and advanced multidimensional innovative measures for green development. Looking ahead, AstraZeneca will build on its existing experience to further increase investments, accelerate innovation and transformation, and probe into its own new model of sustainable development. At the same time, AstraZeneca will continue to collaborate with partners in the pharmaceutical and medical value chain to foster a all-win green situation of China's health system and help achieve the vision of Healthy China 2030 and national "dual carbon" goals as early as possible.

In recent years, AstraZeneca has earned a number of prestigious certifications and honors in the field of climate change. AstraZeneca received double A rating from CDP in both climate change and water security categories; it was honored with the Gold Medal from EcoVadis for two consecutive years, which is only awarded to the top 5% of companies that address corporate social responsibility standards with a robust management system; it was one of the first seven companies certified by SBTi to meet its Corporate Net-Zero Standard as the first emission reduction target in the world; it was the first pharmaceutical company to sign up for all three of the Climate Group initiatives (RE100,

EV100, EP100), committing to achieving the following by 2025 globally: using 100% renewable energy for electricity, transitioning its owned fleet to battery electric vehicles, and doubling its energy efficiency from 2015; in the 2023 STAT report (pharmaceutical industry) – Climate rankings: How top drug companies measure up in combating climate change, AstraZeneca was ranked as No. 1 in terms of climate actions.

V. Several recommendations for promoting the green development of the pharmaceutical industry in Chongqing

Based on AstraZeneca's green action practice and the development of the pharmaceutical industry, the following recommendations are proposed to accelerate the green development of the pharmaceutical industry in Chongqing:

- ***Energy utilization and industry collaboration.*** Located in the upper reaches of the Yangtze River, Chongqing is abundant in water resources. Pharmaceutical companies can collaborate with local hydroelectric and other clean energy companies to jointly promote the utilization of clean energy. For instance, cooperation projects between hydropower plants and pharmaceutical manufacturers can be carried out to deliver stable and sustainable energy support for production using clean energy.

- ***Upgrading of the green industry chain.*** Chongqing is situated in the western region of China. It is recommended that, after identifying the emerging and core industrial chains, the government introduce supportive policies to facilitate the green upgrading of these chains to develop new quality productive forces, such as encouraging the construction of zero-carbon parks.

- ***Circular economy and waste disposal.*** Considering the limited resources, the government can introduce a series of policies to promote the closed-loop development of the circular economy. For example, pharmaceutical companies should be encouraged to innovate in waste disposal by promoting the utilization of waste as resources and initiating recycling projects for pharmaceutical waste to reduce negative environmental impacts.

- ***Green technology and innovation.*** As Chongqing has a certain foundation in sci-tech innovation, pharmaceutical companies can increase their investment in the R&D and application of green technologies, such as advancing the R&D and application of green solvents and the innovation of green manufacturing processes, to minimize the environmental impact in the manufacturing process. Additionally, attention should be given to applying green technologies to the supply side of healthcare services in Chongqing, such as digital innovation, electronic product information (ePI), and decarbonization in clinical trials.

- ***Green innovation and ecological cooperation.*** Both domestic and international, upstream and downstream ecological forces should be united to jointly build a modern, advantageous biopharmaceutical industry in Chongqing that meets green standards. While optimizing and upgrading traditional industries, efforts should also be made to strengthen the integrated development between emerging industries and the biopharmaceutical industry. At the same time, innovation cooperation should be strengthened in green international trade and other aspects to enhance the green standards and specifications of the whole medical industry chain in Chongqing. We also encourage companies from Chongqing to join our Working Group of SMI to plan and practice green initiatives together.

- ***Social responsibility and environmental protection.*** The government should be encouraged to integrate ecological environmental protection into the whole process of economic and social development, give full play to the guiding role in energy saving and emission reduction, and make green, low-carbon and high-quality development one of the general objectives of Chongqing's social and economic development.

To this end, the government should introduce relevant policies to effectively encourage and guide local pharmaceutical companies in Chongqing to more actively fulfill their social responsibilities and participate in local environmental protection and ecological construction projects, such as supporting ecological restoration projects. Leading companies should serve as benchmarks, give back to local communities, and be recognized for their contributions to promoting green development in Chongqing.

Chongqing can accumulate more successful experiences in driving pharmaceutical companies to participate in green transformation and contribute to the goal of global carbon neutrality through continuous innovation and cooperation, while striving to achieve sustainable development of companies, so that pharmaceutical companies will be able to play an increasingly vital role in the global carbon neutrality process and promote higher-quality economic and social development in Chongqing.

Suggestions for Chongqing to Build Modern Manufacturing Cluster

Honeywell

Chongqing is the only municipality directly under the central government in China's central and western regions and serves as one of the dual cores of the Chengdu-Chongqing Economic Circle. With a robust manufacturing base and favorable policy support amid the nation's push for the development of the Economic Circle, Chongqing is well-positioned for growth. In 2023, Chongqing introduced the '33618' initiative, a plan to establish a modern manufacturing cluster that will significantly advance the city's manufacturing sector and enhance its role in the national economy.

As a multinational enterprise with a long-standing investment in Chongqing, Honeywell is excited to contribute ideas for the city's development at the Annual Meeting of Chongqing Mayor's International Economic Advisory Council. We look forward to developing with the city and achieving mutual success.

Honeywell's business is aligned with three powerful megatrends – automation, the future of aviation and energy transition. We provide a range of technologies and services across various industries worldwide. China, as a major manufacturing hub and consumer market in the world, is crucial to our global strategy. Honeywell holds an optimistic outlook on the country and is deeply invested in the Chinese market, driving growth through local innovation. Currently, all of our business units have operations in China, with our Asia-Pacific headquarters located in Shanghai.

Honeywell provides actionable solutions and innovation through our Aerospace Technologies, Building Automation, Energy and Sustainability Solutions, and Industrial Automation business groups. Driving digital, intelligent, and green transformation of industries, our technology can help China to achieve its dual carbon goals. This aligns with the Chinese government's objectives and supports Chongqing's vision for high-quality urban development.

We have long been optimistic about Chongqing's development. As early as 2007, we established Honeywell (China) High-Tech Co. Ltd. in Chongqing, which is now one of our major global engineering service centers. The company is dedicated to providing high-quality, advanced industrial technology and engineering services to clients worldwide. For 17 years, we have consistently invested in Chongqing, contributing to projects such as the Changshou Chemical Park, the Raffles City commercial complex, and Raffles Hospital. Our efforts have made a difference to the city's digital, intelligent, and green transformation. Looking ahead, we will continue to leverage

our leading technologies in intelligent manufacturing, energy conservation, emission reduction, environmental protection, and sustainable development to enhance and upgrade Chongqing's modern manufacturing industry, supporting its high-quality growth.

We believe that developing a modern manufacturing cluster is essential to Chongqing's goal of establishing a modern industrial system. Chongqing can enhance overall planning by integrating industry, talent and institutions to drive technological innovation and industrial transformation. We offer suggestions in four areas, aiming to help Chongqing become an intelligent, green, and livable city, steering it toward high-quality development.

First, we recommend that Chongqing increase investment in technological innovation and accelerate the adoption of advanced technologies. This will drive the transformation and upgrading of Chongqing's manufacturing industry, advancing "Made in Chongqing" to "Intelligent Manufacturing in Chongqing".

Despite its significant economic scale and industrial output, there is still room for Chongqing to enhance R&D investment and the strength of high-tech enterprises. To achieve this, the city should accelerate the development of an integrated industry-university-research collaboration system and fully harness the potential of high-quality talent to drive technological innovation and industrial upgrading.

In 2022, Chongqing's R&D investment reached RMB 68.66 billion yuan, ranking ninth nationwide. By 2023, this investment rose to RMB 75 billion yuan, with an R&D intensity of 2.45%. However, Chongqing's overall technological innovation index ranked only eighth in the country, falling below its GDP ranking. To build a modern industrial system and a competitive manufacturing cluster, Chongqing must further increase investment in technological innovation, with the goal of raising R&D intensity to over 3%, the leading standard in the country.

Chongqing has long been an important industrial base in China and has recently absorbed a significant amount of industrial transfer from the nation's eastern regions, particularly in electronics, such as laptops and electronic components. However, its manufacturing sector lacks competitiveness at the higher end of the value chain. Moreover, despite substantial foreign investment, local enterprises remain relatively weak. Currently, Chongqing has only 77 listed companies in China's stock market, ranking fifteenth nationwide, and 7,565 High and New-Tech Enterprises certified by the Ministry of Science and Technology, also ranking fifteenth in the country.

Given Chongqing's current situation, it is imperative for the city to establish an innovation system that fosters collaboration among industry, universities, and research institutions. Moreover, the government should actively support local enterprises, particularly "unicorn" and "gazelle" companies, as they are the primary drivers of technological innovation. This approach could enable Chongqing to host over 100 publicly listed companies, closing the gap with other major cities along

the Yangtze River Economic Belt. As these enterprises grow and thrive, Chongqing can leverage its strengths in sectors like automotive, electronics, and equipment, evolving from a manufacturing hub into an R&D center. This transformation will optimize the city's economic structure.

In today's fast-evolving digital and intelligent landscape, Chongqing should strive to be a leader in adopting new technologies. To achieve this, the city needs to promote the digital and intelligent transformation of its manufacturing sector, integrate digital technology with the real economy, and enhance the efficiency and safety of industrial production.

Currently, the country is promoting large-scale equipment renewals. By extensively adopting intelligent production technologies and control and supervisory systems, Chongqing can enhance industrial efficiency and safety, transforming from "Made in Chongqing" to "Intelligent Manufacturing in Chongqing". We also hope to see more digital, intelligent, and safety-oriented technologies and management practices emerge from Chongqing and spread across the nation.

Honeywell offers a range of advanced automation and informatization solutions, including Intelligent Instrument Management, Quality Control Systems, Distributed Control Systems, and Intelligent Production Management Systems. These solutions have already been implemented in a number of enterprises across Chongqing. In particular, during the gas detection project at the Changshou chemical Industry Park, Honeywell employed digital and intelligent approaches to ensure the safe operation of critical infrastructure in the chemical sector.

Talent plays a crucial role in driving technological innovation. To improve Chongqing's talent pool, we suggest that the municipal government increase investment in education, particularly in vocational training related to manufacturing. Regarding training resources, education and human resources departments should work closely with businesses to strengthen the coordination between academic institutions and companies. This collaboration could involve accrediting relevant courses and credits as well as organizing vocational and technical competitions. Such initiatives would help bridge the gap between theory and practice, offer students valuable training and internship opportunities, and ultimately enhance their competitiveness in the job market.

As a global high-tech enterprise with a history spanning over a century, Honeywell has consistently valued collaboration with academic institutions around the world. We are committed to supporting talent development in Chongqing. Our efforts focus on bridging the gap between industry and education, by integrating real-world projects into training scenarios and providing teaching tools that match industrial standards. These approaches are widely appreciated by today’s academic institutions.

In China, Honeywell collaborates with over 100 undergraduate programs and vocational schools in the field of industrial internet. We train more than 4,000 students annually in areas such

as airport operation and maintenance, energy equipment cooling, urban pipeline networks, and other Internet of Things (IoT) applications. Additionally, we offer internships and practical training to over 2,000 students each year. Our training programs are tailored to specific projects, ranging from the application of artificial intelligence, low-carbon technology and intermediate technology to the development of industrial IoT and system integration.

Second, we recommend that Chongqing accelerate the development of green industries, promote energy conservation and carbon reduction, and establish Chongqing as a leading city in green transformation and development.

In August this year, the CPC Central Committee and the State Council released guidelines to accelerate the green transition across all sectors of economic and social development. The document emphasizes the need to cultivate green industries and promote the low-carbon transformation of industrial structures, as well as urban and rural development. Chongqing should seize this opportunity to become a model city in green transformation.

Expanding green and low-carbon industries and extending the green industrial chain are crucial for Chongqing's green transformation. In recent years, Chongqing's new energy vehicle (NEV) industry has experienced rapid growth, becoming a key driver of the city's green transition. In 2023, the automotive sector emerged as a major pillar of Chongqing's economy, contributing 23.8% to the city's industrial growth and achieving an output value nearing RMB 500 billion yuan. In the first half of this year, NEV production in Chongqing totaled 391,000 units, marking a 150% increase compared to the previous year. This growth significantly outpaced the national average growth rate of 30.1%, positioning Chongqing at the forefront of automobile production among the top ten provinces and cities. Companies such as Seres and Changan Automobile are leading the charge in this industry.

We suggest that Chongqing position its NEV industry as a key driver for the growth of related sectors, such as lithium batteries and smart devices. This can enhance the entire value chain of the new energy sector. Additionally, Sichuan Province, a major hub for hydropower and lithium battery production in China, naturally complements Chongqing's efforts in advancing its new energy sector. Chongqing should utilize mechanisms and platforms available through the Chengdu-Chongqing Economic Circle to strengthen collaboration with Sichuan Province. This partnership will not only benefit inland new energy industries but also foster a dynamic innovation ecosystem.

At the same time, the Chongqing municipal government should actively encourage enterprises and the public to adopt green production and sustainable lifestyles while promoting the energy-efficient transformation of various buildings, including residential areas, office buildings, and industrial parks. According to the "China Building Energy Consumption and Carbon Emission Research Report (2020-2022)" by the China Association of Building Energy Efficiency, buildings

and construction nationwide consumed 2.27 billion tons of standard coal in 2020, with carbon emissions reaching 5.08 billion tons. These figures represent 45.5% and 50.9% of the national totals, respectively. Notably, carbon emissions during the operational phase of buildings accounted for approximately 22% of the country's total emissions. A report released by the United Nations Environment Programme (UNEP) and the Global Alliance for Buildings and Construction (GlobalABC) in March 2024 highlighted that the energy demand and direct emissions from the building and construction sectors contribute to more than one-fifth of global emissions.

In this context, green buildings play a crucial role in supporting China's "dual carbon" goals and efforts to conserve energy and reduce emissions. Digitalization and intelligent technologies are essential for enhancing energy efficiency and minimizing consumption in building construction.

In this respect, Honeywell employs advanced data collection technologies, such as sensors, to improve energy management. This approach transitions from passive adjustments to proactive energy savings, shifting from continuous operation to on-demand usage. For instance, in a 30,000-square-meter office building, adopting Honeywell's solution can achieve a 16% annual energy savings, reducing electricity costs by RMB 120,000 yuan and cutting carbon emissions by 86 tons.

Honeywell's green building technologies have been successfully deployed in various locations both in China and internationally. Notable examples include the DBS Bank building in Shanghai, Honeywell's factory in Tianjin, and the Shanghai-Aiding-Tibet Apartments in Tibet. We carry out systematic renovations tailored to the characteristics of each building and its environmental conditions. This approach improves the management of the building’s energy system and external environment, effectively reducing energy consumption and achieving emission reduction targets.

In November 2023, Honeywell entered into a strategic cooperation agreement with five enterprises, including Shanghai Lujiazui Group and Waigaoqiao Group, both of which are affiliated to or controlled by the State-owned Assets Supervision and Administration Commission of Shanghai Pudong New Area. This partnership aims to leverage the strengths of each party to advance the development of green and low-carbon industries in Pudong. Honeywell has actively engaged in energy-saving renovation projects for existing buildings, such as the DBS Bank building, Senlan International Mansion, and Ascott serviced apartments. Through these initiatives, we are developing innovative low-carbon solutions and better practices for energy-efficient renovations, setting a benchmark for the industry.

In Chongqing, Honeywell's technology has played a key role in enabling efficient, energy-saving, and green operations at the Raffles commercial complex and in the energy-saving renovation project for Chongqing Gas Group. Our intelligent building solutions at Raffles have been featured in several Chinese media outlets. We are excited to see these green technologies adopted in more

buildings across Chongqing, supporting China's dual carbon goals of achieving carbon peak and carbon neutrality.

Third, we recommend that Chongqing seize the strategic opportunities presented by the building of Chengdu-Chongqing Economic Circle, the Yangtze River Economic Belt, the Belt and Road Initiative, and the New Western Land-Sea Corridor to enhance Chongqing's role as an industrial, transportation, and logistics hub.

Chongqing stands at a convergence point of major national strategies such as the Chengdu-Chongqing Economic Circle, the Yangtze River Economic Belt, and the Belt and Road Initiative. The city serves as a comprehensive transportation hub in the southwestern region, integrating air, rail, road, and water transport.

Currently, Chongqing's status as one of the "dual cores" in the transportation and logistics system of the southwestern region is not sufficiently highlighted. In 2023, the two major airports in Chengdu handled 74.924 million passengers and 7.71 million tons of cargo and mail. In contrast, Chongqing handled 44.657 million passengers and 387,900 tons of cargo and mail in 2023. To fully leverage the functionality of Chongqing's Golden Waterway along the Yangtze River, it is necessary to accelerate the construction of a comprehensive transportation system that integrates air-water and rail-water intermodal transport, thereby forming new competitive advantages. To achieve this, further investment in the transportation sector is needed to enhance the overall competitiveness of Chongqing's ports and railway hubs.

Chongqing can draw inspiration from the Beijing-Tianjin-Hebei city cluster model and actively promote mutual access to the 144-hour visa-free transit policy for Chengdu and Chongqing's aviation ports. This includes incorporating some cities in Sichuan Province into Chongqing's 144-hour visa-free transit range and including Chongqing in Chengdu's 144-hour visa-free transit range. This will enhance the attractiveness of Chongqing's ports to international visitors, allowing more foreign tourists to experience the unique charm and allure of Chongqing.

Digitalization and intelligentization are key to enhancing the operational efficiency of transportation infrastructure. We recommend that the Chongqing municipal government vigorously promote the construction of smart ports, smart terminals, smart warehouses, and smart airports. Honeywell's intelligent fire alarm systems and access control systems are already in use at Chongqing Airport. We believe that the application of more intelligent technologies can further improve the operational level and safety of transportation infrastructure, assisting in the upgrade of Chongqing's comprehensive transportation hub. This will better serve the people and businesses in Chongqing and extend its benefits to the Chengdu-Chongqing region and even the entire western part of China.

In supply chain construction, logistics come first. Honeywell offers a series of mature products and solutions, especially in the fields of intelligent warehousing and interconnected supply chains. Honeywell's warehouse management system can help enterprises achieve more efficient warehouse operations and more accurate inventory management. From sorting systems, conveying systems, robotic systems, palletizing solutions, control systems, and warehouse execution systems, to handheld terminals and voice picking solutions, Honeywell provides end-to-end solutions in the supply chain domain. We hope that these solutions can be more widely applied in Chongqing, contributing to the modern three-dimensional logistics network of the city.

Chongqing and Sichuan Province have strong industrial complementarities in sectors such as electronics, aviation, and environmental protection, offering extensive opportunities for collaboration. Chongqing should focus on its advantageous and emerging industries, promoting cooperation between local leading supply chain enterprises and companies in Sichuan to create a new pattern of efficient coordination and integrated development.

Chongqing and Sichuan can also facilitate cooperation among more enterprises along the supply chain by establishing regional industry organizations and roundtable forums. Particularly, they should make full use of important events such as the Smart China Expo to engage in exchanges with key foreign-invested enterprises, promoting cooperation between these enterprises and local companies in Sichuan and Chongqing. Chongqing can also actively invite multinational enterprises and companies from other regions to host supplier conferences, supply chain conferences, and partner ecosystem events in the city, encouraging domestic enterprises in Sichuan and Chongqing to participate actively in these activities, thereby helping outstanding foreign-invested and nonlocal enterprises find partners in the Sichuan-Chongqing Economic Circle.

In January this year, Honeywell held its 2024 Supplier Conference in Wuhan’s Optics Valley, attracting over 300 people from 102 suppliers worldwide, contributing to the construction of Wuhan New City. Chongqing can also refer to this approach to further increase the understanding of non-local and even overseas enterprises towards Chongqing, help external businesses establish deep connections with enterprises in Chongqing and the Sichuan-Chongqing Economic Circle, and form an efficient and collaborative industrial ecosystem.

Fourth, we recommend that Chongqing continuously improve the urban environment, vigorously develop social undertakings such as healthcare, promote the quality improvement and upgrading of livelihood facilities such as hospitals to make the cite more livable.

To further develop a modern manufacturing industry system, the supporting construction of a livable city is essential. Looking ahead, the development of livable cities will also become a hotspot in urban industrial competition. Improving the urban environment, enhancing public services, building better civilian infrastructure, and accumulating more industries and technologies related to

livable city construction and the upgrading of civilian infrastructure, will bring new demands to the city at the manufacturing level.

Healthcare is a crucial aspect of people's livelihood and a priority area for Chongqing to upgrade its civilian infrastructure. It is recommended that while strengthening and expanding public hospitals, Chongqing should also encourage private capital and foreign investment to establish hospitals, thereby increasing the supply of high-quality medical resources. In 2019, Raffles Medical Group from Singapore officially opened Raffles Hospital Chongqing, which is the first wholly foreign-owned comprehensive international hospital in Chongqing. This exemplifies the Chongqing Municipal Government's commitment to continuously expanding opening-up in the service sector. Over the past few years, Raffles Hospital Chongqing, with its international healthcare philosophy and medical team, has provided Chongqing citizens with new healthcare options, particularly earning a good reputation for its postnatal care services. We suggest that Chongqing further expand its opening-up in areas related to people's livelihood, enabling citizens to enjoy more high-quality services.

Digitalization, intelligentization, and environmentally friendly practices are the main directions for the transformation and upgrading of civilian infrastructure such as hospitals. Honeywell has mature solutions in this regard. Raffles Hospital Chongqing has applied Honeywell’s products, such as a comprehensive weak electrical integration solution, establishing an intelligent, high-quality medical service system, creating a safe, comfortable, reliable, and efficient medical environment, matching outstanding building management efficiency and public management levels, and effectively ensuring the safety of the hospital and its important assets.

Under the pressure of high standards and tight schedules, Honeywell provided a comprehensive integrated solution for designing, manufacturing, and installing an intelligently interconnected hospital, meeting the needs of modern hospital information management from life safety to environmental control, from energy management to service operations, and comprehensively improving medical efficiency and management levels.

We anticipate that the successful implementation at Raffles Hospital can be extended to more hospitals in Chongqing and the Chengdu-Chongqing Economic Circle. The adoption of better technologies will not only modernize hospitals but also tangibly improve the patient experience. Medical services are a vital component of livelihood services, and the continuous upgrading of medical and other livelihood services in Chongqing can further enhance the city's reputation as a livable city, thereby strengthening its attractiveness to talents and enterprises.

Conclusion

The coming period represents a crucial strategic opportunity for the development of Chongqing. We are confident that, riding on the momentum of the building of the "Belt and Road" Initiative, the construction of the "Yangtze River Economic Belt," and the development of the "Chengdu-Chongqing Economic Circle," Chongqing will fulfill its share in national strategic missions while achieving its own high-quality development. Chongqing's emerging industries will continue to grow and thrive, and the city's overall competitiveness will steadily increase, providing immense room for growth for all types of enterprises, including foreign-invested ones.

For the past 17 years since Honeywell's entry into the Chongqing market, we have valued the city's robust industrial foundation and favorable business environment, consistently approaching our operations in Chongqing from a strategic and holistic perspective. We aspire to leverage Chongqing as a crucial base, from which to radiate our influence across Southwestern China and eventually throughout the entire country.

Looking ahead, Honeywell will continue to adhere to a technology-driven approach, promoting the widespread application of advanced technologies in Chongqing and the Chengdu-Chongqing Economic Circle. We are committed to sharing our expertise and technologies in areas such as digital economy, smart manufacturing, energy conservation and emission reduction, as well as advanced materials, to facilitate the economic transformation and upgrading of Chongqing and contribute to the development of a more efficient, intelligent, and environmentally friendly modern manufacturing system. We are confident that through our participation in Chongqing's development, we will also achieve our own growth and progress.

We will always be rooted in China and Chongqing. We hope to further strengthen and optimize our business in Chongqing, making it a model for Honeywell’s operations not only in China but also in Asia. Through relentless long-term efforts, we also aspire to contribute our share to the socio-economic development of Chongqing.