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Key Innovative Industries in Taiwan

Circular Economy

Information Security	New Generation Automobiles	Communications Industry	Circular Economy	Green Energy
Biopharmacy	Smart Machinery	Semiconductors	Internet of Things	International Logistics and E-commerce

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Policy Initiatives

1 | Pathway to Net-Zero Emissions in 2050 |

In response to international net zero emission trends and more stringent international carbon management, the National Development Council of Taiwan published the "Pathway to Net-Zero Emissions by 2050" on March 30, 2022. Taiwan plans to invest approximately NT$900 billion by 2030 and will use the four main strategies of "Energy Transition," "Industry Transition," "Lifestyle Transition," and "Social Transition" to attain the long-term net zero objective.

In terms of industry transformation, Taiwan's government will start with "process improvements," "energy transition," and "circular economy." In terms of a circular economy, Taiwan's government plans to use mainly alternative materials, solid recovered fuel (SRF), and energy and resource integration in the short term, and develop carbon dioxide capture and utilization (CCU) and other breakthrough innovative technologies in the long term.

In the field of resource recycling, the model of large enterprises leading small enterprises will be adopted and state-run enterprises will serve as role models for the gradual implementation of various measures. Taiwan will also combine the resources of industry associations and supply chain centers to encourage small and medium enterprises to establish carbon inventory and carbon reduction capabilities. It will drive upstream and downstream manufacturers to cooperate in green procurement and green production to reduce carbon emissions and form a green supply chain to create competitiveness in Taiwan's net-zero transformation.

2 | Circular Economy Promotion Plan |

The circular economy is regarded as the most powerful engine of growth for the global economy in the post-pandemic era, and Taiwan has listed the circular economy as one of its key policies. The Executive Yuan announced the "Circular Economy Promotion Plan" in December 2018, and the Ministry of Economic Affairs was assigned to implement the plan with the two main strategies of "industrialization of the circular economy" and "circularization of industries" and establish the "Circular Economy Promotion Office." The Plan integrates resources from different government agencies with the aim of incorporating the concepts of the circular economy and sustainable innovation into various economic activities.

Specifically, the government has adopted four major implementation strategies including the "promotion of circular technologies and material innovation," "creation of a new circular economy demonstration park," "promotion of green consumption and exchanges," and "integration of energy resource integration and promotion of industry symbiosis." The plan is designed to help key industries (e.g., metallurgy, petrochemicals, and other materials industries) develop innovative material technologies and increase the value of renewable resources. It will also tap into the capabilities of industry, government, academia, and research institutions to implement a new circular economy demonstration park, and to share the experience that the government has accumulated in the process of integrating resources and planning for the implementation of its strategies (refer to Figure 1).

Taiwan's government currently uses 3 industrial zones, including Dayuan in Taoyuan, Changbin in Changhua, and Guantian in Tainan as circular economy demonstration parks. It mainly uses the "online-to-offline (O2O)" mechanism and the "industrial circular economy information platform" set up at the end of 2020 to screen potential targets, and match them with professional teams including the Industrial Parks Service Center and Industrial Park Association to provide support to companies. Companies that require waste recycling and reuse or alternative fuel can also use the platform to find potential partners.

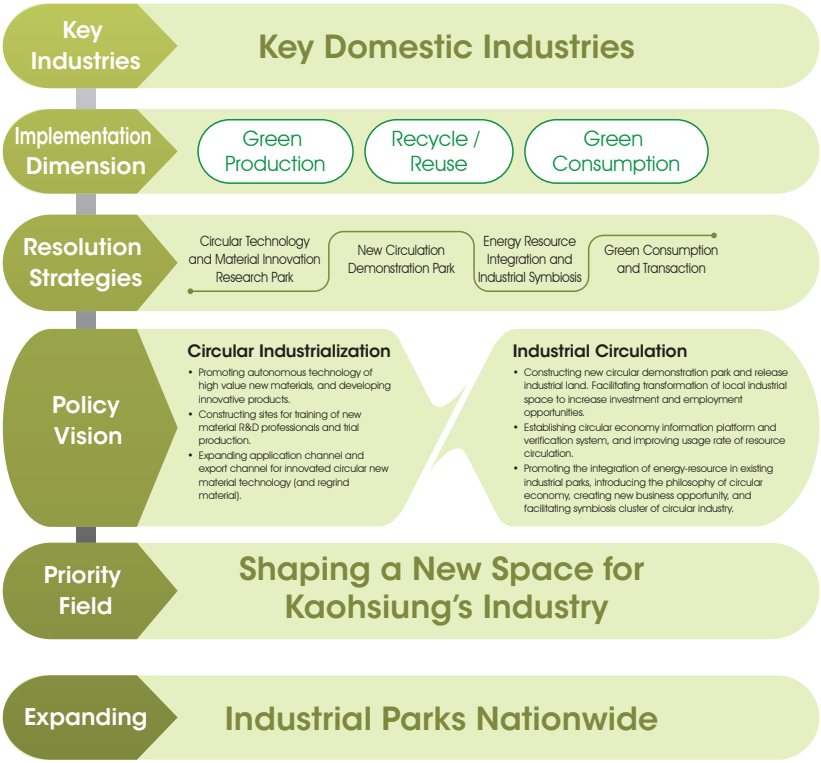

Figure 1 Overall Blueprint of the Circular Economy Promotion Plan

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3 Industrial and Government Support for a Nationwide Circular Economy: Establishment of Taiwan Circular Economy 100 (TCE100)

The "Asia Pacific Circular Economy Roundtable" established the "Taiwan Circular Economy 100" (TCE100) on October 17, 2019. The TCE100 alliance aims to implement internal cycles within companies, expand the energy and resource collaboration between companies, and create a resource recycling system to accelerate connections between arterial and venous industries. As of July 2022, 285 businesses, government agencies, academic entities, and research institutions have joined TCE100. Events such as seminars and forums are organized to facilitate the exchange of ideas between members. Frequent visits to industry trade associations have also been organized so the government can better understand industry pain points and use them as references in policymaking.

Figure 2 Members of the Taiwan Circular Economy 100 Alliance Pose for a Group Photo

The TCE100 alliance seeks to leverage collaboration between the public and private sectors to concentrate industrial innovation capacity. It aims to duplicate successful experiences in production, consumption, and recycling to create new service models based on the circular economy. It will serve as a role model and exert influence while forming strong foundations in the industry and continue to strengthen international connections and open up a new era of a circular economy with a solid foundation in Taiwan to facilitate global expansion. The TCE100 alliance has invited all sectors to take part in the initiative and welcomes international partners (e.g., ATLAS from Japan, EPEA from Germany, and Atlas Copco from Sweden) to form a collaborative platform and jointly create a sustainable supply chain for Taiwan. Together, we can usher in the era of the circular economy and create a better future.

Overview of Industrial Development — Output Value

Taiwan is a world leader in resource recycling. Since 2009, Taiwan began preparing to integrate energy and resources for industrial parks and has achieved significant results in eco-industrial parks and circular industrial parks. We have completed energy and resource integration in 29 industrial parks and 13 industrial clusters and facilitated 145 resource connections, which totaled approximately 5.06 million metric tons/year. The government has also provided support for energy conservation and carbon emissions reduction to more than 350 companies.

Similar to many European countries, Taiwan has a high population density and a lack of resources. Therefore, it has made significant investments in environmental protection over the past 20 years. In 2021, Taiwan's industrial waste reuse rate was 81.1%, and the output value of the resource recycling industry was NT$77.492 billion, with 1,757 companies specializing in recycling and reusing industrial waste. In addition, there have been many successful cases of industrial symbiosis. Taiwan has also completed several successful cases of energy and resource integration. Examples include: (1) cogeneration plants that supply surplus steam to nearby manufacturers to replace the inefficient and highly polluting boilers; (2) paper mills that recycle waste energy in the industrial paper production process and convert it into steam for other production processes; (3) chemical fiber manufacturers and textile companies that recycle PET bottles for production of functional apparel; and (4) livestock farms that use anaerobic treatment of livestock manure to generate biogas for power generation for internal use and sale of electricity to Taipower.

Potential Investment and Collaboration Opportunities in Taiwan

1 Development of Market Opportunities for New Materials

The government is promoting green production processes and introducing smart manufacturing for the development of eco-friendly, safe, and high-value-added products and high-value new materials, and is developing new eco-friendly and low-carbon materials. The government welcomes international companies to engage in investments, cooperation, technology transfers, or joint developments in Taiwan to expand into the new materials market in the Asia-Pacific region.

2 Partnership with Local Industries to Promote Pilot Programs for the Recycling Industry

According to the "National Recycling Zone Pilot Program and New Material Recycling Industrial Park Application and Establishment Plan," the government has identified the establishment of "circular industrial parks" as an important long-term task. It provides international companies with brand new development zones for the development of green and high-value materials.

3 Business Opportunities in the Refining of High-tech By-products

Taiwan is an important global hub for the export of high-tech parts and components, with production processes yielding large quantities of high-tech by-products, such as chemicals and waste, each year, which is favorable to international businesses with technologies for resource refining and reuse to invest in Taiwan. For example, the stay-at-home economy created by the COVID-19 pandemic increased the output of Taiwan's panel industries to NT$727.5 billion in 2020, which ranked second in the world. The continuous increase in the demand from the stay-at-home economy, metaverse, electric vehicles, information security, and green energy have increased the output to NT$1 trillion again in 2021. In response to the green regulations imposed by the EU for the manufacturing sector, Taiwan's flat-panel industry actively introduced green products, green production, and green supply chain regulations and formed alliances with supply chain partners to create a circular value ecosystem.

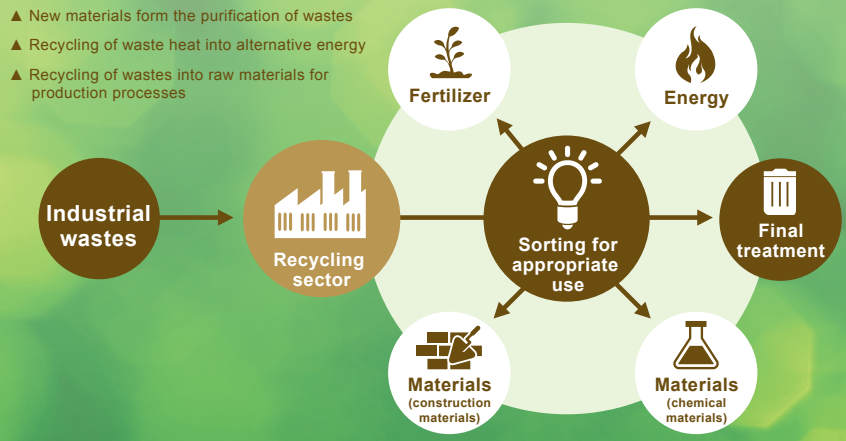


Figure 3 Circular Economy Market Opportunities in Waste Produced by High-tech Industries in Taiwan

Investment Incentive Measures

1 | Tax Incentives |

Taiwan's profit-seeking enterprise income tax rate is 20%. To encourage foreign companies to invest in Taiwan, support industrial innovation, and promote industry-academia collaboration, foreign companies are eligible for the following preferential taxes (Table 1):

Table 1 Preferential Taxes

Item	Preferential Measures
Research, Development, or Introduction of Technologies or Machinery Equipment	• Up to 15% of the company's R&D expenditures may be deducted from its profit-seeking enterprise income tax for current year; or up to 10% of such expenditures may be credited over three years against the profit-seeking enterprise income tax payable by the company. • Royalty payments to foreign companies for imported new production technologies or products that use patents, copyrights, or other special rights owned by foreign companies are, with the approval of the Industrial Development Bureau, MOEA, exempt from the corporate income tax. • Companies are exempt from import tariffs for importing any machinery equipment that local manufacturers cannot produce.

Item	Preferential Measures
Investment in Smart Machinery / 5G / Information Security	• Smart machinery: Use of big data, AI, and IoT in brand-new hardware, software, technology, or technical services for automatic schedules, flexible, or mixed-model production lines. • 5G: Investments in new hardware, software, technology, or technical services that are related to 5G communication systems. • Information security: Companies' investments and purchases of brand-new hardware, software, technology, or technical services for information and communication security products or services are included in the scope of investment offsetting. • For investments between NT$1 million and NT$1 billion, companies can choose from either "5% of investment spending deducted from profit-seeking enterprise income tax (current FY)" or "3% of investment spending deducted from profit-seeking enterprise income tax if the total spending is spread over three years" may be selected, but the total amount deducted may not exceed 30% of corporate income tax that year. • Applicable until December 31st, 2024.
Employee Stock Compensation	• A company employee who has obtained stock compensation worth a combined total of less than NT$5 million and continuously held the stock while remaining in the company's employ for at least two years may choose to be taxed on the market price of the stock at either the time the stock was obtained or the time the stock is sold, whichever is lower.
Special Foreign Professionals	• Special foreign professionals who meet certain criteria are eligible for a 50% deduction of total income tax for amounts exceeding NT$3 million.
Industrial Park Locations	• Companies that set up operations in export processing zones, science industrial parks, or free trade ports are eligible for exemptions on import duties, commodity tax, and business tax for the import of machinery and equipment, ingredients, fuel, materials, and semi-finished products for their own use.
Others	• Companies that use undistributed earnings to engage in substantive investments may exclude the invested amount when calculating their profit-seeking enterprise income tax.

2 | Subsidies |

1. Global Innovation Partnership Initiatives Program

Foreign companies that complement Taiwan's industries are encouraged to invest in Taiwan's R&D innovation and work with Taiwanese companies to jointly develop forward-looking technologies, key technologies, or integrated technologies beyond our current capacities. Such businesses could exert a key influence on Taiwanese industry by: (a) inspiring R&D work on industrial technologies as well as the establishment and development of supply chains; (b) improving R&D efficiency; (c) accelerating the timetable from R&D to production; and (d) contributing actively to the expansion of international markets. Foreign companies successful in endeavors relating to this program will be eligible, upon approval from the MOEA, for subsidies of up to 50% of total R&D expenditures.

2. Pioneers for Innovation Leadership on Technology Program

The program aims to transform Taiwan into a high-tech R&D center and encourage leading international manufacturers to establish cutting-edge R&D bases in Taiwan, empowering their work in forward-looking technologies in Taiwan and connecting with Taiwan's supply chain, thereby creating a division of labor in the areas of research, co-creation, and development, with an eye to strengthening the technological competitiveness of Taiwan's leading industries and accelerating the formation of clusters in emerging industries. Program funding of up to 50% of total expenditures may be granted for any project that has been approved by the Ministry of Economic Affairs.

3. Industrial Upgrading Innovation Platform Guidance Program

To guide industries in Taiwan to develop high-value products and encourage corporations to enter the high-end market to increase the industry's added value, the Industrial Development Bureau, Ministry of Economic Affairs, and the Ministry of Science and Technology are promoting the "Taiwan Industry Innovation Platform Program". The program provides companies that have R&D teams in Taiwan with funding of up to 40%-50% of the project budget for themed R&D projects and funding of up to 40% for projects independently conducted by corporations.

To support innovative R&D programs for resource recycling and reuse, the Environmental Protection Administration has provided subsidies since 2012 to corporations with R&D capabilities, businesses that handle recyclable waste, and public/ private waste disposal entities. The Ministry of Finance also issued the "Regulations Governing Application of Investment Tax Credits for the Purchase of Equipment and Research Expenditures for Resource Recycling" on July 31, 2007 in accordance with Article 23, paragraph 2 of the "Resource Recycling Act." The Regulations apply to the types of businesses described in Article 15, paragraphs 2 and 4 of the "Resource Recycling Act." Entities that meet the aforementioned requirements may also apply for related tax reductions and exemptions.

In the future, the government shall continue to assist companies in actively driving the transformation of production and consumption, so as to solve the problems of resource scarcity and waste pollution at the source. This approach will provide brand-new business models, profit models, and job opportunities to create value for the circular economy.

Leading Taiwanese Companies

1 | Resource Recycling Technologies |

1. Enrestec

Established in 2005, Enrestec has focused on the pyrolysis and recycling of used plastic, rubber, and organic wastes, and the development of soil thermal desorption technology and applications. It has a globally exclusive patent for pyrolysis technology. It is worth noting that Enrestec recycles 36,000 tons of waste tires every year and uses a fully automated continuous pyrolysis system for waste tire pyrolysis and production of green energy and resources such as recycled oil, eco-friendly carbon black, steam, and steel wires. Enrestec has become a pioneer in tire pyrolysis.

In 2017, Enrestec and Shei Chung Hsin Industrial began a cooperation project that uses recycled carbon black materials for the production of wetsuits. The products meet EU inspection standards, and the carbon footprint certification results showed a significant 72% drop in carbon emissions. In 2020, Enrestec's carbon black received Cradle to Cradle (C2C) bronze certification, thus making Enrestec the first recycled carbon black company in Asia to obtain C2C certification. Enrestec also received the ISCC Plus certification issued by the International Sustainability & Carbon Certification in 2022, becoming the first commercialized factory to provide sustainable carbon black/ fuel products in Asia.

2. E&E Recycling

Established in 1998 by 12 manufacturers of household appliances in Taiwan, E&E Recycling is the largest recycling plant of waste household appliances and waste IT equipment. The company has won awards such as the "Taiwan Resource Recycling Company Excellence Award" and the "3rd National Enterprise Environmental Protection Award" in 2021. It is also the first professional treatment facility for recycling waste electronics and resources in Asia. E&E Recycling is equipped with top talents and technologies in Asia and has learned from the experience of Adelmann GMBH of Germany for processing waste electronics and appliances to provide comprehensive solutions for recycling and processing waste electronics and appliances.

In addition to recycling and reusing waste products, E&E Recycling promotes the concept of green design to provide companies with ideas to guide their selection of materials at the product design stage. It has also achieved major breakthroughs in R&D regarding the repeated use of liquid crystal based on liquid crystal extraction technology licensed by the Industrial Technology Research Institute (ITRI) and the value-added technology for producing foam fuel rods through R&D in collaboration with ITRI. The process transforms rigid polyurethane foam (PUR) used as thermal insulators in refrigerators into fuel rods for use in incinerators and cement kilns to thereby reduce coal consumption. For the next phase, E&E Recycling plans to develop organic compost technologies for kitchen waste, use recycled glass for the production of permeable bricks, find uses for recycled plastic materials, develop metal sorting equipment, and upgrade various technologies.

3. FGD Recycling Industrial (FGD)

Established in 1997, FGD Recycling Industrial Co., Ltd. is a Class A Waste Treatment and Disposal Plant in Taiwan and a One-Star Excellence Company in Waste Resource for the Circular Economy. The company is committed to recycling, processing, and reusing electronic waste and uses patented technologies to return waste materials to production processes. FGD's four main businesses include environmental protection (recycling and treatment of waste electronic/ electrical appliances and IT products), machinery development (export of environmental protection equipment), recycling (recycling and sorting of waste plastics), and Class A refinery (recycling and refining of waste electronic parts and scraps). Its customers include over thousands of public and private entities such as domestic and foreign listed enterprises, companies in science parks, and schools at all levels.

FGD has invested extensive resources in the research, development, and innovation of environmental protection technologies, using patented technologies to separate reusable resources (including iron, copper, aluminum, and other metals and plastics) from discarded household appliances and return the materials to the production line for reuse. It also focuses on innovation in machinery and equipment and provides customized professional system design, planning, and integration services for semiconductor and optoelectronics companies. FGD currently recycles up to 1,800 metric tons of plastic materials each month and the new plant scheduled for completion in 2023 will increase the processing volume of recycled plastic by 5 times.

2 Improvement of Processes and Materials

Many industries in Taiwan have joined the circular economy in recent years, with companies forming alliances and integrating resources to invest in the circular economy. For instance, China Steel and LCY Chemical Corp. have actively invested in circular economy concepts relating to processes and materials. In addition to individual industries forming alliances within their industries, the electronics, textiles, plastics, petrochemicals, and steel industries have also accelerated the consolidation of the abundant resources of private enterprises since the second half of 2018 to develop integrated alliances across different industries.

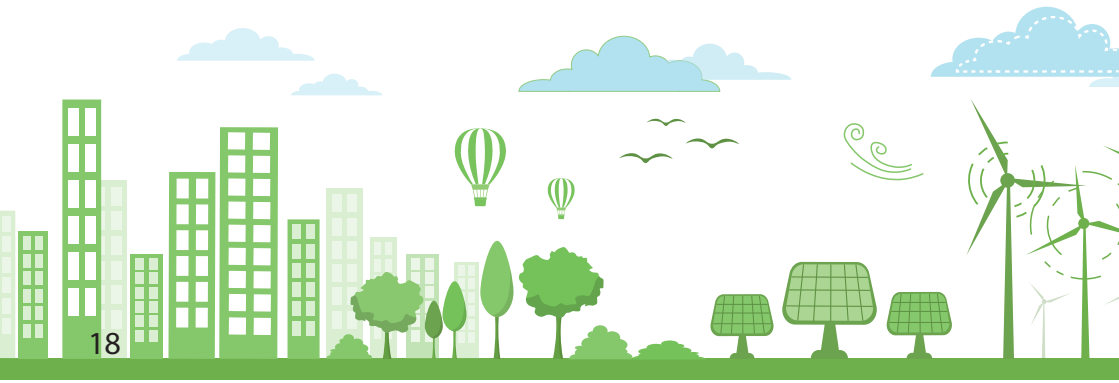
In the case of the petrochemicals industry, LCY Chemical Corp. has developed a biological fermentation method for producing succinic acid and carotenoid from non-food corn products. It produces biodegradable recycled plastic materials from 100% plant sources to replace fossil materials. The recycled plastic materials can be used for coffee cups and paper packaging materials for beverages and ice cream. LCY Chemical Corp. also works with textile companies in Taiwan to apply recycled plastic materials to textile products. LCY Chemical Corp. has also invested in R&D to recycle rigid and durable plastic materials such as plastic components in furniture and automobiles, crushing the plastic materials and recycling them to produce new materials. The process increases the stability and transparency of recycled plastic materials that can withstand impact and low temperatures. The quality of these recycled plastic materials is commensurate to 100% original plastic materials, which facilitates the recycling of plastic products and creates new value.

In terms of the electronics industry, AU Optronics has introduced recycled materials into its production process and actively invests in energy conservation, water conservation, waste reduction, and recycling of raw materials in plants. As a significant amount of water is required in the production process of the display panel industry, AU Optronics has adopted effective recycling and redirection procedures, increasing the average water recycling rate in the production process to 92%. It also developed a comprehensive water recycling system and converted its Longtan Plant into the first plant in Taiwan that recycles 100% of the water used in the production process.

In addition, the increased complexity of production processes and increased production capacity also significantly increase the amount of waste. TSMC has launched a waste management policy and started the construction of the "Zero-Waste Manufacturing Center" in Central Taiwan Science Park in 2021. It will become TSMC's first circular economy demonstration center and is expected to be commissioned in 2023. TSMC plans to gradually expand zero-waste practices to plants in Hsinchu and Tainan. TSMC's Zero-Waste Manufacturing Center recycles waste resources and purifies them into semiconductor-grade chemicals that can be reused in fabrication. It is expected to replace at least 30% of the demand for the extraction of raw materials, reduce the outsourced waste by 140,000 tons, and create benefits totaling NT$1.2 billion from recycling and waste reduction each year.

3 | Testing Facilities |

As Taiwan's most successful industry symbiosis case study to date, Kaohsiung Linhai Industrial Park has 493 companies and is a general industrial park housing more than 20 industries, including petrochemical and steel (refer to Figure 2). The industrial park launched plans for regional energy integration revolving around China Steel in 1993, since then, China Steel has used a cogeneration system and recycled waste heat to produce steam and worked with 14 companies to create 13 types of energy cycles that include the supply of by-



products such as steam, oxygen, nitrogen, argon, hydrogen, and condensation, which increase the usage efficiency of energy and water. These resources were provided for the company's own use and supplied to nearby petrochemical firms, chemicals firms, downstream steel makers, construction, civil engineering, electrical engineering, and domestic industries to achieve significant energy and resource integration, thus achieving the following: 2 million metric tons/ year in energy resource linkage; reduction of fuel consumption by 122,000 kilolitres; and reduction of carbon dioxide emissions by 378,000 metric tons.

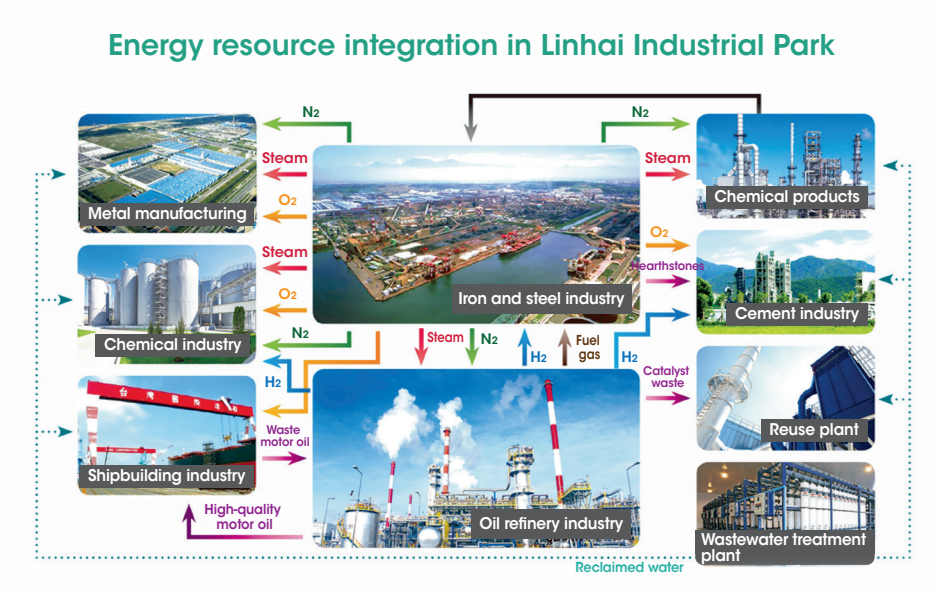


Figure 4 Effective Integration of Regional Energy and Resources in Kaohsiung Linhai Industrial Park

Examples of Successes Achieved by Foreign Companies

1 International Brands and Taiwanese Businesses Jointly Develop the Circular Economy Value Chain

Major international brands such as IKEA and Decathlon have worked with suppliers in Taiwan to establish a circular economy value chain to highlight the green value of their brands. For instance, IKEA plans to reduce carbon emissions for all products by 70% and use sustainable or renewable materials for all products by 2030. To strengthen the circular economy model, IKEA launched the "buyback" service in February 2022 to buy back, refurbish, and resell products sold to consumers. IKEA also works with Taipei 101 and Taipower in the "lease instead of purchase" scheme, uses the recycling and refurbishment circular supply chain, and assembled a special team to develop new business models for the circular economy. Decathlon works with Da Fon Environmental Technology to establish sorting mechanisms to recycle and use waste plastic hangers to produce shopping bags for circular reuse.

Major international manufacturer Dell has successfully worked with strategic partners in Taiwan in establishing a green supply chain and leading the IT industry in the creation of innovative collaboration models for the circular economy to significantly reduce its impact on the environment. In recent years, Dell and Wistron jointly developed the "Closed-loop Plastic Electronic Waste Recycling Solution" and also

worked with Solar Applied Materials and Tripod Technology to recycle and reuse computer motherboards. To date, Dell has used over 21.5 million pounds of recycled closed-loop plastic materials in more than 125 product lines, including computers, monitors, and servers. Dell also launched the "2030 Moonshot Goals," declaring that it will strive to recycle an equivalent product for every product a customer buys, use 50% recycled materials for all products, and use 100% recycled or renewable materials for packaging. It will also work with supply chain partners (e.g., Nanya Technology) for developments in green production and the establishment of a sustainable supply chain.

Japanese companies – JX Nippon Mining & Metals and Tanaka Precious Metals – have invested in the recycling of gold, silver, and copper in Taiwan. They recycle and reproduce metals as functional materials based on customer requirements, and have installed pulverizers and automatic sampling equipment in 2021 to increase their material collection and processing capacity. NIPPON REFINE and World Resources Company from the United States have invested in the recycling of metals such as copper, nickel, and zinc. The RETHMANN Group from Germany recycles plastic bottles for the production of long-fiber plastic materials.

2 Enhancing Energy Recycling and Reuse Efficiency in Plants

German company Merck has three entities in Taiwan engaged in R&D and production involving special materials, Since 2006, Merck has implemented energy conservation projects to improve the dehumidification efficiency of the company's air-conditioning system, reuse wastewater recycled from processes, and recover rainwater to continuously reduce carbon dioxide emissions and waste of water resources. In addition, Merck actively incorporated green concepts into the product and development processes in 2020. To date, the company has developed 890 green alternatives and introduced the first green quantitative chemical analysis tool and biodegradable solvent in the industry. In 2021, Merck worked with Topco Scientific Co., Ltd., a semiconductor supplier, to create one-stop services for green semiconductor materials and accelerate the green transformation of Taiwan's electronics industry. At the end of 2021, it also established the "Semiconductor Material Production and R&D Center" in Taiwan to stabilize the supply chain and reduce carbon emissions.

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