經濟部

TAIWAN

Circular Economy

Key Innovative Industries in Taiwan

Information Security	Next-Generation Vehicle	Communications Industry	**Circular Economy**	Green Energy
Biopharmacy Industry	Smart Machinery	Semiconductor Industry	Internet of Things	International Logistics and E-commerce

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Policy Initiatives

1 | 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 included 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 all kinds of 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 industrial 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).

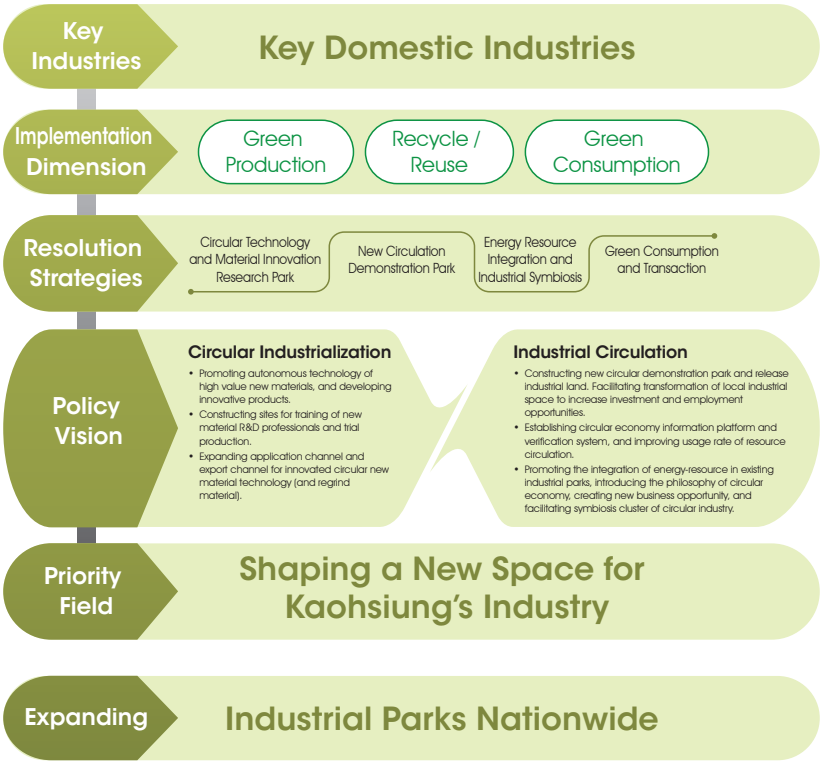

Figure 1 Overall Blueprint of the Circular Economy Promotion Plan

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

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

The "Taiwan Circular Economy 100 (TCE100)" alliance was established at the "Asia Pacific Circular Economy Roundtable" on October 17, 2019. As of July 2021, 245 industrial firms, 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 and frequent visits to industry trade associations have been organized so the government can better understand the problems faced by industry and use them as reference for policymaking.

The TCE100 alliance seeks to leverage collaboration between the public and private sectors to concentrate industrial innovation capacity. It aims to duplicate successful experience 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 will 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 to form a collaborative platform and jointly create a sustainable supply chain for Taiwan. Together, we can all embark together upon 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. Taiwan began preparing to integrate energy and resources for industrial parks in 2009 and achieved significant results in eco-industrial parks and circular industrial parks. We have completed energy and resource integration tasks in 23 industrial parks.

Taiwan is similar to many European countries in that it 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 2020, Taiwan's industrial waste reuse rate reached 81.16% and the output value of the resource recycling industry was NT$74.1 billion. 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 environmentally-friendly, safe, and high value-added products and high-value new materials, and is developing new environmentally-friendly and low-carbon materials. The government welcomes international companies to engage in investments, cooperation, technology transfers, or joint development in Taiwan to develop 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, and the production processes yield large quantities of high-tech by-products each year. The conditions for investment in Taiwan are favorable to international businesses with technologies for resource refining and reuse. 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. In response to the green regulations imposed by the EU for the manufacturing sector, Taiwan's flat-panel industry actively introduced green product, green production, and green supply chain regulations and formed alliances with supply chain partners to create a circular value ecosystem.

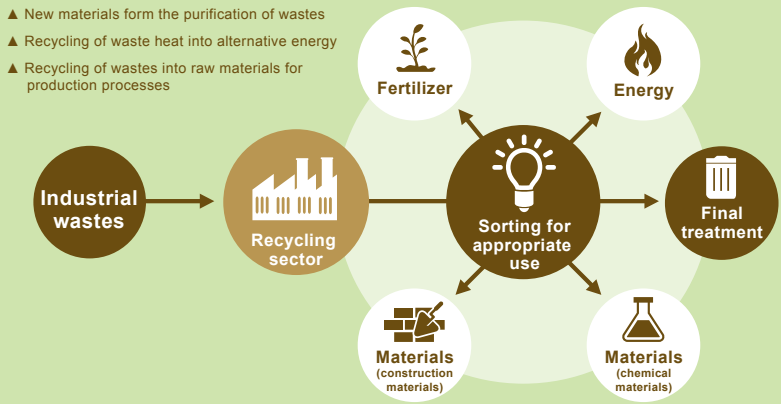


Figure 3 Circular Economy Market Opportunities in Waste Produced by High-tech Industries in Taiwan

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 tax(es)
R&D and introduction of technology or mechanical 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 is, with the approval of the Industrial Development Bureau, MOEA, exempt from the corporate income tax. • Imported machinery which local manufacturers cannot produce are eligible for duty-free treatment.

Item	Preferential tax(es)
Investment in smart machinery / 5G	• Smart machinery: Automatically scheduled, flexible, or mixed-model production lines that utilize big data, AI, and IoT. • 5G: Related investment projects include 5G communication systems, and new hardware, software, technology, or technical services. • For investments of no less than NT$1 million and no more than NT$1 billion, 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 total spending spread over three years" may be selected, but the total amount deducted may not exceed 30% of corporate income tax that year. • The applicable periods are January 1, 2019 through December 31, 2021 (smart machinery) and January 1, 2019 through December 31, 2022 (5G).
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.
Foreign special professionals	• Foreign special professionals who meet criteria are eligible for a 50% deduction of total income tax for amounts exceeding NT$3 million.
Setting up operations in industry parks	• 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 amount when calculating their profit-seeking enterprise income tax.

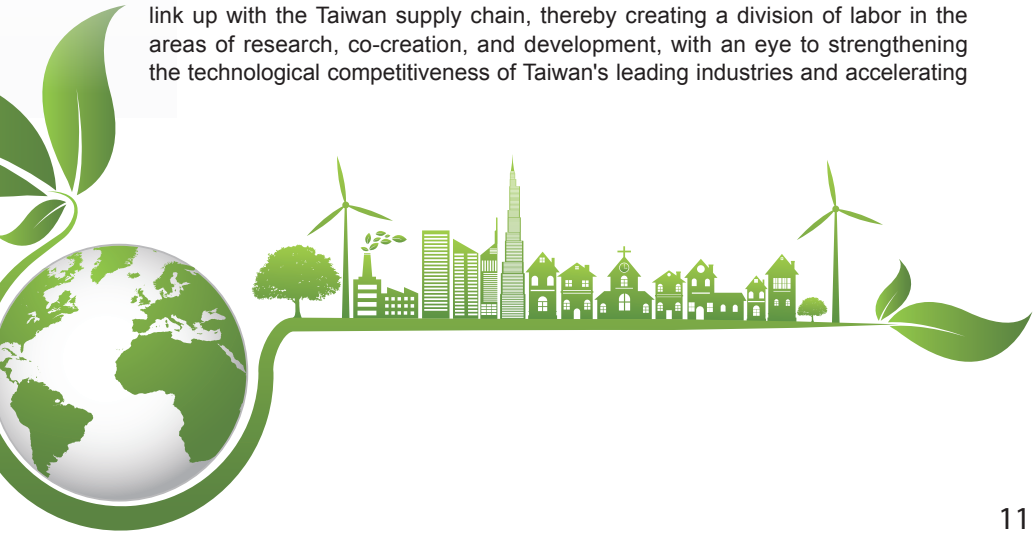
2 | Subsidies |

1. Global R&D Innovation Partner Program

Some foreign companies have a high degree of complementarity with Taiwan's industries, so we encourage them to come to Taiwan to plan and develop forward-looking technologies more advanced than those that Taiwanese firms currently possess, as well as key technologies or integrated technologies. By engaging in R&D work on such technologies in cooperation with Taiwanese firms, they could exert a key influence on Taiwanese industry by: (a) spurring 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 expansion of international markets. Foreign companies that achieve such things, after gaining approval from the MOEA, will be eligible for subsidies of up to 50% of total R&D expenditures.

2. Program for the Development of Pioneering Companies

The purpose of this program is to build Taiwan into a high-tech R&D center and encourage leading international manufacturers to establish cutting-edge R&D bases in Taiwan so that they can work here on forward-looking technologies and link up with the Taiwan 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. Taiwan Industry Innovation Platform Program

The Industrial Development Bureau and the Ministry of Science and Technology are jointly running the "Taiwan Industry Innovation Platform Program" to guide industries to develop towards greater value, and encourage companies to enter high-end product application markets to increase the industry's overall added value. The program provides companies with R&D teams in Taiwan with 40-50% of funding required for theme-based R&D projects, and up to 40% of funding for R&D projects proposed by companies.

To support innovative R&D programs for resource recycling and reuse, the Environmental Protection Administration has provided subsidies since 2012 to corporations with capacity for R&D, firms that handle recyclable waste, and private-sector waste disposal entities. The Ministry of Finance has 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, organic wastes and the development of soil thermal desorption technology and applications. It has a globally exclusive patent for the 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. It 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' carbon black also received Cradle to Cradle (C2C) bronze certification, thus making Enrestec the first recycled carbon black company in Asia to obtain C2C certification.

2. E&E Recycling

E&E Recycling was founded by 12 manufacturers of household appliances in Taiwan in 1998. It is the largest recycling plant of waste household appliances and waste IT equipment as well as the first professional treatment facility for recycling waste electronics and resources in Asia. E&E Recycling is equipped with the top professional talent and technologies in Asia, and has learned from the experience of Adelmann GMBH of Germany for processing waste electronics and appliances to provide total 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 stage of product design. 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 the conduct of R&D work in collaboration with ITRI. The process transforms rigid polyurethane foam (PUR) into fuel rods for use in incinerators and cement kilns and reduces the use of coal. Next, 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.

2 Improvement of Processes and Materials

Many industries in Taiwan have joined the circular economy in recent years, with companies forming alliances to integrate resources for use in the circular economy. For instance, China Steel and LCY Chemical Corp. have actively introduced process materials into the circular economy. Individual industries have forming alliances for 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 expanded applications by working with textile companies in Taiwan to use recycled plastic materials in textile products.

LCY Chemical Corp. Has also invested in R&D to recycle rigid and durable plastic materials such as plastic components of furniture and automobiles. It crushes the plastic materials and recycles them to produce new materials. The process increases the stability and transparency of recycled plastic materials that can withstand low temperature and impact, and have quality commensurate to 100% original plastic materials to facilitate the recycling of plastic products and create new value.

3 | Testing Facilities |

Kaohsiung Linhai Industrial Park is Taiwan's most successful industry symbiosis case study to date. It has 493 companies and is a general industrial park with more than 20 industries including petrochemical companies and steel makers (refer to Figure 2). Plans for regional energy integration with China Steel as the core have been implemented since 1993. China Steel uses a cogeneration system and recycled waste heat to produce steam. It works with 14 companies to create 13 types of energy cycles that include the supply of by-products such as steam, oxygen, nitrogen, and argon, 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 tons/year in energy resource linkage; reduction of fuel consumption by 122,000 tons; and reduction of carbon dioxide emissions by 378,000 tons.

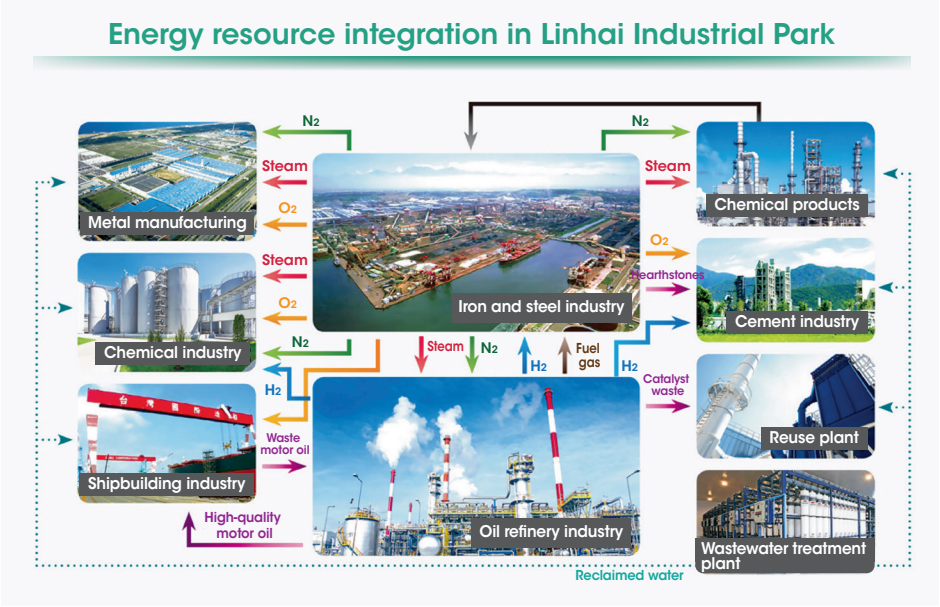


Figure 4 Effective Integration of Regional Energy and Resources in Kaohsiung Linhai Industrial Park

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 demonstrate the green value of their brands. For instance, IKEA plans to reduce overall carbon emissions by 80% from their 2016 level by 2030, and to implement the use of sustainable or renewable materials for all products by 2030. Decathlon plans to reduce the carbon emissions of individual products by 40% from their 2016 level by 2026.

Major international manufacturer Dell has successfully worked with strategic partners in Taiwan in the establishment of a green supply chain and led the IT industry in the creation of innovative collaboration models for the circular economy to significantly reduce its impact on the environment. In 2014, Dell and Wistron jointly developed the "Closed-loop Plastic Electronic Waste Recycling Solution." It also worked with Wistron, Solar Applied Materials Technology, and Tripod Technology in recycling materials from computer motherboards in 2017. Dell has recycled over 21.5 million pounds of closed-loop plastic materials in more than 125 product lines including computers, monitors, and servers.

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 capacity for the collection and processing of materials. 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 operates the recycling of 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 work involving special materials, and has implemented energy conservation projects since 2006. These projects have improved 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 procedures in 2020. It has developed 890 alternative green products and introduced the first green quantitative chemical analysis tool and biodegradable solvent in the industry. Merck also works with semiconductor supplier Topco Scientific Co., Ltd. to create one-stop services for green semiconductor materials and accelerate the green transformation of Taiwan's electronics industry.

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