

# TAIWAN CIRCULAR ECONOMY INDUSTRY CHAIN

2023



New Outlooks in Recycling Technologies, New Era of Net Zero Carbon Emissions:  
Towards Sustainable Net Zero Supply Chains.

# 2023

## Taiwan Circular Economy Industry Chain

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## ► Taiwan’s Circular Economy Promotion Plan

Circular economy is one of the policies under the 5+2 Innovative Industries Plan (i.e., Asia Silicon Valley, smart machinery, green energy, biomedicine, national defense, new agriculture, and circular economy) implemented by the Taiwanese government. The government is promoting sustainable development through extending the life cycle or recycling of resources to effectively reduce waste and pollution, creating the new economic model of “Cradle to Cradle.”

On December 20, 2018, the Executive Yuan passed the Circular Economy Promotion Plan, showing Taiwan’s resolve in moving towards a circular economy. Industries are encouraged to transition from a linear economy of “extraction, manufacturing, use, and disposal” to a circular one with “sustainable resources.” By incorporating the concepts of a circular economy, sustainability, and innovation into economic activities, Taiwan hopes to create a win-win situation for the economy and environment and meet international standards.

## Circular Economy vs Linear economy

### Linear economy

Consumed products are discarded, harming the environment and depleting resources



### Circular economy

A cycle of production, consumption, and recycling/reuse results in sustainable development and zero waste



Figure 1. Differences between a circular economy and conventional linear economy (source: Executive Yuan)

The Circular Economy Promotion Plan covers the “5 R’s,” namely Reduce, Reuse, Recycle, Recovery, and Repair, as well as ways to more efficiently recycle and reuse resources-Redesigning, Rethinking, and Redefining products. The ultimate goal is to achieve “complete resource circulation (zero waste)” and “environmental and resource sustainability (extremely low use of environmental resources).” This fundamentally addresses issues such as dwindling resources, waste, and pollution, and also

provides new business and profit models, as well as employment opportunities, adding more created value. Specifics of the four major promotion strategies are as follows:

### 1. Promote Circular Technologies and Dedicated Zones for R&D of New Materials

Promote R&D of new, high-value materials and expansion of export areas; establish a dedicated zone for circular technology and R&D innovation; cultivate talent at the International College of Materials; and drive industry transition to a circular economy.

### 2. Establish a Circular Demo Site

Establish a demo site for circular technologies; integrate cross-zone resources; promote low carbon and clean manufacturing technologies; and adopt environmental monitoring and simulation for in-depth carbon reduction pathways.

### 3. Encourage Green Consumption

Promote green consumption models (e.g., Industrial Information Platform of Circular Economy, key by-product transaction validation, new business models, and pilot projects); ensure green procurement for government projects (i.e., increasing the use of recycled pellets in public constructions); and encourage government agencies to prioritize recycled products.

### 4. Facilitate Energy & Resource Integration and Industry Symbiosis

Bolster the recycling system (e.g., recycling centers, regional energy and resource integration, and technology and equipment integration and output); ensure the quality of recycled products; and set examples for biogas reuse (electricity generation) at pig farms.

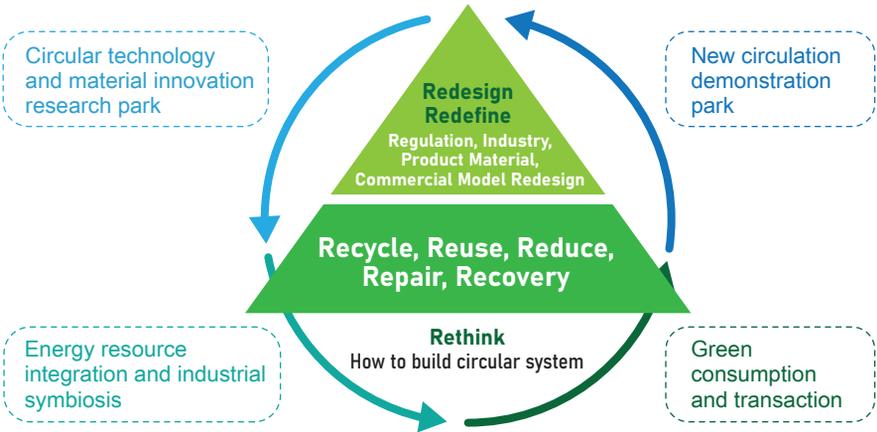


Figure 2. Strategies to Promote a Circular Economy (source: Circular Economy Promotion Office, CEPO)



## ► Taiwan's 2050 Net-Zero Emissions Policy

In March of 2022, the government formally announced Taiwan's Pathway to Net-Zero Emissions in 2050, mapping out a plan of action to achieve net zero emissions by 2050. The goal is to facilitate research and innovation in key fields, guiding industries to make the green transition and drive new economic growth. The government hopes that different milestones will drive green financing, increase investments, and ensure fairness through the transition.

Taiwan's Pathway to Net-Zero Emissions in 2050 involves "energy transition," "industry transition," "lifestyle transition," and "social transition" with "technology R&D" and "climate legislation" as the basis for governance. The 12 Key Strategies formulates specific action plans for energy, industry, and lifestyle transition.

The 2050 Net-Zero Transition concerns the nation's competitiveness and environmental sustainability. Establishing competitive, circular, sustainable, resilient, and safe transition strategies will further drive economic growth, private investments, green employment opportunities, achieve energy independence, and improve social welfare.



Figure 3. The Executive Yuan's Taiwan 2025 Net-Zero Transition: 12 Key Strategies



## ▶ Key Strategy for Net-Zero Transition “Resource Recycling and Zero Waste”

The Ministry of Environment (MOENV) is actively promoting resource circulation based on the excellent foundation of recycling Taiwan has built in the past. Shifting the focus from waste management to the four major materials (i.e., biomass, organic chemical substances, metals & chemicals, and inorganic recycled pellets), the MOENV has proposed the Resource Recycling and Zero Waste strategy. The strategy transforms waste into materials, fuel, and fertilizer to reduce the use of raw materials, and is implemented by government ministries. Strategy goals are depicted as follows:

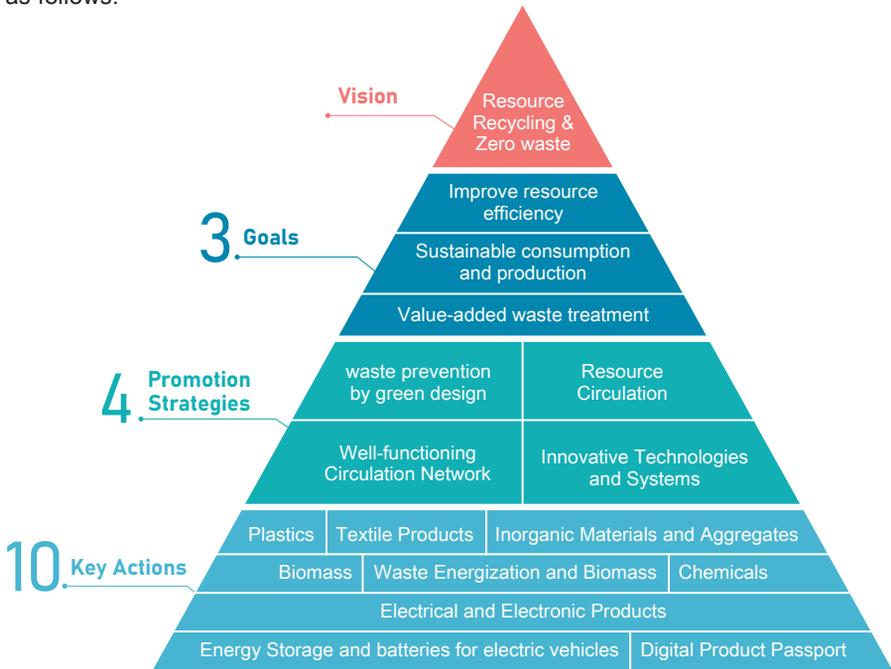


Figure 4. The MOENV's Resource Circulation Action Plan (Source: MOENV)

## **1.Green Design to Reduce Consumption at the Source**

Promote sustainable production and consumption, guide manufacturers to improve product design and extend warranty services, increase the use of recycled materials to replace raw materials, drive manufacturers to expand the scope of responsibility and establish a circular business model through circular procurement, and reduce the use of disposable products from the source.

## **2.Energy and Resource Recycling and Reuse**

Improve sorting of raw materials, recycled materials, and waste, and step up recycling on the front end ; promote the use of combustible waste as fuel, the use of inorganic waste and chemical waste as materials or pellets, and the treatment of organic waste in fertilizer.

## **3.Free-Flowing Circular Network**

Link upstream, midstream, and downstream industries to for resource circulation, and develop regional circular networks or ecological industry parks. An example is prompting companies to integrate their own upstream, midstream, and downstream partners and propose a collective Resource Circulation Network Waste Clearance Plan. This can be further develop into Virtual Circular Network Parks that spans regions and industries, transforming waste into raw materials to increase the benefits of industrial resource circulation.

## **4.Innovative Technologies and Systems**

The MOENV is currently drafting amendments to develop innovative technologies that will improve the quality of recycled resources, promote high value applications, and create a favorable environment for the development of resource circulation. Furthermore, the MOENV is closely following international trends and has implemented the Digital Product Passport to track products. The disclosure of product environment information facilitates repair, remanufacturing, and circulation. It also enhances the market competitiveness of sustainable products, and guides consumers to engage in green consumption, which further influences producers to engage in green production.

The MOENV also plans to enact a special law for resource recycling that integrates reduction, recycling, and reuse. By instituting “resource circulation promotion fees” and providing subsidies, the plan promotes effective circulation of recyclable waste or resources. To track and review the progress of policy implementation, the MOENV will also work with the Ministry of Economic Affairs (MOEA), Ministry of Agriculture (MOA), Ministry of the Interior (MOI), National Science and Technology Council (NSTC), Ministry of Health and Welfare (MOHW), Ministry of Transportation and Communications (MOTC), Public Construction Commission (PCC), and Ministry of Finance (MOF) to establish indicators and measures for resource recycling each year.

# 02 Industry Overview

## ► Dedicated Agency for Management and Policy Implementation

The MOENV established the Office of Resource Circulation in July 2021 to formulate and provide oversight to resource circulation policy. Shifting the focus from waste management in the past, the MOENV now considers the life cycle of materials and formulates specific measures for biomass resources, organic chemical resources, metals and chemicals, and inorganic resources. Following the example of the European Union (EU), Japan, and South Korea, the MOENV is implementing an interdepartmental Resource Circulation Action Plan to “maximize resource circulation” and “minimize waste treatment.”



Figure 5. The MOENV's Resource Circulation Action Plan (Source: MOENV)

In recent years, the MOENV has been actively promoting eco-friendly practices in industries by emphasizing lightweight packaging, incorporating redesign concepts into product design and manufacturing, and championing Cradle to Cradle designs. The MOENV is also encouraging businesses to voluntarily minimize waste at its origin, hosting industry events on waste reduction. The events inspire companies to enhance processes, optimize raw materials, and implement policy changes (like sorting). Sharing experiences and reduction technologies among companies helps reduce production costs and waste for industries.

## ➤ Waste Plastic Recycling and Reuse

Plastic, derived from oil refining, is widely used in industries, agriculture, livelihoods, and even the military. According to the Global Plastics Outlook published by the Organisation for Economic Cooperation and Development (OECD) in 2022, global volume of plastics manufacturing nearly doubled in the past two decades, and annual waste grew nearly 2.3-fold to over 350 million metric tons. Only 9% of plastic waste worldwide is effectively reused. 19% is incinerated, 50% is buried in landfills, and up to 22% is still not properly disposed of and leaked into the environment, posing an ecological hazard.

Plastic waste that is not properly disposed of accumulates in the environment, and microplastics smaller than 5 mm have been proven to already pollute ecosystem food chains. They pose a potential threat to human health. Hence, the United Nations Environment Assembly adopted a resolution in March 2022 to review the overall life cycle of plastics, and formulate a legally binding convention to end plastic pollution.

The MOENV thus established the Recycled Plastic Pellet Promotion Platform in 2020 and jointly advocated the use of recycled plastic pellets together with Unilever, Kao, Greenvines, Horng En, and Yomei to achieve 25% use of recycled plastic pellets in 2025.

Taiwan has approximately 170 recycled plastic materials companies, forming a dense industrial cluster in central and southern Taiwan, and providing the world with a wide variety of recycled plastics, including rPET, rPP, rLDPE, rHDPE, rPS, and rPC. Using polyester (PET) as an example, global demand was approximately 1.7 million tons in 2019, of which approximately 25% is supplied by Taiwanese companies. Most of these recycled plastic materials are converted into high value products, such as jerseys, sneakers, and luxury goods.



Figure 6. Plastic Recycling Journey

### PET circulation: From B2T to B2B to T2T

Approximately 1/3 of PET worldwide is used to make plastic containers and 2/3 are used to make textiles and garments. Fast fashion has created a huge amount of waste that is quickly becoming a new environmental hazard. According to a survey by Textile Exchange, only 1% of the global textiles industry is recycled and reused. Compared to cotton, linen, and wool, PET accounts for over 55% of clothing and has the highest recycling potential. PET recycling technologies can be divided into: Bottle to Textile (B2T), Bottle to Bottle (B2B), and Textile to Textile (T2T).

Taiwanese companies play an important role in innovation and R&D in the global textiles supply chain, and have performed especially well in the PET circulation. Far Eastern New Century, Li Peng, Nan Ya Plastics, Shinkong Textiles, and their satellite companies have provided OEM services to major international brands, such as NIKE, Adidas, and IKEA. Aside from conventional mechanical recycling methods, companies have been actively developing chemical recycling technologies in recent years, and implemented ICT smart selection procedures, resolving waste clothing recycling from the root of the problem.

## ► Recycling and Reuse of Precious Metals in E-waste

According to the 2022 Global Transboundary E-waste Flows Monitor published by the UN, the world generated 53.6 million tons of e-waste (on average 7.3 kg per person) in 2019. If the world continues to do nothing, the amount of e-waste generated is expected to increase to 74.7 million tons in 2030 and reach 110 million tons in 2050.

Taiwan is the world's largest supplier of printed circuit boards (PCB) and the output value of PCB in 2022 was NT\$903.3 billion, up 10.5% compared to the previous year with a global market share of over 30%. Taiwan has a complete and concentrated PCB industrial cluster, and flourishing semiconductor and panel industries. Hence, Taiwan should promote locally sourced materials, recycle precious metals in e-waste, and gradually promote and implement a circular economy. Most e-waste contains precious metals, such as gold, silver, platinum, and copper, which can all be recycled.

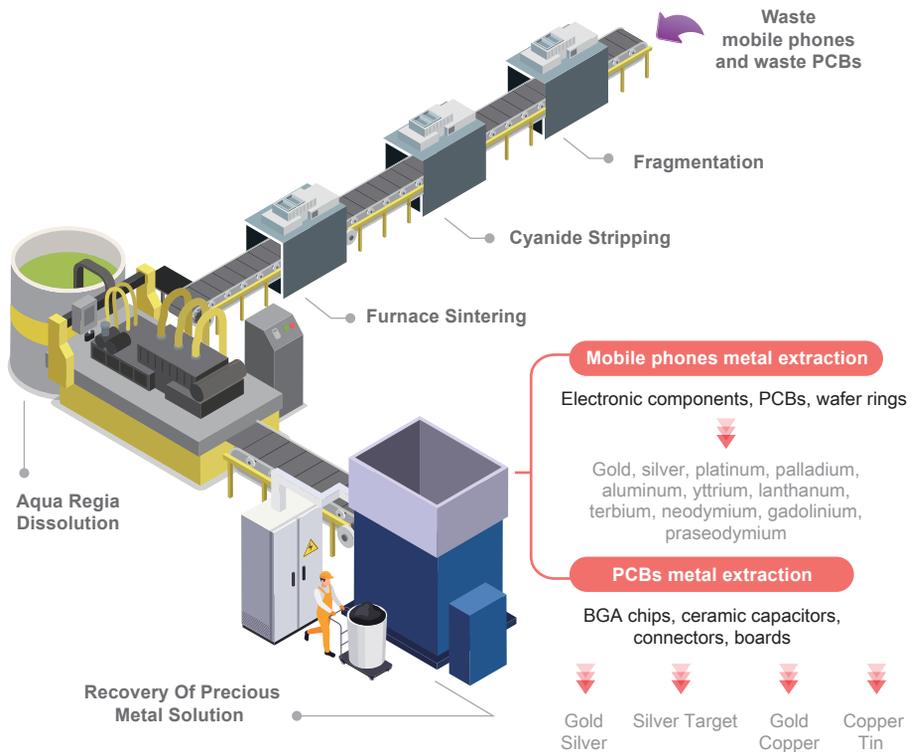


Figure7. Common E-waste Recycling – Metal Extraction Process

Taiwan discards over one million PCBs from digital products alone (such as computers). This number exceeds two million if we include electrical appliances. In recent years, Taiwan has disposed of around 30,000 metric tons of PCBs containing metal content during various processes annually. Additionally, approximately 1,000 metric tons of PCBs with finished components are discarded yearly. Hence, the market price of recycled gold alone exceeds NT\$10 billion. When factoring in copper, silver, and palladium, then the number exceeds tens of billions of dollars. This circular economy approach to PCBs not only helps mitigate their environmental impact but also generates significant economic benefits.

### Total E-waste worldwide

Source : UN 2022 Global Transboundary E-waste Flows Monitor

53.6 million tons in **2019**

74.7 million tons in **2030**



Figure8. Total E-waste worldwide

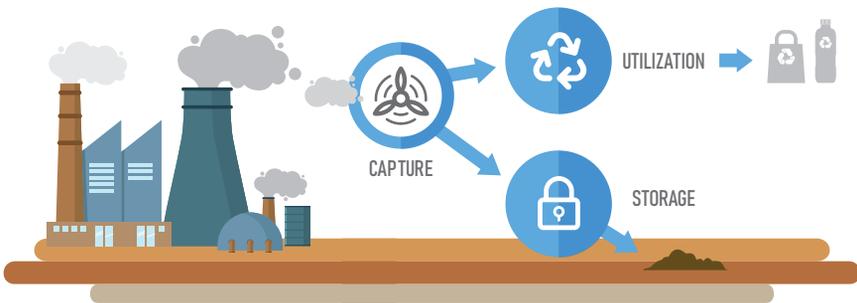


## ► Adopting New Circular Economy Technologies

In response to climate change, achieving net zero emissions in 2050 has become a global consensus. However, this goal appears particularly daunting for certain heavy industries and the power sector. Therefore, the International Energy Agency (IEA) endorses Carbon Capture, Utilization, and Storage (CCUS) as a crucial strategy to resolve this issue.

According to IEA projections, the world needs to capture approximately 1.67 billion tons of CO<sub>2</sub> by 2030 and 7.6 billion tons by 2050 to achieve the goal of net zero emissions by 2050. Considering that global carbon emissions will reach 36 billion tons in 2050, and the capture of 7.6 billion tons of CO<sub>2</sub> accounts for about 21% of total emissions, this means that the global carbon capture market will provide US\$2 trillion in business opportunities.

As such, the EU plans to introduce carbon pricing in 2026, and the Taiwan government will include CCUS as a key strategy for the net-zero transition by 2050. In addition, the Taiwan Carbon Solution Exchange (TCX) was established on August 7, 2023 to actively drive transition in traditional industries (e.g., petrochemical, cement, and steel).



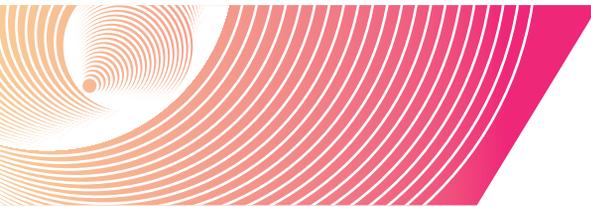
While these industries are actively cooperating with the government's carbon reduction policies, carbon capture and storage technologies still need to be deployed and upgraded for the commercial application of technologies and to seize business opportunities from negative emission technologies.

Carbon capture technology development in Taiwan mainly targets industries with high carbon emissions, such as petrochemical, cement, and steel. Taiwan has achieved notable progress in carbon capture, such as microalgae carbon capture technology, flue gas chemical carbon fixation processes, oxygen-enriched combustion, pure oxygen combustion third-generation carbon capture technology, high-performance carbon fixation, and calcium-based carbon capture with pure oxygen calcination technology. However, there is still room for improvement in the R&D, particularly in "phase two reuse technology."

On the international market, phase two reuse technology has great application potential, and can directly use or recycle CO<sub>2</sub> that is captured for products or services with economic value, such as construction materials (cement, asphalt), industrial gases and liquids (enhanced oil recovery, EOR), fuel (methanol, biomass fuel), polymers (polyurethane foam, polycarbonate), chemical products (preservatives, carbon black), new materials (carbon fiber, graphene), and agricultural and food products (animal feed, cosmetics), thereby creating a mature carbon circular economy.

Taiwan is actively subsidizing research projects for key technologies in the carbon cycle and possesses the necessary R&D capabilities in demonstration fields. Notably, the industry has already generated relevant technological advancements. However, there remains a gap in the development of "phase two reuse technologies" within Taiwan.

Multinational companies will need to collaborate with Taiwanese teams to bridge the gap. Companies can also further develop applications of innovative carbon cycle technologies in order to secure a position in the global carbon circular economy supply chain.



## ► Business Opportunities in E-Waste Recycling

Taiwan is famous for its semiconductor industry, which has the highest output value in the world, and the export value of its mid- and downstream IC packaging and testing and PCB industries ranks first in the world. As the market value of consumer electronics and mobile devices continues to increase, the amount of e-waste generated worldwide has gradually grown (expected to increase to 74.7 million tons in 2030 according to statistics of the UN).

Taiwan currently generates more than 100,000 tons of PCB waste each year, in which more than 60% is nonmetallic waste (approximately 60,000 tons). Despite recycling companies' attempts to utilize crushed PCBs as filling material during the metal recycling process, the quantity employed was insufficient, rendering the PCBs ineffective for recycling and reusing. Currently, there are three main e-waste treatment technologies, the first is mechanical and physical treatment methods, i.e., using different physical methods to crush PCBs, and then use washing or drying to extract the metals needed. The second is the common pyrometallurgy treatment, but it is only applicable to metal recycling, and remaining substances (such as fiberglass cloth) are burned. It also raises concerns about air pollution. The third is hydrometallurgy treatment, such as pickling, electrolysis, and dissolution methods, which use chemical reactions for recycling. This also creates pollution from chemical sludge however. Biological treatment methods take longer and are not suitable for current industry practices.

Taiwan has established mature electronic waste recycling and precious metal extraction technologies. The government continues to drive technological upgrades and encourages electronic companies to implement circular economy, sustainability, and innovation in economic activities to reduce their carbon footprint. However, the development of environmental protection and reuse technologies still requires technical cooperation with leading companies worldwide, such as MESS SAR dry technology, SULFOX wet acid production technology, WSA wet reclamation technology, and SAR technology. Companies should collaborate on new circular economy service models and business opportunities in the electronics industry, in order to provide more eco-friendly high-tech electronics products and further drive the development of green electronics products.



# Investment Incentives



## ► Tax Measures

In addition to establishing a profit-seeking enterprise income tax rate of 20%, the following preferential tax measures are also extended to foreign companies, aiming to incentivize their investments in Taiwan, promote industry innovation, and facilitate collaboration between industry and academia:

Items	Preferential Measures
Develop and Introduce Technologies or Machinery and Equipment	<ul style="list-style-type: none"> <li>■ Companies may deduct up to 15% of their R&amp;D expenses from their profit-seeking enterprise income tax in the current year; or deduct up to 10% of expenses from their profit-seeking enterprise income tax over the course of 3 years.</li> <li>■ 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 Administration, MOEA, exempt from the corporate income tax.</li> <li>■ Import duties are waived for machinery and equipment not manufactured in Taiwan.</li> </ul>
Investments in smart machinery /5G/information security	<ul style="list-style-type: none"> <li>■ Smart machinery: Use big data, AI, and IoT for new hardware, software, technologies, or technical services, such as automated scheduling and flexible or mixed production lines.</li> <li>■ 5G : Related investments include new hardware, software, technologies, or technical services of 5G communication systems.</li> <li>■ Information security: Include investments of companies in new hardware, software, technologies, or technical services for information security products or services into the scope of deductibles.</li> </ul>

Items	Preferential Measures
Investments in smart machinery /5G/information security	<ul style="list-style-type: none"> <li>■ When the investment amount reaches NT\$1 million and above but no more than NT\$1 billion, there are two options for deductibles: “deduct 5% of the investment amount from the profit-seeking enterprise income tax in the current year” or “deduct 3% of the investment amount from the profit-seeking enterprise income tax over three years”; however, the deductible may not exceed 30% of the profit-seeking enterprise income tax payable each year.</li> <li>■ Applicable until December 31, 2024</li> </ul>
Employee stock awards	<ul style="list-style-type: none"> <li>■ Where company employees receive stock awards within NT\$5 million, hold the shares, and continue to serve at the company for two years, they may be taxed at the price when the shares were acquired or transferred, whichever is lower.</li> </ul>
Specific foreign professionals	<ul style="list-style-type: none"> <li>■ Half of the salary income exceeding NT\$3 million of specific foreign professionals that meet the criteria is exempted from inclusion in gross consolidated income.</li> </ul>
Companies in various industrial parks	<ul style="list-style-type: none"> <li>■ Companies in export processing zones, science and industry parks, and free trade zones will enjoy import duty, commodity tax, and business tax exemptions for imported machinery and equipment, raw materials, fuel, supplies, and half-finished products.</li> </ul>
Other	<ul style="list-style-type: none"> <li>■ Undistributed earnings invested by companies may be listed as deductibles and exempted from the profit-seeking enterprise income tax.</li> </ul>

## ➤ Subsidy Measures

### 1. Global Innovation Partnership Initiatives Program

Companies approved by the MOEA may receive subsidies of up to 50% of total R&D expenses. These incentives are designed to encourage foreign companies that complement and mutually benefit Taiwan’s industries to engage in innovation and R&D activities in Taiwan. Activities include the development of advanced technologies surpassing current industry standards in Taiwan, as well as key and integrated technologies needed by industries through collaborative R&D with



Taiwanese companies. These endeavors are expected to have a significant positive impact on domestic industries, such as facilitating the establishment and development of an industrial technology R&D and supply chain, improving R&D efficiency, accelerating the timetable from R&D to industry application, and assisting in the active development of international markets.

## **2. Pioneers for Innovation Leadership on Technology Program**

Companies approved by the MOEA may receive subsidies of up to 50% of their total R&D expenses in order to develop Taiwan into a high-tech R&D center; attract major companies with technological leadership around the world to establish an advanced R&D base in Taiwan; develop prospective technologies and collaborate with domestic industry chains; develop a collaboration system for research, co-creation, and development to strengthen the technical competitiveness of leading industries in Taiwan; and accelerate the development of emerging industry clusters.

## **3. Industrial Upgrading Innovation Platform Guidance Program**

Industrial Development Administration implemented the Industrial Upgrading Innovation Platform Guidance Program to facilitate the development of industries with higher added value. The program encourages companies to develop high-end product applications market, ultimately raising the industry's value-added ratio. For companies with an R&D team in Taiwan, 40% to 50% of project funding is subsidized for theme-based R&D projects, and up to 40% of project funding is subsidized for R&D projects proposed by companies.

Furthermore in 2012, the MOENV began subsidizing corporations with R&D capabilities, companies responsible for handling mandatory recyclable waste, and public/private waste treatment companies, and implemented resource recycling and reuse innovative R&D projects. In accordance with Article 23, Paragraph 2 of the Resource Recycling Act, the MOF promulgated the Regulations Governing Deductibles for Investments by Resource Recycling and Reuse Companies in Equipment and Research on July 31, 2007. Eligible companies are those defined by regulations established under Article 15, Paragraphs 2 and 4 of the Resource Recycling Act and may apply for tax reductions or exemptions.

Going forward, the government will continue to assist companies in driving the transition and reengineering of production and consumption systems, and resolve issues with resource shortage, waste, and pollution from the source. This will also create new business models, ways to profit, and employment opportunities.

# 05 Taiwan Representative Companies

## ► Circular Economy

### FAR EASTERN NEW CENTURY

[www.fenc.com](http://www.fenc.com)



Established in 1945, Far Eastern New Century is a subsidiary of the well-known Far Eastern Group in Taiwan and mainly involved in yarn, fabrics, dyeing and finishing, and garments.

The company began recycling and reproducing plastic bottles in 1988 for sustainable development and environmental protection. It made a breakthrough in applications in 2010 and began producing R-PET that meet requirements for food-grade packaging applications, becoming the largest R-PET manufacturer in Asia and second largest in the world.

The company obtained approval from the Taiwan Food and Drug Administration (TFDA) in 2022, and became the first company to receive approval in Taiwan to produce “R-PET for food containers and packaging.” The technology has been recognized by major beverage brands around the world, and the company has become an important supplier of sustainable packaging materials for global brands.

### CHUNGTAI RESOURCE TECHNOLOG CORP.

[www.chinalab.com.tw](http://www.chinalab.com.tw)



Established in 2001, Chungtai Resource Technology Corp.’s main businesses include: recycling and treatment of waste lighting sources and mercury containing waste, and recycling and treatment of waste PCBs. The company has established new pyrolysis and incineration facilities, heat recovery electricity generation system, and bottom ash reuse facilities, and provides total solutions for waste recycling, including: incineration, solidification, chemical, and cleaning. The company actively cooperates with the government’s circular economy and renewable energy policies.

## SUNNY FRIEND ENVIRONMENTAL TECHNOLOGY CO., LTD.

[www.sunnyfriend.com.tw](http://www.sunnyfriend.com.tw)



Established in 1994, Sunny Friend became the base for environmental protection of the Ruentex Group in 2001, and became the first company in Taiwan to specialize in the incineration of biomedical waste. Sunny Friend has comprehensive waste treatment experience from R&D, design, drawing, operation, to system modification.

A technological pioneer, the company currently has successfully applied overseas technologies in hazardous waste treatment in Taiwan and overseas. The company also engages in hazardous waste clearance, incineration, solidification, materialization, and landfill treatment. It effectively integrates hazardous waste treatment services across upstream, midstream, and downstream.

## FGD Recycling Industrial Co., Ltd.

[www.fgd.com.tw](http://www.fgd.com.tw)



Established in 1997, this leading Class A waste treatment company is the largest company in central Taiwan. Ranking first MOENV evaluations for several years consecutively, it maintains service locations in Taiwan, Hong Kong, Shenzhen, and Shanghai.

Main businesses include: Environmental protection (e-waste recycling and treatment), machinery R&D (environmental protection equipment turnkey), recycling (waste plastic recycling, sorting, and selection), and Class A refining (e-waste, tailing recycling and refining).



## ► Precious Metal Recycling

UWIN NANOTECH CO., LTD.

[www.uwin-nano.com](http://www.uwin-nano.com)



Established in 2009, UWin Nanotech is the most complete supplier of eco-friendly stripping agents in the world, and its businesses include: eco-friendly stripping agents for gold, silver, palladium, nickel, tin, copper, aluminum, titanium, stainless steel, tungsten titanium, and ITO. It is able to quickly and efficiently strip specific metals from e-waste, PCB, or hardware. The process is safe and toxic-free, and creates greater economic benefits through recycling and reuse.

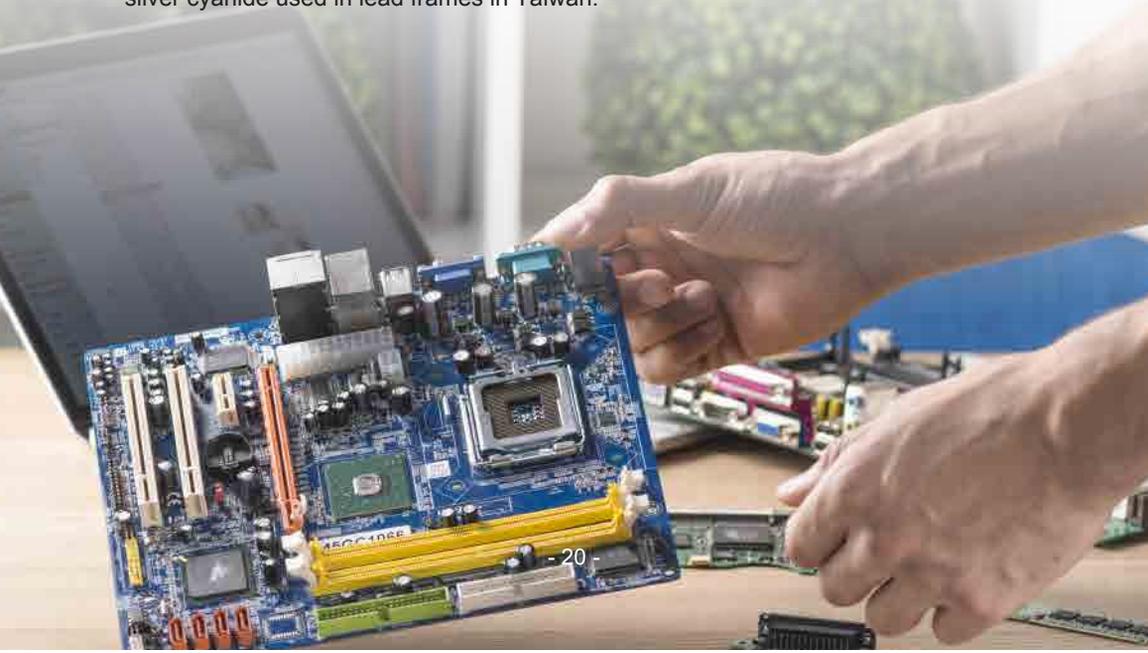
SOLAR APPLIED MATERIALS TECHNOLOGY CORP.

[www.solartech.com.tw](http://www.solartech.com.tw)



Established in 1978, Solar Applied Materials Technology is the largest manufacturer of optical data storage thin-film targets in the world. It also engages in precious metals and rare metals recycling and refining, special forming, processing, and sales worldwide.

Solar Applied Materials Tech's main products lead the market, making the company the world's largest manufacturer of thin-film targets for optical discs and targets for hard disks. It is also the largest supplier of potassium gold (III) cyanide and potassium silver cyanide used in lead frames in Taiwan.



## Jiin Yeeh Ding Enterprise Corp.

[www.jyd.com.tw](http://www.jyd.com.tw)



Established in 1997, the company's headquarters is located in Hsinchu. A domestic IT waste treatment company, Jiin Yeeh Ding is positioned as a precious metal recycling technology company that mainly engages in the clearance and treatment of e-waste, refining and sales of precious metals, and resource recycling and reuse.

The company has a Class A waste clearance and treatment permit and uses innovative recycling technology to extract 99.99% pure gold, silver, palladium, and platinum from e-waste, solving the issue of e-waste generated by high-tech industries.

## Super Dragon Technology Company Limited

[www.sdti.com.tw](http://www.sdti.com.tw)



Established in 1996, Super Dragon Tech mainly engages in business waste recycling and treatment and precious metals refining; it is able to refine gold to 99.95% purity and silver to 99% purity, which are widely accepted in the market, and its products are sold to jewelry stores and special purpose companies.

[Products and services]:

1. Sale of copper, tin, and aluminum.
2. Precious metal recycling/sale and applied materials manufacturing (targets, gold salt).
3. Waste IT product recycling, treatment, and semiconductor component cleaning.



## Examples of Foreign Investment

### ▶ Taiwan Cube Energy (TCE) - First Private Waste-to-Energy Plant in Taiwan

Taiwan Cube Energy (TCE) held a ground breaking ceremony at the Taoyuan Technology Park in 2021. This marked the beginning of development and construction of the first private renewable energy power plant in Taiwan. Unlike power plants that generally use fossil fuels, this power plant uses domestically produced solid recovered fuel (SRF) that meet standards of the EU and MOENV for electricity generation. After its projected completion in 2025, it will be able to convert 150,000 tons of SRF to generate 160 million kWh of electricity from renewable energy.

### ▶ REMONDIS Makes Largest Overseas Investment in Taiwan

Major German recycling company REMONDIS began construction of the phase one plastic recycling plant at the Fangyuan Industrial Park in Changhua, Taiwan in October 2021. The investment amount reached NT\$1.5 billion and production is expected to begin in December 2023, increasing plastic recycling and treatment capacity by approximately 1,200 tons per month.

REMONDIS and LEALEA Group jointly established REMONDIS LEALEA Corporation Limited for SRF, which uses wind power, steam, and heat medium generated with green electricity from LIBOLON for all processes from bottle flakes to pelletizing. This is provided to the recycled bottle flake plant of REMONDIS and the recycled pellets are provided to LIBOLON's spinning plant for production.

# PCB Flake to Chip (REMONDIS) by Green Energy of LIBOLON

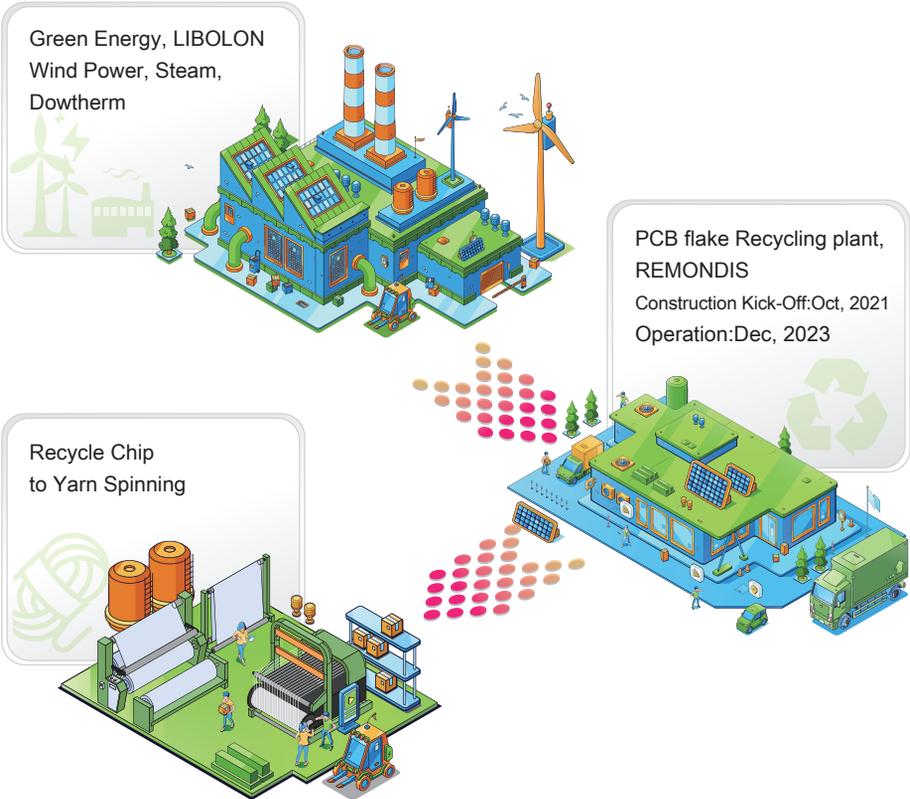


Figure 9. LIBOLON Green Energy and Circular Economy Project (source: LEALEA Group)

# 2023

## Taiwan Circular Economy Industry Chain



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# 2023

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