



# Overview and Case Studies on Resource Recycling in R.O.C. 2013

APO Center of Excellence on Green Productivity



Center of Excellence on Green Productivity

Asian Productivity Organization



## About the APO

The Asian Productivity Organization (APO) is a non-profit, non-political international partnership of Asian countries established by its member countries to provide technical and management service to industrial, agricultural and service sectors in order to promote economic prosperity and improve the living standards of people living in those countries.

The APO was established in Tokyo on May 11, 1961. The organization currently includes twenty member countries: Bangladesh, Cambodia, Republic of China(ROC), Hong Kong, Fiji, India, Indonesia, Iran, Japan, Korea, Laos, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam (Hong Kong 1997 suspension). Member countries are represented through each country's National Productivity Organization (NPO). The ROC representatives participate in APO projects through China Productivity Center (CPC).

## About the APO COE GP

In 2013 the Asian Productivity Organization established the Center of Excellence on Green Productivity (APO COE GP) in ROC. ROC is a founding member of APO and has been pursuing success in the field of green productivity for a long time. The Government of ROC commits to share with member countries in the pursuit of this aspiration and would like to be a catalyst through hosting the APO COE GP.

We look forward to using this platform to share ROC's experience, contribute to the green growth of other member countries, promote regional innovation and sustainable development, and jointly with member countries to enhance green productivity and competitiveness.

The APO Center of Excellence will ensure ROC's long-term cooperation with member countries in APO projects and domestic and foreign investment experts. Through training exercises and benchmarking visit exchanges, APO will assist Member Countries in enhancing green productivity and innovation to create a sustainable green economy.



# Overview and Case Studies on **Resource Recycling** in R.O.C. 2013

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The 55th session of the Asian Productivity Organization (APO) Governing Body Meeting in Tokyo in May 2013 approved the establishment of the APO Center of Excellence (COE) on Green Productivity in the Republic of China. Managed by the China Productivity Center, this center supports the APO in promoting and implementing related projects and is an example of the importance of the GP issue across the world.

At a time when environmental awareness is becoming increasingly important and consumers favor environmentally friendly products and services, this manual looks at ways to support APO member countries in the implementation of GP models in the fields of Resource Recycling, Green Energy, Green Factory and Ecological Agriculture Innovation, including the diffusion of related tools and techniques for GP models.

I would like to take this opportunity to thank the APO and the local implementing organizations for their hard work in making this manual available. My special thanks also go to the R.O.C. government's Ministry of Economic Affairs, Ministry of Foreign Affairs, Council of Agriculture and Environmental Protection Administration for their guidance and support.

The implementation of the COE plan is of great significance in terms of the effectiveness of industrial upgrading and international linkage. We hope to use this opportunity to share the results of the promotion of GP and to promote the sharing of knowledge and cooperation opportunities. It is hoped that through close interaction with APO members, all stakeholders worldwide will jointly improve GP in the Asia-Pacific region.



Mr. Sheng-Hsiung Hsu

December 15, 2013

Chairman of the APO Center of Excellence on Green Productivity Advisory Committee  
APO Director for Republic of China (R.O.C.)  
Chairman of China Productivity Center

Against simmering concerns over climate change and energy resources, the world is being driven to go green. Governments across the world now promote low-carbon economies and industrial upgrades while fine-tuning domestic energy and trade policy decisions. It remains to be seen how the world facilitates the synergy of industrial growth, improvements in entrepreneurship and leverages competition in the name of sustainable development.

As one of the Asian Productivity Organization (APO) founding members, the Republic of China (R.O.C.) is active in relevant events and has witnessed the socioeconomic development of member countries for five decades. The APO Center of Excellence (COE) on Green Productivity (GP) symbolizes the arrival of a new era in green technology, one in which R.O.C. and other APO members will play key roles in the green economic development of the Asia-Pacific region.

The Industrial Development Bureau is proud to have received the affirmation of the APO and its members by having the APO COE on GP established in R.O.C. and has given its full support. We aim to use this platform to engage in close cooperation with the APO Secretariat and APO members, especially in the fields of Resource Recycling, Green Energy, Green Factory and Eco-Agriculture. It is also hoped that these publications encourage businesses worldwide to work together to promote green productivity for future sustainable development.

We would like to express our sincere thanks to everyone who has been involved in creating this manual and we appreciate the invaluable support from APO and R.O.C.'s cross governments. In the near future, the IDB looks forward to bridging the cooperation opportunities with member countries and working closely with industry to jointly promote green productivity for industrial development.

Industrial Development Bureau  
Ministry of Economic Affairs, R.O.C.  
December 15, 2013



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Finally and most important, we would like to thank the Environmental Protection Administration, Industrial Development Bureau, and the Taiwan Green Productivity Foundation whose generous support brought this project to fruition.



## I 1. Introduction

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Recognized as a global leader in sustainable development, the Republic of China (R.O.C.) has been awarded the honor of hosting the Center for Excellence on Green Productivity (COE GP) by the Asian Productivity Organization (APO). The COE GP was launched in June 2013 with the mission of enhancing, demonstrating, and sharing Taiwan's experiences in GP with other APO member-nations. In order to fulfill this goal, a series of activities including workshops, research, and regional/international visits by expert delegates will be conducted from 2013 to 2015.

The overview and case studies in the R.O.C. in this manual contain technical and practical information on

four separate themes—namely, (1) resource recycling, (2) green energy, (3) green factory, and (4) agricultural innovation—while also detailing the global status, technological development, and corresponding policies within each area. The 2013 manual is based on independent studies by leading research institutes in Taiwan and its case studies demonstrate the best practices on policy implementation and technology application within public and private sectors.

With the publication of the 2013 manual on Overview and Case Studies on Resource Recycling in R.O.C., the COE GP wishes to convey its utmost sincerity in leading the international community toward a more productive and sustainable future.

## 2. Resource Recycling: Global Status and Trend

The World Trade Organization (WTO) defines natural resources as “stocks of materials that exist in the natural environment that are both scarce and economically useful in production or consumption, either in their raw state or after a minimal amount of processing.” Over the years, the substantial increase in the amount of solid waste and the indiscriminate disposal of waste had brought forth serious environmental pollution issues. Thousands of workers across Asia have been dismantling electronic waste with chisels and cutting torches since the 1980s. Southern Taiwan along with many cities in Asia have turned into dumping sites for e-waste and other waste materials from the West. Precious metals are usually recovered from circuit boards by acid baths and open burning, which cause serious air pollution and

generate wastewater. These processes also damage the environment and public health in countries that lack proper infrastructure for dismantling and recovering the waste materials in a safe and sound manner (shown in Figure 2-1).

According to the United Nations (UN), the world population will increase by 20% to reach 8 billion, and the global average GDP/capital (GDP/c) will increase to one and a half times the current value sometime around 2025. Obviously, both the increase of the population and the remarkable growth of global GDP/c will drive an increase in the volume of waste. At the same time, waste composition will keep changing due to the production, consumption, and inclusion of more and more complex products. Personalized medicine,



Figure 2-1. Untreated e-waste severely pollute the environment

new computers and gadgets, networked homes and full-home management systems, fully-customized consumer products, personal security and personal energy products are the latest technological creations. It goes without saying that the present waste management systems and resource-recycling technologies cannot handle the increasing amount of waste being generated, and this is especially true for impoverished countries.

Two major global trends for resource recycling are as follows:

- (1) The rapidly-growing stream of waste electrical and electronic equipment (WEEE) continues to be a pressing challenge and is directly related to waste trafficking. As the world becomes increasingly-interconnected and as electrical and electronic products (i.e. PCs, gadgets, digital cameras) are quickly devalued and become obsolete, the expansion of the WEEE stream will become an even greater challenge for waste management in the years to come.
- (2) Many governments around the world have hailed the hi-tech and 'green' industries as beacons of hope lighting the way towards economic recovery. The demand for precious or rare earth materials as new artificial materials for use in e-technologies and 'green' industries has quickly transformed into an international topic of concern.

### ► 2.1 WEEE Recycling

E-waste is defined as electrical or electronic equipment discarded as waste, including all components, subassemblies and consumables that are part of the product at the time of discarding. It includes televisions, mobile phones, computers, and entertainment electronic devices that consist of valuable as well as harmful and toxic components. Figure 2-2 shows that the amount of e-waste generated around the world has reached 17 million tons/year, with the major e-waste contributors coming from the United States and Europe.

Illegal exports of e-waste to Asia and Africa are on the rise. Illegal shipments of such waste to new European Union (EU) member states have resulted in air, water, soil, and habitat pollution, creating severe health risks for residents and factory workers. Recent data show that on average 9.3 million tons of e-waste are placed on the market in the EU-27 every year. It has been forecasted that WEEE generation will reach to 12.3 million tons by 2020, which represents 24 kilograms of WEEE per EU resident per year. However, 90% of the e-waste buried in landfills, incinerated, or recovered without pre-treatment contains hazardous materials. Faced with the fast-growing waste stream and severe environmental issues, the EU recently passed legislations to restrict the use of hazardous substances in electrical and electric equipment (Restriction of Hazardous Substances Directive, RoHS 2002/95/EC) and to promote the collection and recycling of such equipment (Directive 2002/96/EC). These measures have been enacted since February 2003. Directive 2002/96/EC on WEEE is a key element of the EU's environmental policy on waste management and addresses a particularly complex waste flow as it deals with a variety of products, different materials and components, diverse hazardous substances, and varying growth patterns. This policy seeks to prevent and reduce waste while also improving the environmental performance of all operators involved. Another aim is to induce design modifications that make e-waste easier to dismantle, recycle, and recover. The objectives of WEEE of Directive 20/96/EC include:

- Divert WEEE from landfills and incinerators to eco-friendly reuse, recycling, and other forms of recovery
- Preserve resources, raw materials, and energy
- Encourage producer responsibility
- Integrate national measures on WEEE management, putting in place common minimum standards for treatment

Furthermore, the RoHS directive enacted on July 1, 2006 reduces the amount of hazardous substances dispersed through waste management operations, especially shredder residues that are contaminated by hazardous materials. Unlike in the original RoHS Directive, the European Commission's (EC) environmental strategies now must take into account the aims of the Lisbon strategy and consider issues such as economic growth and employment. Another fundamental change is that the RoHS substance restrictions would be imposed only if the substance poses an unacceptable risk to human health and the environment. Previously, the approach was based on a principle of precaution. Specified in Annex I, the scope of the RoHS is no longer linked to the scope of the WEEE Directive. The new Annex I includes two

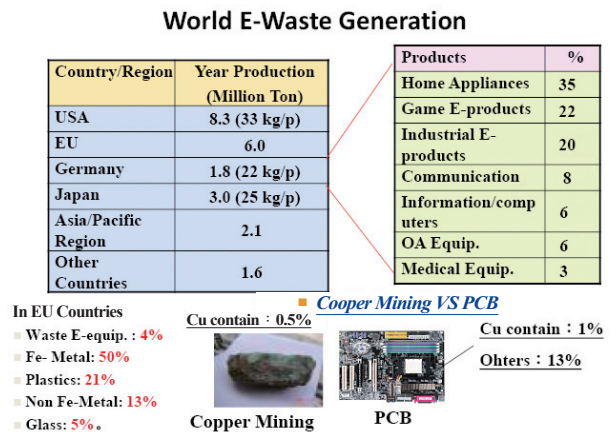


Figure 2-2. E-waste generation around the world

## International E-waste Regulations

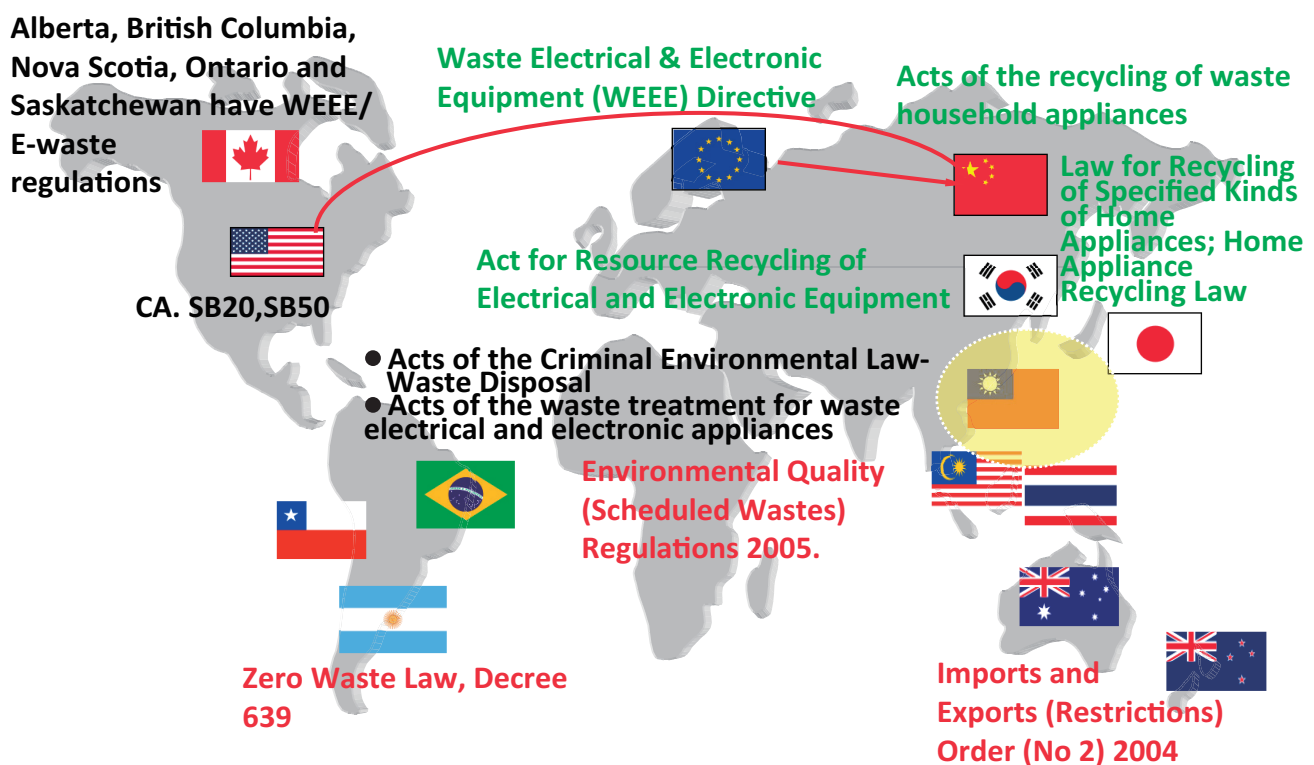


Figure 2-3. International E-waste Regulations

additional categories: Medical Devices (category 8) and Monitoring and Control Instruments (category 9).

Globally, the consumption of electric and electronic products have reached an unprecedented scale. As such, an exponential increase in e-waste is an international issue of concern. Since e-waste in many areas of the world does not undergo proper treatment, many countries are already feeling the effects of air, water, and soil pollution along with the resulting health risks. Many countries have already enacted legislations, focusing their efforts on the management of WEEE and seeking to mitigate the deleterious effects of WEEE on the environment, to recover valuable components in e-waste for reuse, and to develop new techniques and technologies to facilitate resource recovery. Figure 2-3 showcases the new laws and regulations on e-waste recycling and treatment that have been implemented in different parts of the world.

## ► 2.2 Raw Materials Demand in the Green Industry

In November 2008, the EC presented a Communication to the European Parliament and Council titled, “The Raw Materials Initiative – Meeting our Critical Needs for Growth and Jobs in Europe.” Given the increasing global demand from new emerging powers for raw materials and possible concomitant supply shortages, this initiative aims to provide a policy response to Europe’s growing concerns regarding access to raw materials.

Outlining an integrated strategy to ensure access to raw materials at fair market prices on non-discriminatory terms, the Raw Materials Initiative is built on three key pillars: (1) providing access to raw materials in world markets at undistorted conditions, (2) maintaining a sustainable supply of raw materials from European sources, and (3) reducing the EU’s consumption of primary raw materials. This measure identified 41 minerals and metals that are of strategic

importance to Europe, and of these 41, 14 are classified as “critical” based on the two factors of supply risk and environmental country risk.<sup>1</sup>

According to the Renewable Energy Policy Network for the 21st Century (REN21), global new investment in renewable power and fuels was USD 244 billion in 2012, down 12% from the previous year’s record amount of USD 279 billion. Despite the setback, the total in 2012 was the second highest ever and 8% above the 2010 level. As renewable energy takes off, China, which controls 97% of the global supply of rare earth elements (REEs), a critical raw material to the development of most renewable technology, has tightened its supply. As industries and governments worldwide scramble to formulate solutions, the complex process of recycling rare earths has been pushed into the spotlight.

In the United States, renewable energy accounted for an estimated 25% of its newly-installed generating capacity in 2010 and made up 11.6% of the country’s total capacity by the end of 2010. Meanwhile China added approximately 29 GW of renewable capacity, which accounts for around 26% of its total capacity. Also, in 2010, renewable energy accounted for about 41% of new capacity in the EU, representing 22.6 GW of total installations. Globally, wind capacity was increased to 39 GW, taking its total capacity to 198 GW. Whereas, existing solar photovoltaic (PV) capacity grew to 72% in 2010 to around 40 GW in total capacity.

A recent report by the Stratfor Global Intelligence Service finds that a typical 1.5-MW wind turbine requires about 350 kg of REE, mostly neodymium. REEs are a set of 17 elements within the periodic table, which despite their name, are almost all relatively plentiful in the Earth’s crust, with cerium being just about as abundant as copper. However, these elements are highly dispersed, and it is rare to find them in their concentrated rare earth mineral form.

<sup>1</sup> Environmental country risk assesses the risk that producing countries might strive to improve their poor environmental performance and in so doing place regulations on the supply of raw materials to Europe.

The scarcity of concentrated deposits of REEs, as shown in Figure 2-4, means that by comparison to other materials, they are only available in tiny quantities. The U.S. Congressional Research Service (CRS) estimates that the global production of all 17 REEs combined amounts to just 124,000 tons annually, whereas, the world demand is 134,000 tons per year and projected to rise to 180,000 tons by 2012. According to the CRS, new mining projects could take up to 10 years before reaching production, and the shortfall is currently being met by previously-mined stocks. The CRS estimates that China controls roughly 97% of the world's entire production capacity of REEs. While REEs are extremely valuable, the refining of these elements is extremely harmful to the environment as the process involves boiling acid and other toxic chemicals.

The Öko-Institut recommends taking action in the short-term to first establish an European recycling

scheme for REEs based on the following steps before looking towards large-scale implementation:

- Form a European competence network that consists of recyclers, manufacturers, and politicians,
- Conduct basic research as few companies in Europe are involved in rare earth refining.
- Implement material flow analysis to identify the main waste streams,
- Integrate REE waste collections into existing schemes such as the WEEE Directive,
- Organize major R&D projects to examine complex chemical processes,
- Analyze whether the European Investment Bank could reduce financial risks for investments, and
- Adapt the legal EU framework to optimize post-consumer rare earth recycling.

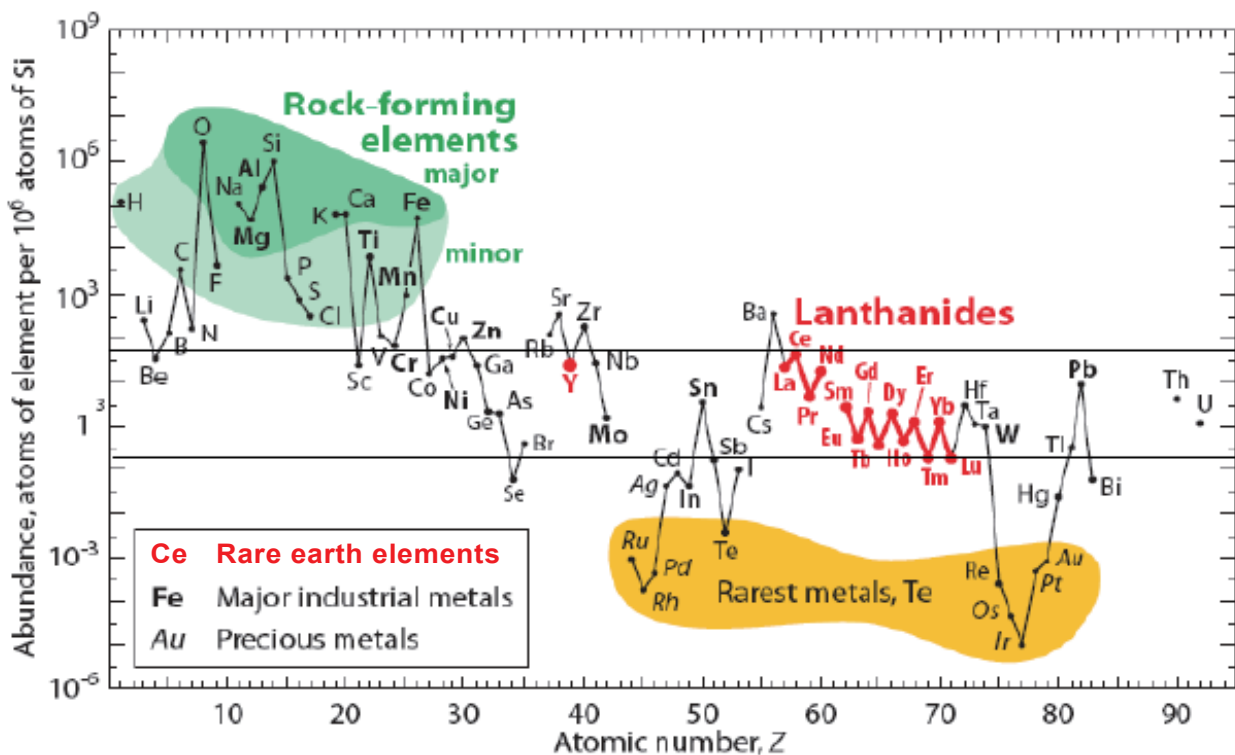


Figure 2-4. Abundance of precious metals and rare earth elements



In 2009, Japan also published a similar document entitled, "Strategy for Ensuring Stable Supplies of Rare Metals." As one of Japan's keys strategies for securing rare metals, including REEs, the plan calls for recycling scrap materials. Like the U.S., for many years, Japan has maintained a national strategy of stockpiling enough metals to cover 60 days of domestic demand. Their stockpile includes seven metals, namely chromium, cobalt, manganese, molybdenum, nickel, tungsten, and vanadium. Besides recycling, the measure also urges the government to facilitate the recovery of used rare metals through a three-prong approach: (1) establishing a new recycling system, (2) strengthening the utilization of the existing system, and (3) promoting the R&D of recycling technologies. In addition, Japan's environmental ministry has recently set out plans to develop a system for recycling the rare and precious metals used in 45 different gadgets including mobile phones. The Japanese government has earmarked around USD 1.2 billion for research on recycling REEs, opening new supply routes, and stockpiling REEs. As part of this push, Japan's Ministry of Economy, Trade, and Industry selected Tokyo-based Hitachi to head efforts to find technology solutions for recycling rare earth metals from "urban mines." Presently, Hitachi has developed a method to recycle high-performance rare earth magnets from the motors of hard disk drives, air conditioners, and compressors.

### 3. Key Resource Recycling Policies in the R.O.C.

Promulgated in 1974, the Solid Waste Disposal Act (WDA) has already been amended several times. Many of these amendments were made during 1980 to 1987 when Taiwan's economy, industry, and commerce began to flourish. While the economy prospered, Taiwan also saw unprecedented levels of environmental pollution. The construction of sanitary landfills and incineration plants did not mitigate the

problem as it was expected to. In 2001, the Solid WDA was amended in compliance with the Zero Waste Policy, focusing on the prevention of arbitrary waste disposal. The major policies and regulations related to municipal solid waste (MSW) management in Taiwan are illustrated in Figure 3-1.

The initial Solid WDA only regulated end-of-pipe

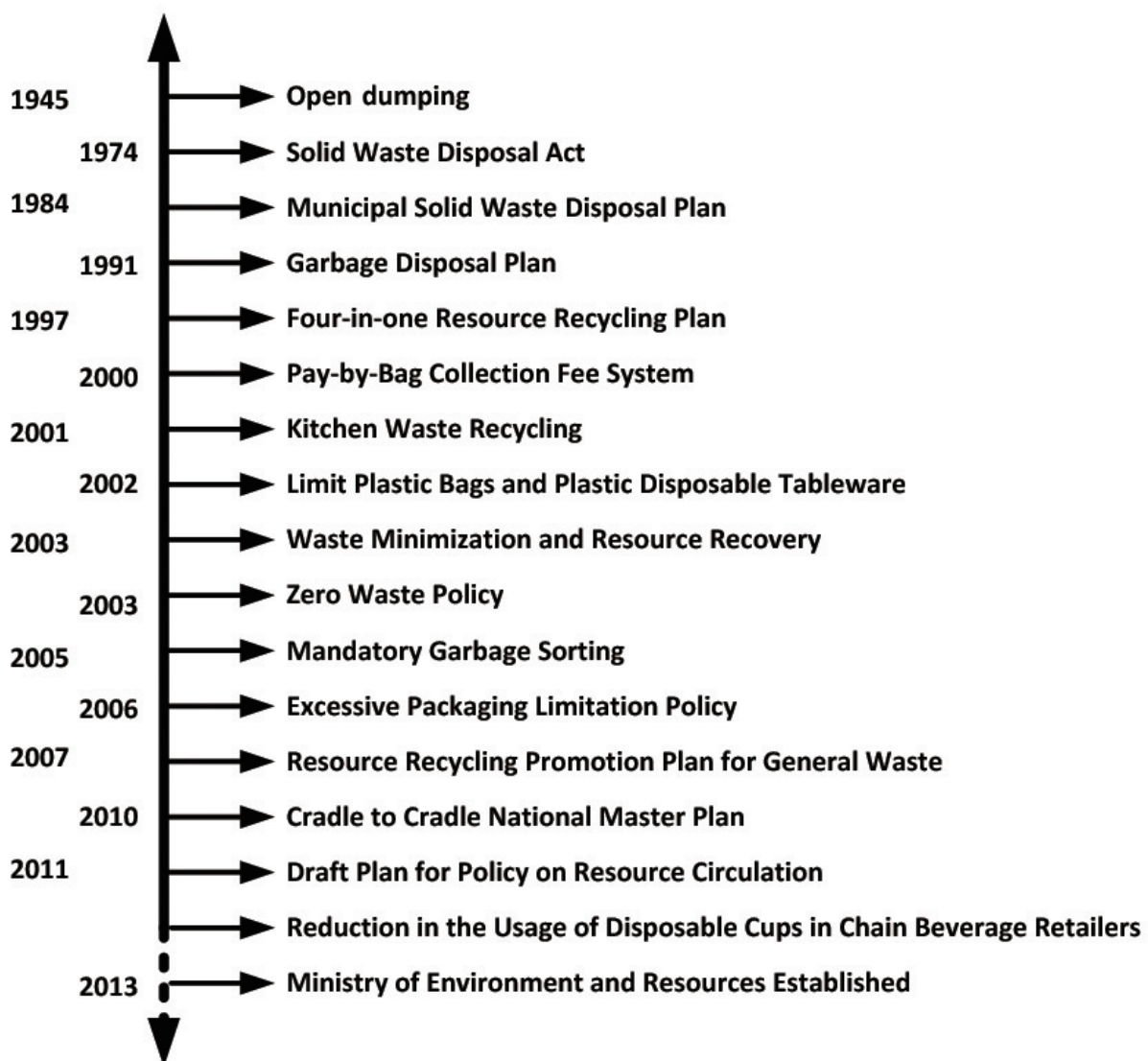


Figure 3-1. Major Policies & Regulations Related to MSW Management in Taiwan

Source: Environmental Protection Administration, 2012

control and did not govern the entire product life cycle. Thus, new legislation that encouraged enterprises to employ renewable resources and guided them in designing and producing easy-to-recycle products was greatly needed. In 2002, the Resource Recycling Act (RRA), which comprised of six chapters and 31 articles, came into effect. Key features of the Act included implementing resource recycling, expanding and diversifying recycling approaches, and varying recycling methods for different products. All citizens were encouraged to participate in order to achieve the goal of “comprehensive resource recycling for zero waste.” Key principles based on the prerequisite of feasible technological and economic conditions were established for substance use and waste management.

### ► 3.1 Current Status of Industrial Waste Recycling

Taiwan is a key player in the global information and communications technology (ICT) industry. This high-tech island is a leader in various industries including

notebook computers, wafer contract foundries, IC encapsulation testing, and IC design. The R.O.C. remains as the world’s top producer of notebook computers, producing a monthly average of over 14 million units. Yet, Taiwan is not only a leader in the technology industry. It has also seen successes in reducing waste. The average volume of MSW generated per person decreased from 1.14 kg/day in 1998 to 0.48 kg/day in 2012. Moreover, according to the Industrial Waste Recycling Promotion Program implemented by the Industrial Development Bureau (IDB), out of the 17.1 million tons of industrial waste generated in 2013, 13.8 million tons (approximately 80.5%) were recycled. The IDB also estimated that, in 2013, there were 1,467 factories in the industrial waste recovery business, generating USD 2.19 billion in revenue. These included factories from the chemical, electrical, and bio-engineering industries, and many of which were reusing waste as alternative materials to produce recycled products such as aggregate raw material, soil amelioration, bricks, cement, concrete, paper products, reclaimed rubber, solvents, etc. In the

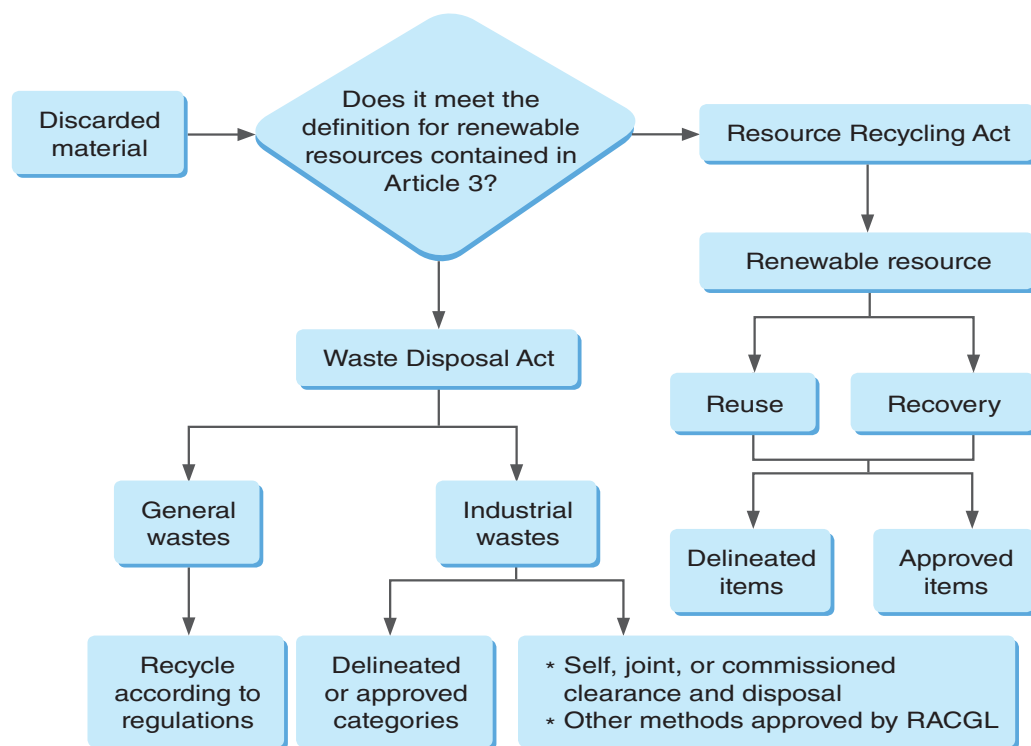


Figure 3-2. Regulations on waste recycling

steel, cement, paper, and power generation industries, waste was recycled as auxiliary fuel. The R.O.C. policy on waste management features waste prevention, reuse, recycling, and other forms of recovery and disposal. A sure sign of success is when the population and economy continue to grow and prosper without increasing the amount of waste generated.

In order to legally reuse industrial waste materials, companies must comply with several key regulations: the WDA, RRA, Waste Recycling Management Regulations, and the Resource Recovering Management Regulations. In order to determine which of these regulations to reference when recycling waste, enterprises must first identify whether the material fits the definition for renewable resources under Article 3 of the RRA (i.e. substances that have lost their original usefulness, are economically and technologically feasible to recycle, and may be reused or recovered as delineated or approved by the RRA). If the material indeed meets the definition, the RRA and its related regulations should be followed. If not, the company should look to and apply stipulations in the WDA and its associated regulations. The process for identifying the relevant regulations is depicted in Figure 3-2.

The RRA encompasses the major regulations governing the recycling of renewable resources and its goals are to conserve natural resources, promote the recycling and reuse of materials, mitigate environmental loading, and build a society where resources are used sustainably. The five chapters of the RRA covers general provisions, source management, operational management, assistance and incentive measures, and penal provisions. On the other hand, enterprises reusing or recovering renewable resources should comply with the Renewable Resource Recovery Management Regulations and report to the appropriate governing authorities.

If the material does not fall under the RRA, then it must be recycled according to Article 39 of the WDA. Reuse of industrial wastes should be conducted in

accordance with provisions prescribed by the Responsible Agency for the Industry at Issue at Central Government Level (RAICGL). Enterprises recycling industrial wastes should comply with the Waste Recycling Management Regulations promulgated by RAICGL. There are 85 categories of industrial wastes stipulated in the Waste Recycling Management Regulations, and 53 categories of them come from manufacturing industries. If waste items belong to the delineated categories, enterprises can recycle them in accordance with the prescribed methods without requesting special permission. If not, they can apply for a recycling permit from RAICGL.

Waste disposal policy in Taiwan progressed from being centered on waste disposal technologies to focusing on resource recycling. Yet, the focus today has shifted to source reduction, which stresses recycling and encourages enterprises to use ecological designs to achieve resource reuse maximization and waste minimization (zero waste) while fostering the importance of sustainable substance circulation within management levels. Source reduction brings multiple benefits such as lowering operational costs, enhancing corporate image, and decreasing solid waste generation. During the initial period of various source reduction promotions, the IDB and Environmental Protection Administration (EPA) offered resource guidance to environmental groups, enterprises, and local governments in order to encourage more and more industries and organizations to join the effort.

### ► 3.2 The EPA Recycling Fund

In 1997, the EPA began promoting the 4-in-1 Program, which allowed enterprises that were unable to recycle wastes for which they are responsible to pay a recycling, clearance and disposal fee to the Resource Recycling Management Fund. The Fund Management Committee utilized the fund as an incentive to integrate local sanitation fleets, communities, and recycling firms to promote resource recycling. The products listed for recycling included electronic appliances, data processing objects, and lighting equipment.

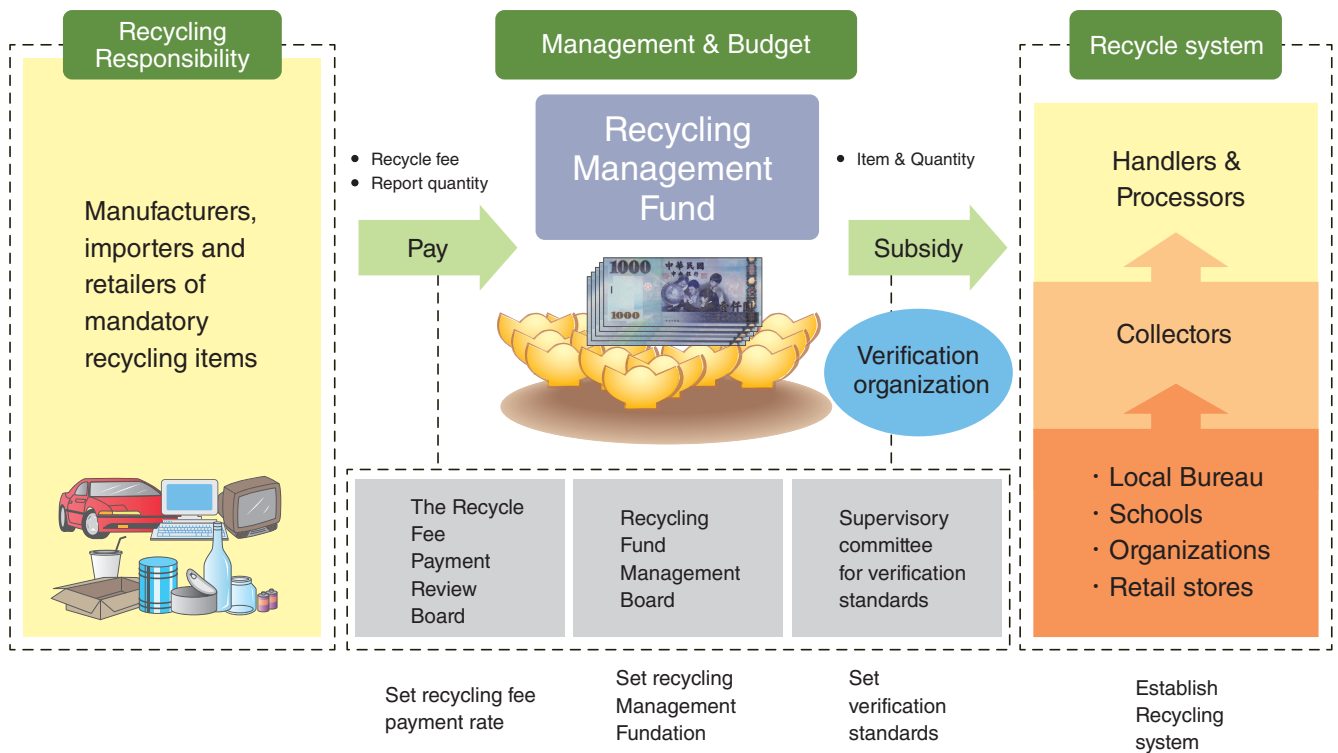


Figure 3-3. Operation of Resource Recycling Management Fund

Source: Environmental Protection Administration, 2012

Integrating communities, recycling firms, local governments, the 4-in-1 Program employs the recycling fund to expand resource recycling. Local communities established recycling centers to sort resources and general household garbage, which is then collected at recycling points or by local sanitation fleets or private recycling firms. The fund subsidizes local sanitation fleets and recycling firms, helping them establish comprehensive recycling systems to recycle resources effectively.

The fees paid by manufacturers/importers of objects or containers are used to establish a Resource Recycling Management Fund, which subsidizes the recycling and disposal of objects or containers and provides incentives for residents to engage in resource recycling. The fees are determined by the Committee based on factors such as material, volume, weight, recycling value, and the previous year's recycling rate. The Recycling Fund provides subsidies to entities after the EPA has confirmed that the appropriate quantity of resources has been properly recycled and disposed

of. The 4-in-1 Program is illustrated in detail in Figure 3-3.

There are currently 33 items (Table 3-1) in which manufacturers/importers are responsible for in terms of recycling, clearing, and disposing. Annually, the Recycling Fund is valued at over NT\$60 million and is divided into two parts: 70-80% is trust fund, used to fund subsidies for recycling and disposal, and the other 20-30% is a non-operational fund, used for subsidizing recycling machinery and storage sites for local sanitation fleets; rewarding communities, agencies and schools for engaging in recycling; as well as funding publicity, audits, inspections, executive administration, and research development.

Diversified recycling channels for resource recycling in Taiwan center on two major systems. The first is a civil resource recycling system that includes trash collection and incentive recycling programs for usable yet outdated products. The other system is the local government recycling system, which collects

resources that have been pre-sorted by local communities via recycling trucks. In terms of the categories of waste, the first category is wastes or containers that are to be recycled, cleared, and disposed of by manufacturers/importers. The other category includes waste that is worth recycling, and is a category of recycling that can operate on its own without subsidies and government interference. For waste that falls under these two categories, the items must be pre-sorted for pick-up by sanitation fleets on the designated collection day. After collection, local sanitation teams will classify the resources or entrust recycling firms to sort the items based on the materials and send the resources to various recovery plants for reuse.

Taiwan has established a labeling system (Figure 3-4) to help the public distinguish recyclable items and general garbage. Besides complying with the 4-in-1 Program, manufacturers and importers have also been

requested to place recycling labels on recyclable products or containers that they produce or import. For ease of recognition and to raise public awareness for resource recycling, all recycling facilities and equipment, such as resource recycling trucks and bins, that are used by environmental protection units or placed in public location and vending points must visibly display the recycling label. As a result of these aforementioned policies, the daily amount of garbage collected per person for disposal was 0.397 kg in 2012, seeing a 60% decrease from the peak record of garbage generated per person in 1998. The resource recycling rate in Taiwan has increased from 5.88% in 1998 to 53.94% in 2012. At the same time, reusing and recycling industrial wastes will not only ameliorate the negative impacts of industrial activity on the environment but will also reduce operating costs, create more profits, and promote sustainable development.



Figure 3-4. Resource Recycling Label

Source: Environmental Protection Administration, 2012

Table 3-1 List of Items for Recycling and Disposal

<b>Container class</b>	1.	Iron containers
	2.	Aluminum containers
	3.	Glass containers
	4.	(1) Aluminum bags (2) Paper tableware
	5.	Waste plastic containers (1) PET (2) PVC (3) PE (4) PP (5) PS expanded (6) PS unexpanded (7) Other plastics (8) Bio Plastic
	6.	Pesticide containers
	7.	Batteries
	8.	Cars/motorcycles
	9.	Tires
<b>Categories</b>	10.	Lead acid batteries
	11.	Information technology (1) Notebooks (2) Chassis (3) Motherboards (4) Monitors (5) Hard disks (6) Printers (7) Power adapters (8) Keyboards
	12.	WEEEE (1) TVs (2) Washing machines (3) Refrigerators (4) Air conditioners (5) Fans
	13.	Lighting equipment

## 4. Remarks on Expectations for Resources Recycling in the R.O.C.

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Although Taiwan's major renewable energy, semiconductor, electronic, and ICT industries continued to grow in 2013, nearly 98% of its resources come from fossil fuels, metal ores, or other imported natural resources. Hence, the security of natural resources has risen to the forefront as one of the key national security policies. Currently, electronic waste—outdated TVs, PCs, digital cameras, MP3 players, and other products that consumers routinely discard every few years and replace with smaller, sleeker, and more powerful models—is rapidly becoming a global environmental and economic issue. Electronic waste accounts for roughly 8 million tons of electronic products discarded globally in 2013, and of this amount, only 15 to 30 percent is properly recycled. The remainder finds its way into landfills not equipped to handle e-waste or toxic-dumping grounds, causing serious pollution issues.

Original Equipment Manufactures (OEMs) and retailers respond to this crisis with numerous programs to encourage recycling; yet, looking closely at these programs, it becomes clear that OEMs and retailers rely on a very fragmented and immature industry to handle product recycling. Worse yet, the lack of automation and hazardous working conditions associated with the handling of toxic chemicals and heavy metals may also damage the reputation of these companies and brands. Bill Wiseman of McKinsey & Company pointed out that, “With strong linkages to nearly all of the world’s leading OEMs, Taiwan’s tech firms enjoy access and experience in developing countries where labor costs are still relatively low. With some investment in R&D, Taiwanese manufacturers could turn electronic waste processing from a low value-added waste handling business that no country wants into a high-growth, profitable, and green technology industry in the target country.” Precious metals extracted in the recycling process can reduce the cost of producing new products. By focusing on both ends of the product life-cycle—production and

recycling—engineers could gain experiences that can help them develop materials that are easier to recycle along with modules and products that could help bring down costs over a product’s entire lifespan.

Taiwan’s early experience with waste minimization and pollution prevention helped drive home the benefits of recycling and reusing wastes. Building a strong recycling industry leads to more efficient usage of the island’s resources, which promotes economic growth while protecting the environment. Accordingly, the EPA promulgated the Resource Recycling Act on July 3, 2002, which has become an important milestone in developing a resource-recycling society. In 2008, the MSW Zero Waste policy was enacted by the government to establish a sound material-cycle (SMC) society through minimizing the generation of waste and maximizing recycling and reuse efforts. Green productivity guidelines for waste recycling, treatment and management not only reduces the amount of waste generated but also ensures that all recycling procedures are conducted legally. Good practices minimize the risk of wastes falling out of the system and getting handled illegally.

### **Future Expectations**

Taiwan has a population of 23 million people, but the island lacks natural resources, so nearly 98% of its resources including fossil fuels and metal ores are imported. The Taiwanese government hopes that the development of ‘hi-tech’ and ‘green’ industries will serve as beacons of hope lighting the way to economic recovery. This high-tech island remains a leader in various industries including notebook computers, wafer contract foundries, IC encapsulation testing, and IC design. Also, Taiwan’s renewable and low-carbon energy industry saw continued growth in the solar power and LED sectors. However, these ‘green’ industries need to develop hi-tech and clean-tech solutions for recycling metals, rare earths,



precious metals, and other resources. Waste minimization and recycling have become top priorities in Taiwan's municipal and industrial waste management strategies over the past ten years. Urban mining is indeed a new and important way of decreasing the island's dependence on imported raw materials.

### Recycling in Taiwan = Operating an Urban Mine in Taiwan

Developing the 'hi-tech' and 'green' industries is the key to building an "Eco-friendly Recycling Society" (shown in Fig. 4-1) in the near future.

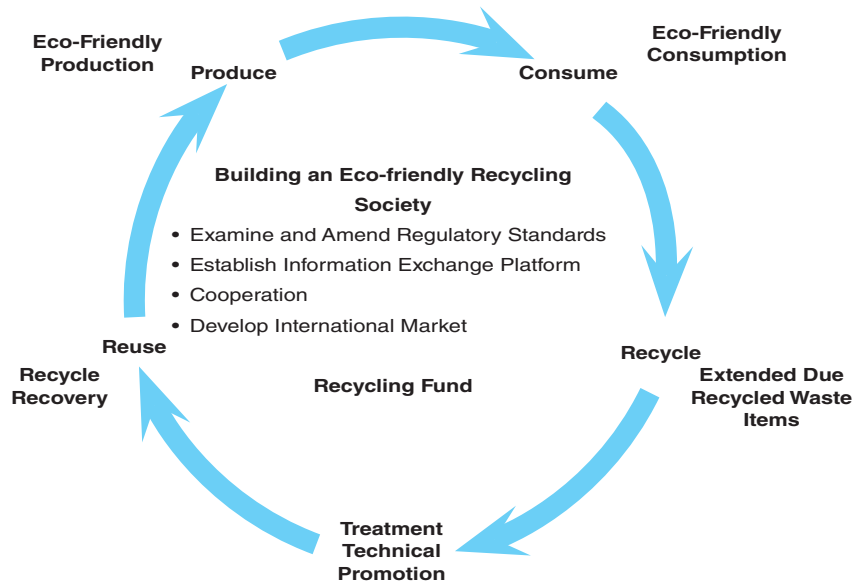


Figure 4-1. Building an Eco-friendly Recycling Society

## 5. Case Studies

With a population of 23 million people, Taiwan unfortunately lacks its own natural resources. With nearly 98% of its resources including fossil fuels and metal ores imported, Taiwan, not surprisingly, deems the security of its natural resources as a critical national security issue. While the recovery of these materials is "one of the next future trends of urban mining," recycling technology is still in its developing stages. To curb growing e-waste exports to developing countries, global standards and regulations for the reuse and recycling of electronic goods must be put in place. The performance of recycling plants can be improved through design modifications that make WEEE easier to dismantle, recycle and recover, and this is a key cornerstone to building a SMC society. Below, this manual shares Taiwan's experiences in recycling and lessons in technology development, which may be of assistance to other countries looking to improve and/or build their waste recycling efforts.

### ► 5.1 Case Studies on Paper Recycling

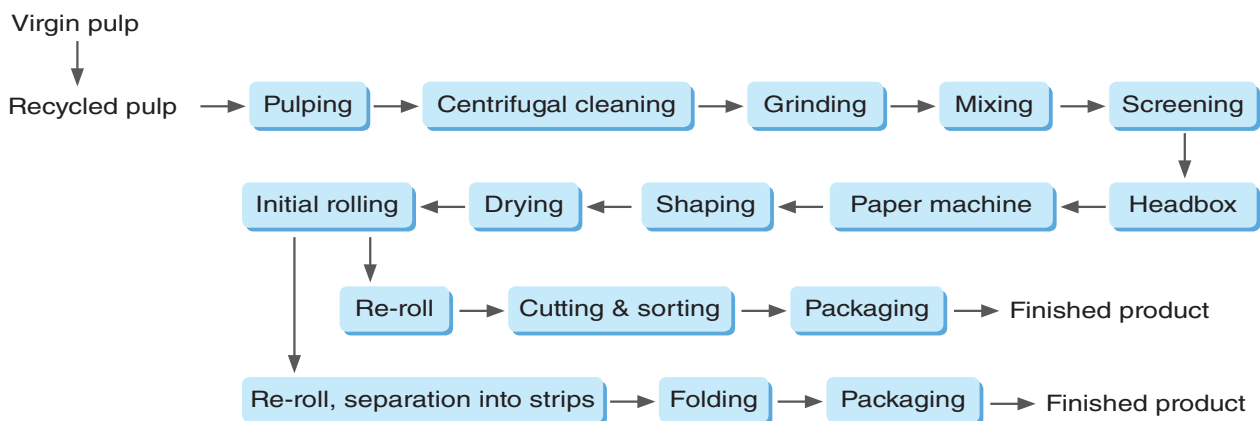
#### (1) Cheng Loong Corporation

Cheng Loong Corporation produces recycled paper that consists of over 92% recycled materials and uses of corrugated fiberboards to manufacture packaging containers and boxes. All of these products meet the

basic standards set forth by the Green Mark Program, and in total, the enterprise has obtained 16 eco-labels for its corrugated boxes and paper products. The company also makes an effort to promote green products, encouraging consumers to fulfill their environmental responsibility by choosing eco-friendly alternatives. Specializing in producing linerboards from recycled paper, the Cheng Loong Corporation has found its niche in supplying eco-friendly linerboards to American businesses. These linerboards replace the conventional kraft paper that has been used in the past. In reusing millions of tons of recycled paper annually, Cheng Loong Corporation curbs the amount of waste generated while positively contributing to the community, economy, and environment.

#### Technical Principles

Paper recycling is carried out by placing waste paper into deinking facilities and then processing with appropriate chemical agents and various treatment processes which include separating ink, screening impurities, and recycling fiber. Through this process, top quality recycled pulp is derived. The recycled and processed pulp is then sorted based on its characteristics and made into high-quality recycled paper by adding the appropriate quantity of fiber.



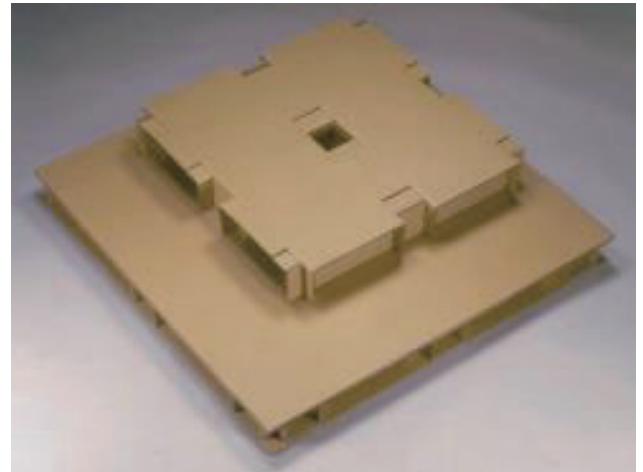
## Product Usage

The company's key products include recycled paper products (paper size: 31"× 43" and 24.5 "× 34.5"), recycled copy paper (paper size: 25"× 35.2" and 23.4"× 33.2"), and paper towel products (paper size: 230 mm × 230 mm, interfold). These products are suitable for office and residential use, and all of them can be customized according to customer needs.



## Environmental Benefits

- Reducing deforestation
- Reducing amount of waste disposed
- Recycling used paper and reusing resources
- Conserving energy and raw materials
- Lessening carbon dioxide emissions

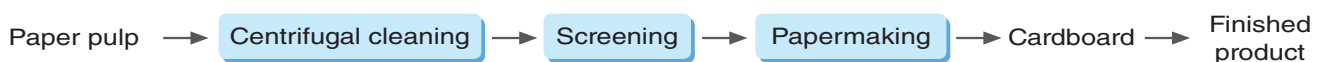


## (2) YFY Packaging Inc. Shin Wu Mill

Established in 1950 as one of the first privately-owned paper mills, YFY Packaging continues to be an industrial leader and its main products include paper (for household and industrial use), art and specialty paper, paper containers, and paper food containers. Fully committed to fostering a corporate culture that promotes environmental protection, the company has implemented a wide range for eco-friendly measures including clean production processes, waste reduction, recycling, and zero pollution standards while also utilizing microorganisms to make paper pulp, making use of green ink and digital printing, as well as establishing zero inventory management.

## Technical Principles

Paper pulp is processed by the pulper and then filtered through a coarse sieve for centrifugal cleaning to remove debris and impurities such as scrap metal, stone, plastic bags, styrofoam, and other particles. Afterwards, the appropriate chemical agents are added to help preserve the paper pulp and increase inter-layer adhesion. The next step is to adjust the color and whiteness of the paper. Then, the pulp is processed into reams of paper by the paper machine, producing durable paper that is suitable for photocopying and packaging purposes.



## Product Usage

The company's key products include kraft paper (basis weight of 130-340 g/m<sup>2</sup>) and coated duplex paperboard (basis weight of 230-400 g/m<sup>2</sup>), which are typically processed into paper cartons, paper products, packaging materials, etc.



## Environmental Benefits

- Reducing waste
- Recycling and reuse waste paper
- Reducing deforestation



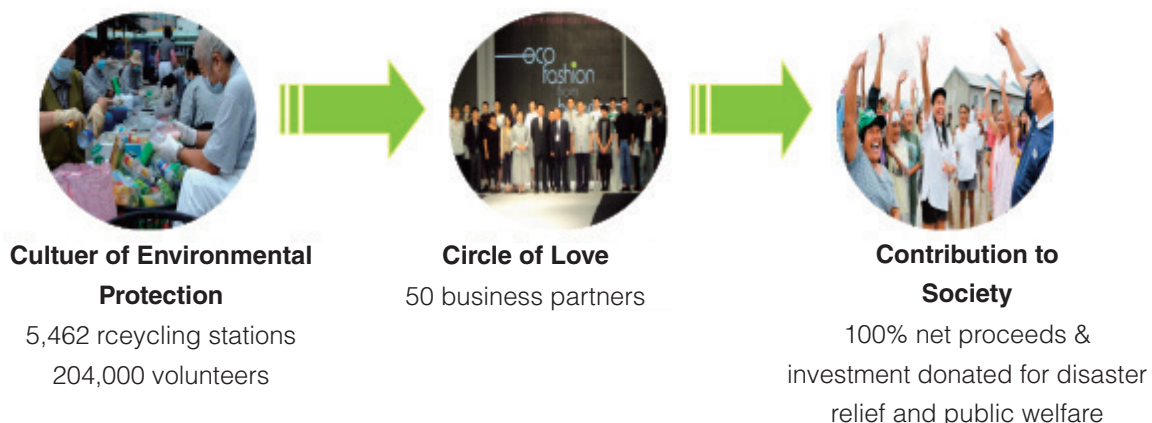
### ► 5.5 Case Studies on Recycling Plastic Bottles

#### (1) DA.AI Technology Co. Ltd.

DA.AI Technology, an excellent example of a recycling platform, is driven by the efforts of people from all walks of life ranging from volunteers and supporters to business partners. These individuals and entities are all dedicated to protecting of our environment, contributing to the long-term health of society, and upholding the three core values of building a culture of

environmental protection, fostering the circle of love, and contributing to society.

DA.AI products are made from recycled PET bottles that have been collected, treated, and sorted by over 204,000 volunteers (80,000 of which are regular volunteers and the remaining 124,000 are part-time volunteers). Purchasing treated bottles from recycling centers, DA.AI and its business partners proudly manufacture and promote trend-setting eco-friendly products that are noted for their elegance, simplicity,



Tzu Chi volunteers' spearhead recycling efforts—DA.AI's key support

environmental impact, and educational value. These eco-friendly products can be found in 117 stores and service booths located across the R.O.C. and ten other countries abroad. In 2013, DA.AI offered over 385 educational presentations, exhibitions, and events to promote a “greener” lifestyle. Their products are non-polluting (never piece-dyed) and most are produced from up to 100% recycled materials. Moreover, each product contains a very special ingredient: the volunteers' love and dedication towards making this world a better place.

### Product Usage

Depending on the nature of the product (clothing,

blankets, quilt covers, or scarves), each can be customized to fit the customers' needs. These textile products are typical everyday necessities such as clothing, bedding, and furniture.

### Technical Principles

Using recycled plastic No. 1, PET, as the raw material to manufacture their eco-friendly products, the company activates a new life cycle for post-consumer bottles. The next goal is to ensure its products are easy to be recycled in a Cradle-to-Cradle “zero-waste” closed-loop process, that is, the products, after their uses, can be recycled and used as the raw materials for new products again.



Cradle to Cradle (C2C) Closed-Loop Process

### Environmental Benefits

When compared to the process using crude oil/petroleum as the raw material, DA.AI's green technology saves up to 77% of carbon emission and 84% of energy consumption.

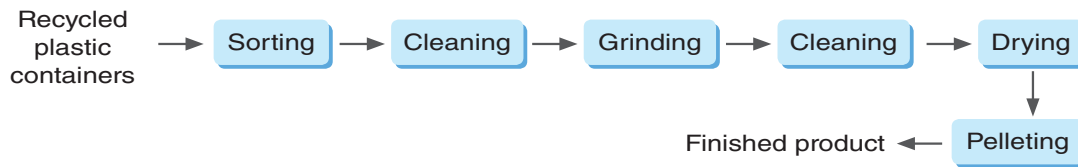
### (2) Da Fong Environmental Technology

Understanding the importance of creating a low-carbon environment, Da Fong Environmental Technology is at the forefront in terms of its efforts to effectively reduce its carbon footprint and obtain certifications in this area. Figures show that by utilizing recycled materials, the company has lowered its

carbon emissions by 65%. By leveraging its areas of expertise, Da Fong has not only created new value for the enterprise through taking advantage of recycled plastic but has also greatly reduced resource consumption while conserving energy and lowering carbon emissions.

### Technical Principles

After plastic containers are preliminarily sorted at recycling centers, they are collected and transported to factories for processing. Next, the plastic is sorted, grounded, washed, dried, and made into plastic flakes, which is then molded into pellets. These recycled plastic pellets can then be used to manufacture various plastic products.



### Product Usage

According to their melt flow index or melt index, plastic materials are categorized into various grades such as blown film extrusion, blow molding, injection molding, extrusion molding, and spin trimming (flat yarn). Moreover, customized recycled plastic pellets with different features can be produced to meet customer needs.



### Environmental Benefits

- Employing professional recycling and processing technology to promote recycling and achieve sustainable use of resources
- Using recycled materials can reduce 65% of carbon emissions
- Certified for using 100% recycled materials from recycled plastic
- Obtained ISO9001, 14001 and OHSAS18001 certifications
- Obtained the Carbon Footprint Certification
- Received the German Blue Angel certification

### ► 5.3 Case Studies on Recycling Glass Containers

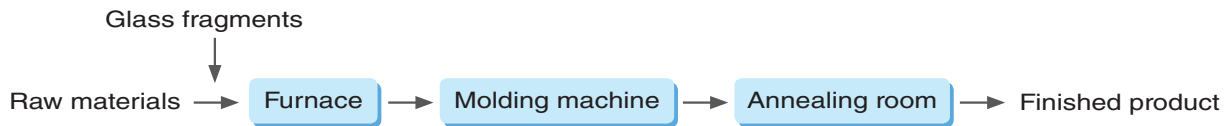
#### (1) Taiwan Glass Industrial Company, Ltd., Hsinchu Factory

##### Technical Principles

Glass pieces are manually screened for waste matter including ceramics, stones, and other foreign particles. Discolored glass and glass with unusual properties along with iron, aluminum and other metals are removed. Glass particles are crushed to less than 17 mm in size and washed. Caps are removed via a vibration process. Plastic particles are sorted out and stored for other use. Batches of well-mixed materials



along with glass fragments are then transported into the furnace for melting via a feeding machine. The melting process consists of two phases to create the necessary conditions for melting glass: the first takes place in the furnace (using heavy oil), and the second in the operating room (using gas). Temperature must be strictly controlled in the process. Finally, the glass product is produced, annealed (slow cooling), inspected, and packaged.



### Product Usage

- Glass containers feature wide and narrow openings. The diameter of the wide opening containers range from 34-182 mm with a height of 40-271 mm, weight of 44-1,700 g, and a capacity ranging from 30 -5,335 cm<sup>3</sup>. Bottles with a narrow opening have a diameter spanning 23-168 mm, weight of 18-1,520 g, and a capacity ranging from 10-4,300 cm<sup>3</sup>. The shape of containers can be made according to consumer needs.
- These glass containers are mainly used to store food, medicine, kitchen utensils, and ornaments.



### Environmental Benefits

- Lowering industrial waste emissions
- Recycling and reducing waste while enhancing safety
- Conserving energy and resources
- Conserving raw materials

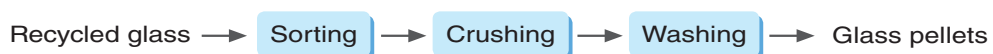


### (2) Spring Pool Glass Industrial Company, Ltd.

The amount of glass recycled by Spring Pool Glass Industrial Company accounts for over half of the total amount recycled in Taiwan. Upon collecting glass products, the company processes the items by first sorting manually based on color and type. Next, after impurities are removed, the glass is then mechanically crushed and melted to remove the sharp surfaces and form high-intensity, round glass pellets (with a diameter of approximately 0.6-12 mm).

### Technical Principles

Glass containers are recycled, sorted, washed, and crushed while regulating the particle size and sorting for color. This is to ensure that the product meets the standards that glass and ceramic manufacturers hold for raw materials.

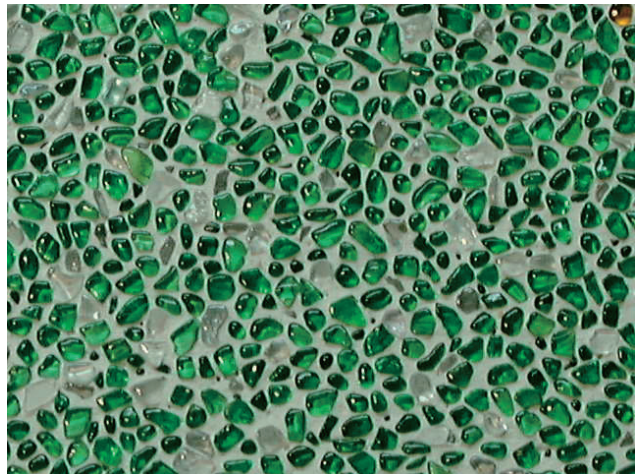


## Product Usage

The diameter of glass pellets is approximately 0.6-12 mm. Pellets come in various colors including white, green, brown, and other special colors. Glass and ceramics manufacturers use these raw materials to make a variety of glass bottles and artwork.

## Environmental Benefits

- Eco-friendly method for recycling waste
- Fire-resistant, weather-resistant, low coefficient of expansion, highly stable, anti-aging, and non-degenerating
- Nonporous, non-absorbent, and does not discolor when kept dry



## ► 5.4 Case Studies on Recycling Rubber

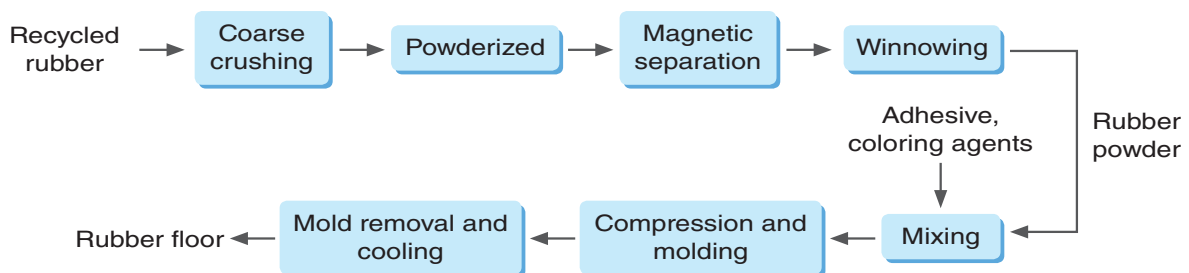
### (1) Jun Lung Rubber Industries Company, Ltd.

## Technical Principles

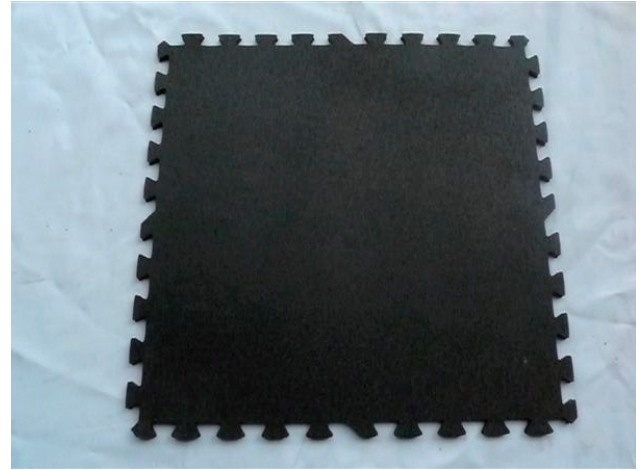
Taking the plastic waste products, defective products, scrap materials, and unusable tires generated by the manufacturing processes in the rubber factory (including synthetic rubber and rubber products), Jun Lung Rubber coarsely crushes and grinds the different particles into powder. This process separates the rubber powder from the steel wire, fiber, and other materials. Then, via magnetic separation and winnowing, the rubber powder, steel wire, and fiber are completely sorted and separated for recycling. Adhesives and coloring agents are then added to the recycled rubber powder, which is homogeneously mixed and then molded and compressed into pieces that can be made into a variety of rubber tiles.

## Product Usage

The standard measurement for rubber tiles is 50 by 50 cm (length by width) with the depth ranging from 1 to 10 cm. The specific sizing and features of these tiles can be customized. These rubber tiles are aesthetic, durable, wear-resistant, non-slip, and sound-absorbing, making them extremely suitable for use in schools, parks, sidewalks, and other public places.







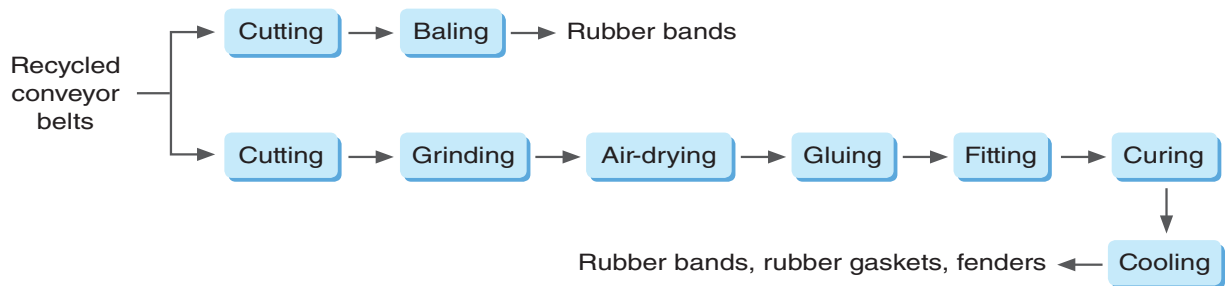
### Environmental Benefits

Recycling rubber to produce rubber tiles and other products can help alleviate the exploitation of natural rubber as well as the consumption of synthetic rubber and petroleum while also reducing waste generation and diminishing the resources consumed in the production and recycling processes.

### (2) Chiao Her Rubber Industry Company, Ltd.

#### Technical Principles

Once recycled conveyor belts undergo various treatment processes including cutting, grinding, drying, gluing, fitting, curing, bonding, and cooling, they can be regenerated into a variety of new products including rubber bands, rubber gaskets, and fenders.

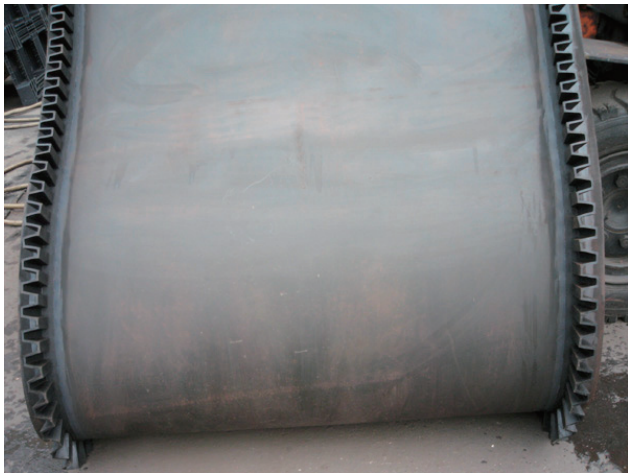


### Product Usage

The main products are conveyor belts and rubber gaskets. Conveyor belts are generally  $\leq 2$  m in length but can be customized according to client needs. Rubber gaskets and fenders can also be customized. Conveyor belts and anti-slip rubber mats are generally used in factories.

### Environmental Benefits

- Decreasing industrial waste and processing costs
- Reducing environmental pollution
- Providing cost savings for consumers



## ► 5.5 Case Studies on WEEE Recycling

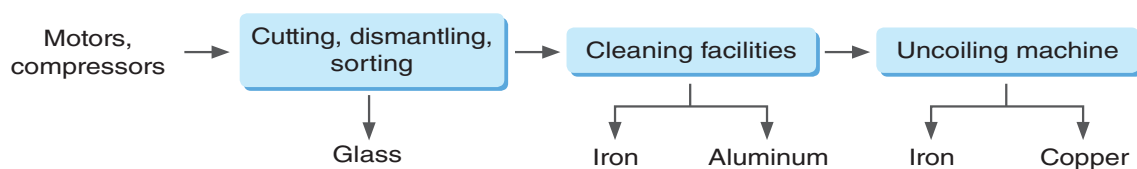
### (1) E&E Recycling Incorporated

The latest global IT innovations and marketing strategies have increased consumption in electrical and electronic products. With the R&D cycles of these products shortened, new models are appearing faster than ever. As such, older models quickly become obsolete, which in turn greatly increases in the amount of e-waste generated. E-waste contains hazardous toxins such as lead, cadmium, and mercury which are released into the environment when these products are incinerated or disposed in landfills. As the first treatment plant of for WEEE in Asia, E&E Recycling has made every effort to fully recycle and reuse e-waste.

#### Technical Principles

E&E Recycling collects electric appliances such as refrigerators, washing machines, and television sets for their motors and compressors, which are dismantled and removed for reuse. After the residual lubricating oil is collected and removed, these parts are then put through an automated cleaning facility and washed with warm water to further remove remaining traces of oil. Coils of copper wire are processed by uncoiling machinery, and other particles including iron, copper, aluminum, and glass are filtered and sorted out as recycled materials for other use.

#### Technical Processes



## Product Usage

On average, these products feature a purity level of 98% and do not come in specific sizes. Isolated metal particles can be sold to steel mills or processing plants to be manufactured into steel and metal parts. Whereas, the glass can be crushed, serving as raw materials for glass products.



## Benefits of Waste to Resource Management

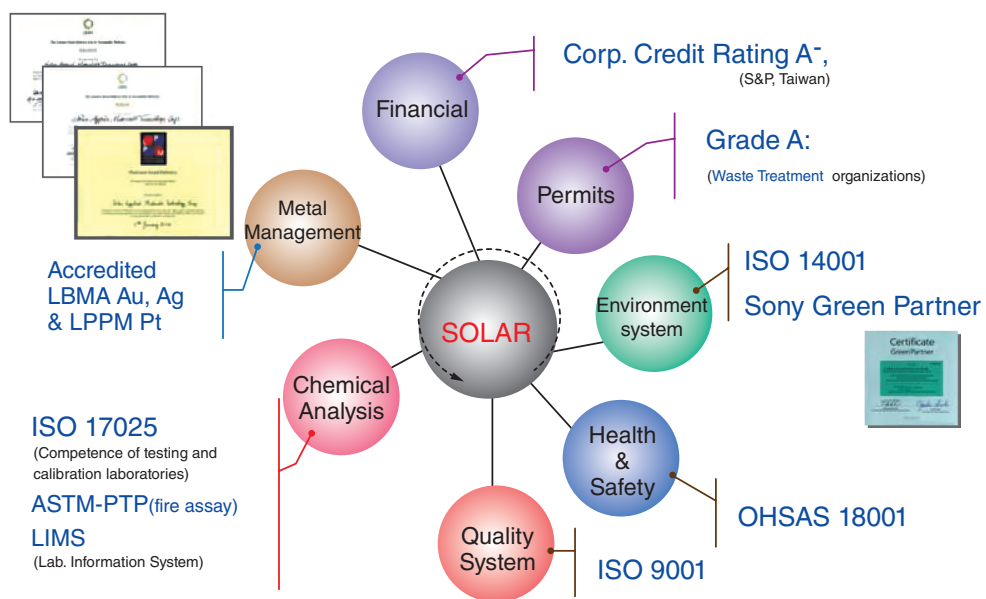
- Recycling waste
- Supplying raw materials to steel and metal factories



## (2) Solar Applied Materials Technology Corporation (Solartech)

Solartech focuses on the recycling of precious and rare metals, which is a critical advanced raw material for IT and chemical industries. The company has reached a significant milestone through product development and industrial penetration.

In terms of quality control, Solartech complies with ISO standards in which it implements in its production and environment management. Also, Solartech has special permits granted by the EPA for using cyanide chemicals to recycle spent solution from precious metal plating.



To align the company's mission with the government's policy on green industry and upgrading traditional industry, Solartech established a precious metal refining plant for recycling electronic wastes, petrochemical catalyst, and automotive catalyst. So far, Solartech has captured the majority of the market share (over 80%) of spent catalyst recycling for local petroleum refineries and petrochemical industries. Solartech is devoted to developing high value-added precious material products. Moreover, Solartech has been accredited by the London precious metal market for its precious metal management practices.

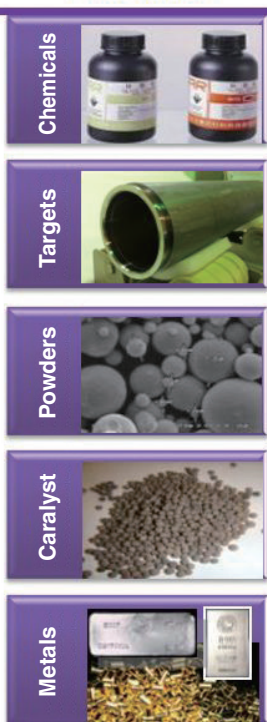
### Technical Principles

Integrating advanced thin film material development and manufacturing, vacuum induction melting, hot rolling, forging, powder metallurgy and bonding technology, Solartech developed various key materials for emerging industries such as Optoelectronics, MicroElectro Mechanical, Semiconductor, Thin Film Solar Cell, and Flat Panel Display. Solartech is now the leading supplier of sputtering targets for data storage devices, both optical and magnetic. The enterprise is also involved in the latest development of flat panel displays and solar energy applications. Together with Solartech's products, metal refining, analytical laboratory service, and components refurbish services.

### Recycle & Refining



### Products



### Service & Components



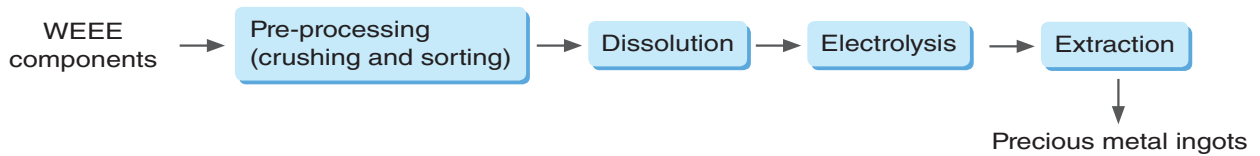
### Labs / Assay



### Technical Processes

Recycled electronic waste products are dismantled to remove metal-containing components, which are then crushed, sorted, and pre-treated. Next, the materials

are dissolved and go through different procedures such as electrolysis, reduction, or liquid extraction to form gold bullion, silver bullion, platinum ingots, palladium ingots, and other precious metal products.



### Product Usage

After processing, the purity of the gold, silver, platinum, and palladium can reach 99.999%. These metallic raw materials are used in the Liquid Crystal Display, LED, and ICT industries.

in waste recycling and treatment, Chung Tai has researched and developed its very own processing equipment for recycling discarded lighting units, and the most notable feature is that this equipment can process 95% of derivatives from discarded lighting units into reusable raw material products. As a global leader in technology and resource processing equipment, Chung Tai has achieved the highest recovery rate and best purity standard for mercury in the industry.

### Benefits of Waste to Resource Management

- Promoting recycling and reducing waste generation
- Recycling precious metal resources
- Supplying raw materials to manufacturers that require metal

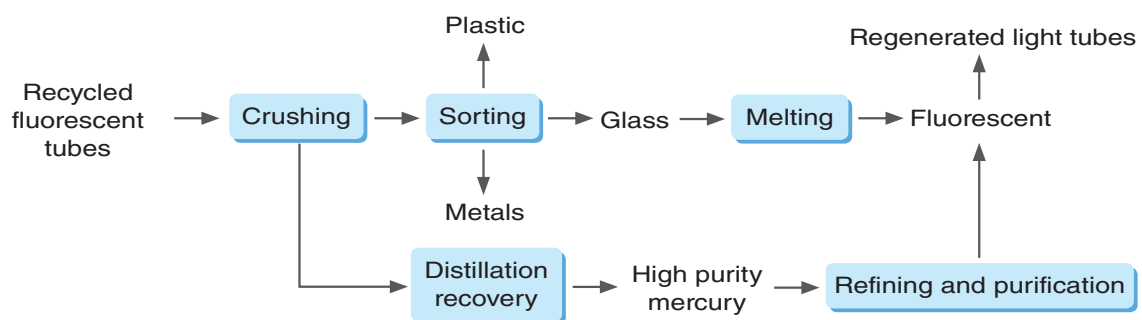
### Technical Principles

Under airtight conditions, the metal connector is first removed from the lighting unit, and then the light tube is crushed. The resulting broken glass, fluorescent powder, metal and plastic particles are then individually sorted. The glass, metal, and plastic are recycled and reused at the appropriate factories while the fluorescent powder is put through a distillation recycling equipment to recover the mercury. After the mercury is refined and purified, glass is then added. The mixture is then melted and other components are added to form regenerated light tubes.

### ► 5.6 Case Studies on Recycling Lighting Units

#### Chung Tai Resource Technology Corp.

Chung Tai Resource Technology Corporation has long been dedicated to recycling lighting units with a mission to preserve our environment by reusing and recycling resources. Through its years of experience



## Product Usage

Regenerated light tubes are about 580 mm × 2.9 mm in size with a product life of about 7,500 hours. Weighing about 107 g, these lamps are available in 20 W and 40 W and are suitable for general indoor lighting, home lighting, etc.

## Environmental Benefits

- Reducing the amount of waste generated
- Recycling and reducing waste products while enhancing safety
- Conserving energy and resources

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## Contact List

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YFY Packaging Inc. Shin Wu Mill	886-3-486-1701	886-3-486-1078		<a href="http://www.yfy.com.tw">http://www.yfy.com.tw</a>	No. 281, Yongfu Rd., Shin Wu Township, Taoyuan County, Taiwan (R.O.C.)
DA.AI Technology Co. Ltd.	886-2-2657-5245	886-2-8751-3450	ting_hung@daait.com	<a href="http://www.daait.com">http://www.daait.com</a>	2F., No. 63, Zhouzi St., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)
Da Fong Environmental Technology	886-4-2422-4266	886-4-2422-0648	service@df-recycle.com.tw	<a href="http://www.df-recycle.com.tw">http://www.df-recycle.com.tw</a>	No. 7 Hunei Ligong 1 Road, Hemei Township, Changhua County
Taiwan Glass Industrial Company, Ltd., Hsinchu Factory	886-3-530-0333	886-3-530-0332	tgj@taiwanglass.com	<a href="http://www.taiwanglass.com">http://www.taiwanglass.com</a>	No. 470, Chunghua Road, Sec. 4, Hsinchu City
Spring Pool Glass Industrial Company, Ltd	886-3-538-9165	886-3-538-0914	spglass9@ms34.hinet.net	<a href="http://www.hcspg.com.tw">http://www.hcspg.com.tw</a>	No. 176 Niupu Road, Hsinchu City
Jun Lung Rubber Industries Company, Ltd.	886-4-9225-4236	886-4-9225-4236	Jun.lung@msa.hinet.net	<a href="http://www.junlung.com.tw">http://www.junlung.com.tw</a>	No. 11 Gong Ye North 2nd Road, Nan Gang Industrial Park, Nantou City
Chiao Her Rubber Industry Company, Ltd.	886-4-2791-0002	886-4-2791-0002	chiaoher@gms77.hinet.net	<a href="http://www.chiao.com.tw">http://www.chiao.com.tw</a>	No. 2 Zhangbin East 2nd Road, Gounei Village, Xianxi Township, Changhua County



Company Name	Telephone	Fax	E-mail	Website	Address
E&E Recycling, Inc.	886-2-8969-1000	886-2-8969-3000	erecycle@mail.eer.com.tw	<a href="http://www.eer.com.tw">http://www.eer.com.tw</a>	25F., No.7, Sec. 2, Xianmin Blvd., Banqiao Dist., New Taipei City 220, Taiwan(R.O.C.)
Solar Applied Materials Technology Corp.	886-6-602-5008	886-6-600-9533	ykchuang@solartech.com.tw	<a href="http://www.solartech.com.tw">http://www.solartech.com.tw</a>	No.16,Gong 1st Rd.,Liuying Dist., Tainan City73659, Taiwan (R.O.C.)
Chung Tai Resource Technology Corp.	886-2-2358-7001	886-2-2358-3078	yehch@chinalab.com.tw	<a href="http://www.chinalab.com.tw">http://www.chinalab.com.tw</a>	3F.,No. 9,Sec. 2,Chung Shiao E.Road, Taipei City 100, Taiwan (R.O.C.)
Wistron Corporation	886-2-6616-9999	886-2-6612-2941	Magic_sc_liu@wistron.com	<a href="http://www.wistron.com">http://www.wistron.com</a>	21F.,No. 88,Sec. 1,Xintai 5th Rd.,Xizhi Dist.,New Taipei City 22181, Taiwan (R.O.C.)
Amia Co., Ltd	886-3-386-0601	886-3-386-1183	George@persee.com.tw	<a href="http://www.persee.com.tw">http://www.persee.com.tw</a>	No. 19,Dagong Rd., Dayuan Township, Taoyuan Country 33759, Taiwan (R.O.C.)
KD Holding Corporation	886-2-2162-1688	886-2-2162-1681	f.h.lee@sesc.com.tw	<a href="http://www.kdhc.com.tw">http://www.kdhc.com.tw</a>	5F.,No. 132, Xingshan Rd., Neihu District, Taipei 11469, Taiwan (R.O.C.)
Far Eastern New Century Corporation	886-3-620-9000	886-3-620-9057	ctchang@cfp.fenc.com	<a href="http://www.fenc.com">http://www.fenc.com</a>	369, Ya-Tung Sec. Wen Shan Road,Lin, Wen Shan Lii, Hsinpu, Hsinchu, Taiwan (R.O.C.)

## I How APO Member Countries Will Benefit

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The APO COEGP will enhance, demonstrate and share with other countries its excellence in GP. It shall develop models in various sectors including manufacturing, service and agriculture to serve as showcase to inspire stakeholders in member countries. It shall initiate research to be undertaken in collaboration with APO on green issues. It shall provide technical assistance in specific sectors and

provide experts to member countries when needed. A database on GP experts and other indicators will be established by the COE GP to serve the needs of members. The database will be made available online to community of experts and practitioners. Best practice manuals and handbooks shall be published to serve the needs of all stakeholders.



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