

Toward a zero waste society in Taiwan

H.-W. Chen¹ & H. Houng²

¹*Director General of Solid Waste Management Bureau,
Environmental Protection Administration, Taiwan, R.O.C.*

²*Advisor, Environmental Protection Administration, Taiwan, R.O.C.*

Abstract

Taiwan, an island with dense population but limited resources, bears a heavy environmental burden. Although industries in Taiwan have been booming for decades, the escalation of waste generation has never ceased and will profoundly affect the lifestyles and the living standards for generations to come. Therefore, how to use resources wisely, to achieve a sustainable society, has become an ever more serious issue that is concerning both the government and the people of Taiwan.

As the natural resources are waning and the costs of garbage disposal is constantly rising over time, waste disposal policies have shifted from traditional disposal methods, such as sanitary landfills and waste incineration, to new methods, such as minimization at the source, sorting, separation of dry and wet garbage, pre-treatment, and transferring of garbage from remote areas. Moreover, with the policies of front-end prevention (restricting the use of plastic shopping bags and plastic disposable dishes) and the back-end per-bag trash collection fee, households are rewarded to reduce the amount of garbage. Communities are also encouraged to set up garbage self-disposal systems or other flexible and diversified methods, which are aiming to ease the pressure on the end-of-pipe treatment and induce recycling and reuse of materials. With the principle of “extended producer responsibility,” businesses and institutions are required to work on the “green design” and “life cycle analysis,” and to set up an “environment management system” to meet the future needs of environmental protection from international markets. The government will also assist the Center for the Exchange of Industrial Waste Information and the promotion of environmental management systems, and subsidize the R&D of the new environmental technologies. All of these measures will be taken to help businesses establish corporate images and thereby increase their competitiveness in the international markets.

Although the adoption and the implementation of the strategies and policies of “zero waste” will encounter certain obstacles, we should still actively strive to establish concrete policies and objectives for campaigns, strict law enforcement and the encouragement of innovation and trials. What we will need to achieve this will be: understanding and support of the general public, the cooperation of private sectors, as well as the open-mindedness of the public sectors. Our natural resources are so scarce and precious that we must work in tandem with the global trend to achieve a “zero waste” world.



1 Introduction

As an island country with high population density and limited resources, Taiwan has been experienced impacts of the waste problems resulting from economic development for decades, dealing with environmental quality and the needs of comfortable lives. Therefore, building up a sustainable society through minimization of waste generation and optimization of resource utilization has become a critical task that can no longer be ignored.

Recently, an increasing number of developed countries have steered away from traditional waste management approaches (end-of-pipe treatments like incineration and landfill) and have made efforts to reduce resource consumption, restrict generations of waste streams, and promote pretreatments of resource recycling. This movement is to reach the “zero waste” perspective by means of maximizing the resource recycling and minimizing the waste amount simultaneously. Ever since the *Waste Disposal Act* (WDA) promulgated in 1974, we have completed “end-of-pipe” waste treatments in terms of storage, collection, treatment and final disposal. Moreover, the *Resource Recycling Act* (RRA), which emphasizes the upstream waste management and resource recycling, was promulgated in 2002 to comply with the worldwide trends of sustainable development. We are presently reviewing the current status of our solid waste management and evaluating overseas experience and technologies, to set long-term waste management objectives of a sustainable “zero waste” society.

2 Current status of solid waste management policies

According to the WDA, our fundamental law for solid waste management, the waste is classified into “general waste” and “industrial waste.” General waste, also generally known as municipal solid waste (MSW) including garbage, excrement and urine, and animal corpses in solid or liquid form generated by households or other non-industries, has the capacity to pollute the environment. Industrial waste (IW) includes the waste generated from the manufacturing industries, commercial activities, medical organizations, educational institutes, agriculture use, construction and demolition, and military applications. Accordingly, our zero waste policies are formulated into different programs, namely the *Review and Prospecion of Municipal Solid Waste Management Program* for MSW and *Zero Waste Policy for Industrial Waste* for IW, respectively.

Concerning MSW management, there was no proper treatment before 1984; most of the waste were dumped or disposed of in unqualified facilities, without consensus of environmental and sanitary concerns. To solve the problems, the construction of sanitary landfills was initiated in 1984 for proper waste treatment, and the construction of incinerators in 1991, with the considerations for higher requirement of environmental quality, the difficulty of land acquisition for landfills, and the maturation of incineration technology. Thus the MSW treatment approach has been gradually shifted from landfill to incineration; the



weight of incineration in the MSW treatment reached 64% in 2002 (fig. 1), and the treatment rate promoted to 96%, which was incomparable to the 2.4% in 1984 [4].

For the optimization of resource utilization and the elimination of wasting, our government coordinated the public, resource recycling sectors, local sanitation fleet, and integrated resource recycling fund to enforce the tasks of resource recycling and waste minimization in 1997. As a result, the resource recycling of MSW has reached 15.5% by end-2002 (fig. 2) [4]. From 2002, the *Restriction Use of Plastic Shopping Bags and Plastic Disposable Dishes* has been promoted to advocate the environmental-based consuming and further diminishing the garbage generation. By June 2003, statistics revealed that the use of plastic shopping bags has decreased to 20%; for the plastic disposable dishes, to 4%. In addition, people using self-provided shopping bags have increased to 79%, from less than 20% before the policy undertaken [12]. These data obviously demonstrated the shift of consuming custom induced by the policies of front-end prevention.

Since 2000, Taipei City government has initiated the implementation of *per-bag Trash Collection Fee*, based on the principle of “Pay As You Throw.” Furthermore, the enforcements of waste sorting and resource recycling undertaken have established the model of “Recycling First” waste management. This year (2004), the Taipei City government even takes it a step further by promoting the recycling of kitchen waste for livestock feeding and composting to effectively reuse the organic waste as well as reduce the total amount of garbage.

IW management is not an easy task due to its complexity of physical and chemical composition. Enormous illegal dumping sites of IW were uncovered all over the island. Until 2000, the incident of spent solvent dumping in Chi-San River that polluted the source of drinking water for 2 million residents emerged the urgency of effective management for IW. The government decided to establish an organization specifically responsible for the fulfillments of the proper IW treatment and the elimination of illegal dumping, by means of managing IW generation, tracking waste streams, enhancing the control of manifests, and establishing IW treatment facilities [3].

Since the establishment of “Industrial Waste Control Center” in 2000, there have been improvements regarding the declaration of IW disposal, the installation of IW treatment facilities, and the proper treatment of IW. The numbers of declaration enterprises have been even more as the several extension of declaration list has been regulated since 2002. By the end of 2003, there are 12,785 enterprises listed for the Internet declaration and 88.5% of them (11,319 enterprises) actually declared their waste disposal through Internet. The waste amount declared in 2003 was 11.42 million tons, consisting of 12.26 million tons general IW and 1.16 million tons hazardous IW. It is also revealed that the reuse or reutilization is the most applied waste approach, reached 9.46 million tons (70.6% of totally declared IW), including 8.89 million tons general IW (70.6% of totally declared general IW) and 0.47 million tons hazardous IW (70.6% of totally declared hazardous IW) (table1) [5].



In addition to regulating the IW management, the “green procurement” has been advocated in the public sectors. In the year of 2002, the sum of green procurement in the governments has been over \$ 80 million; among them, 65.6% are green products. Moreover, the application of “Eco-label” has been encouraged and as a result, the Eco-label application has grown to four times of the year before [11]. In June 2001, Industrial Development Bureau (IDB) of Minister of Economic Affairs (MOEA) established the Recycling Industry Network to assist and encourage the waste recycling in the industries. The first Award of Superior Industrial Waste Clearance and Resource Recycling granted by EPA in December 2003 was to praise the domestic entities that have paid attention to the proper IW treatment and resource recycling [13]. We expect this encouragement can build up the patterns of proper IW treatment and resource recycling practices in the industries, and meanwhile provide an educational platform for industries.

3 The structure of zero waste policy in Taiwan

The Zero Waste policies of developed countries – including Australia [1,10], Japan [6~8], and New Zealand [2,9] – all emphasize on the front-end preventions such as diminishing resource consuming, restricting waste generation, and promoting resource recycling, instead of traditional end-of-pipe treatment like incineration and landfill. Since the promulgation of the WDA, we have preliminary achievements of resource recycling and reuse, and furthermore, the promulgation of the RRA in 2002 has even conformed to the international trends. In RRA, “non-product” no longer means “waste,” rather the waste is considered as recyclable material. The act also clearly cited that “Priority consideration shall be given to the use of substances that reduce waste production to achieve resource sustainability insofar as is economically and technologically feasible. Priority consideration shall be given to material recovery, energy recovery, and appropriate disposal, in that order, of substances that have lost their original utility.” We have also combined the investigation of the overseas waste management philosophy and approach with the current status of our waste management, to establish our zero waste policy for the coming 20 years.

Based on the waste management status in 2001, our zero waste policies advocate the green design, cleaner production, green consumption, green procurement, waste minimization, resource recycling, reuse, and recovery, to diminish the consumption of materials, promote effective utilization of resources, and gradually achieve zero waste goals resulting from recycling optimization, waste minimization and reuse maximization. According to our laws and regulations, national conditions and the responsibilities of different authorities, the measures and goals of zero waste policies for MSW and IW would describe hereunder, respectively.

3.1 Measures and objectives of zero waste policy for MSW

The zero waste objectives of MSW are based on the current status of MSW generation, treatment (fig. 1) and the resource recycling (fig. 2). After 2007,



MSW is not allowed to be disposed of in landfills except for remote area, and the goal of volume reduction is set for 25%. Total volume reduction by 2011 is expected to reach 40%; by 2020, 75% (table 2). We wish a 100% volume reduction could be regulated some day, if the related policies, treatment, and management approach is mature and available. The following specific measures are established for the zero waste goal of MSW:

1. Enforcing the implementation of the RRA: diminishing the resource consumption, reducing the waste generation, and promoting the resource recycling through the combination of consultation, enforcement, and rewards.
2. Reducing the volume of MSW generated: promoting waste minimization through a complete program of no-landing trash collection, the use of certified trash bags, and the measures for per-bag trash collection fee.
3. Enriching resource recycling: enforcing the waste sorting, listing of recycling items, encouraging private-run resource sorting facilities, and the installation of environmental industrial parks to upgrade the recycling technology, open the channels for recycling materials, and increase the recycling rate of listed items.
4. Promoting reuse: establishing the sorting facilities, recycling facilities, and the market channels of the reused products to reach the goals of waste recycling and diversified waste treatment, especially for the kitchen waste, bulky waste, incombustible waste, and residuals of resources.
5. Reinforcing the MSW collection system: subsidizing the local authorities to MSW collection privatization in order to improve the clearance and collecting efficiency.
6. Enhancing the operation and remediation of final disposal: continuously planning the constructions of local sanitary landfills, joint treatment facilities for landfill leachate and excrement, and the storage facilities for inorganic resources (inert waste), to properly treat and reuse the waste and incineration ash; also continuing the remediation of saturated landfills, clearance of waste dumped in watercourse and other dumping ashes to complete the MSW management tasks.
7. Promoting the reuse and reutilization of treated incineration ash: planning the installation of bottom ash sorting and fly ash vitrification facilities for the resource recycling of incineration ash with the goal of zero-landfill, and promoting no boundary cooperation between local governments to save the administration resource and increase the MSW treatment performance.
8. Developing tactical tools to discourage landfill disposal: revising rules and regulations to discourage final disposal including the: impose of tariff mechanisms for landfills, and stepping up penalties for the illegal receiving of regulated waste.

3.2 Measures and objectives of zero waste policy for IW

Regarding IW, based on the current status of declaration, estimation (table 1), characteristics of various waste, and the possibility of recycling, the objectives are set as follows: volume reduction to 5% by 2007, to 10% by 2011, and to 20%



by 2020; recycling rate to 60~75% by 2007, to 70~80% by 2011, and to 85% by 2020, as details listed in table 2 [5]. As the same with MSW, we wish a 100% waste reduction could be regulated some day, if the related policies, treatment, and management approach is mature and available. The following measures are regulated to improve the IW management toward the objective of “zero industrial waste,” for the effective utilization of energy and materials, industrial waste minimization, and the establishment of recycling technologies and market channels.

1. Setting objectives of IW volume reduction and recycling rate for different enterprises: investigating the waste quantity, characteristics and flow of IW generated from the manufacturing industries, commercial activities, medical organizations, agriculture use, construction and demolition, educational institutes, military applications and public transportation by the Responsible Agency for the Industry at Issue (RAII), and consequently setting up the objectives in short-term (2007), mid-term (2011), and long-term (2020) for IW volume reduction and recycling rate.
2. Raising IW declaration rate and completing the IW data base: increasing the numbers of listed enterprises for declaration, further establishing the complete data base of our IW, including waste volume, waste type, generation process, and waste flow, and annually reviewing and revising the data base, strengthening the declaration of IW reuse, recycling, and recovery, to build up a reliable base of recycling policies.
3. Driving the reduction of waste generated: setting up objectives for volume reduction and recycling rate of IW through the coordinating from “Renewable Resource Recycling Promotion Committee” to, assisting the installation of responsible organizations specific for zero waste in RAI to plan the related tasks overall, requesting the use of material in harmony with the spirit of cleaner production, providing incentives for R&D of green-design and cleaner production, encouraging enterprises volunteers for volume reduction of IW and proactive involvement of industries in waste reduction.
4. Improving the facilities of IW treatment and final disposal: setting up tipping fee for public-run IW incineration and landfilling, but based on the comprehensive cost of waste treatment, to create economic incentives for IW recycling and finance source of promoting zero waste policies; establishing IW storage for emergency use and “special IW treatment center” in the northern, central and southern parts of Taiwan, to detoxify and recycle hazardous IW; coordinating the treatment of non-recyclable IW in MSW incinerators, to maximize the utilization of MSW incinerators’ capacity, energy recovery, and treatment of IW as well; regulating the inspection of waste landfills, to prevent the receiving of hazardous IW or recyclable IW.
5. Reinforcing the implementation for the RRA: diminishing the resource consumption, reducing the waste generation, and promoting the resource recycling through the combination of consultation, enforcement, and rewards.
6. Proactively promoting resource recycling: setting up recycling districts in all the industrial parks (and scientific parks) for resource recycling operation, providing incentives for R&D and trials of recycling technology, as well as



promoting the installation of environmental industrial parks, to upgrade domestic technology and the value of recycled materials.

7. Assisting the resource recycling industries and paving the channels of recycled products: assisting the installation of resource recycling, reuse, and recovery facilities, to create job opportunities and activate the market of recycling products, formulating the standards and specifications of recycling products and the normalization of green procurement.
8. Providing educational training and establishing an informatics system of zero waste policy for IW: routinely holding the communication and education program, building up a national informatics system for zero waste to distribute the information of related technology, regulation, and policies; publishing annual reports of zero waste implementation to share the information and provide access for reviewing and integrating the public contribution, and the completion of informatics system based upon the existent "Recycling Industrial Network."

Table 1: Internet declaration and estimation of IW quantity from 2001 to 2003 (ton).

Item		2001	2002	2003
Declaration of general IW	Contract	1,020,836	1,311,051	1,451,202
	Self	994,491	1,217,382	967,504
	Recycling	7,723,093	7,956,030	8,991,105
	Export	19,273	471	20
	Temp. stored	999,004	735,757	845,367
Total		10,756,697	11,220,691	12,255,198
Declaration of hazardous IW	Contract out	242,534	288,323	364,229
	Self	65,066	74,392	89,066
	Recycling	225,936	195,508	467,809
	Export	74,387	61,528	74,133
	Temp. stored	70,821	106,134	169,021
Total		678,744	725,885	1,164,327

4 Conclusions

Since the promulgation of the WDA, we have made leaping progress in waste clearance and the increase of resource recycling year by year. Moreover, in harmony with the novel ideas of zero waste in developed countries, non-products are no longer considered waste in the promulgated RRA, and the waste defined in WDA is regarded as reusable or recyclable resources. Thus the waste management mechanism has shifted from back-end treatment to front-end



prevention. The presently regulated zero waste subjects, with the following development of policies and feasible technologies, will lead Taiwan toward a zero waste society.

Table 2: The objectives of volume reduction and recycling rate for solid waste.

Waste type		Goals	2007	2011	2020
General waste (MSW)		Volume reduction	25%	40%	75%
IW	Manufacturing industries	Volume reduction	5%	10%	20%
		Recycling rate	75%	80%	85%
	Medical organizations	Volume reduction	5%	10%	20%
		Recycling rate	20%	40%	45%
	Construction & demolition	Volume reduction	5%	10%	20%
		Recycling rate	75%	80%	85%
	Agriculture use	Volume reduction	5%	10%	20%
		Recycling rate	86%	89%	92%
	Educational institutes	Volume reduction	5%	10%	20%
		Recycling rate	20%	30%	45%
	Military applications	Volume reduction	5%	10%	20%
		Recycling rate	60%	70%	80%

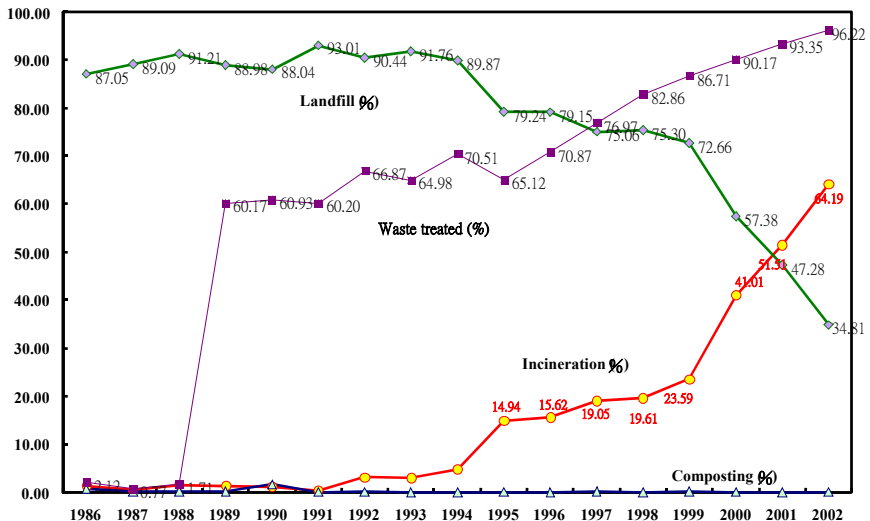


Figure 1: Statistics of MSW treatment approach before year 2002.

Although we will only meet our first stage of zero waste policies for the coming 20 years, the implementation of the strategies and policies of “zero



waste” will encounter certain obstacles. We should still actively strive to establish concrete policies and objectives for campaigns, strict law enforcement and the encouragement of innovation and trials. What we will need to achieve this will be: understanding and support of the general public, the cooperation of private sectors, as well as the open-mindedness of the public sectors. The other internal factors like the feasibility of policies, the sufficiency of manpower and financing resources, shall be reviewed on an annual basis to assure efficient implantation. Our natural resources are so scarce and precious that we must work in tandem with the global trend to achieve the “zero waste” world. With the spirit of sustainable development and overall considerations about social welfare, economic development, and environment protection, we anticipate developing a sustainable zero waste society through waste minimization and recycling optimization.

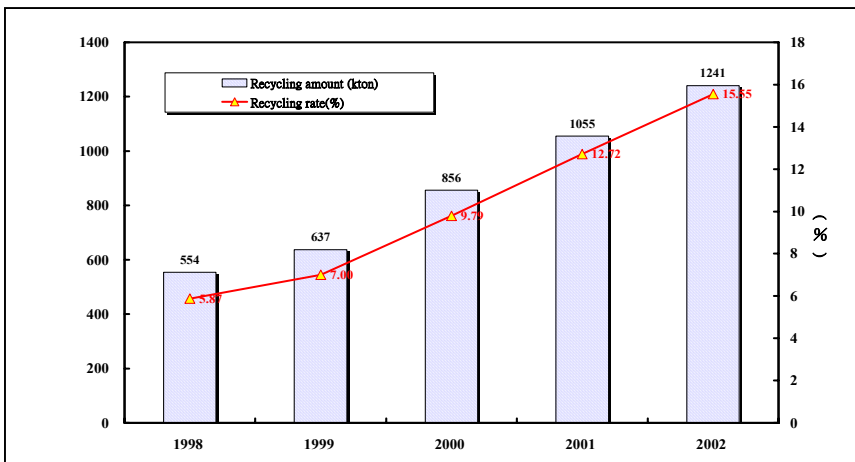


Figure 2: Performance of resource recycling from year 1998 to year 2002.

References

- [1] Australian Capital Territory, 1996. A Waste Management Strategy for Canberra: No Waste by 2010. Canberra, Australian.
- [2] Ministry for the Environment, 2002. The New Zealand Strategy: Towards zero waste and a sustainable New Zealand. Wellington, New Zealand.
- [3] Environmental Protection Administration, 2001. National Plan for Industrial Waste Control and Clearance. Executive Yuan, Taiwan, R.O.C.
- [4] Environmental Protection Administration, 2003. Review and Prospection of Waste Treatment Plan. Executive Yuan, Taiwan, R.O.C.
- [5] Environmental Protection Administration, 2004. Draft of Zero Waste Policy for Industrial Waste. Executive Yuan, Taiwan, R.O.C.
- [6] Minister of the Environment, 2000, Fundamental Law for Establishing Sound Material-Cycle Society, Japan.



- [7] Minister of the Environment, 2000, Fundamental Plan for Establishing Sound Material-Cycle Society, Japan.
- [8] Minister of the Environment, Japan. <http://www.env.go.jp/>.
- [9] Ministry for the Environment, New Zealand. <http://www.mfe.govt.nz/>.
- [10] Australian Capital Territory. <http://www.act.gov.au/>.
- [11] EPA ePapers, Green Procurement in 2002, Apr. 15th, 2003.
- [12] EPA ePapers, the Review and Amending of Plastic Restriction Use Policy, Dec. 1st, 2003.
- [13] EPA ePapers, First Award of Superior Industrial Waste Clearance and Resource Recycling, Dec. 1st, 2003.

