TAIWAN

Community Action Leads Government Toward Zero Waste

By Cecilia Allen

A garbage collector in Taipei separates bones from recyclable kitchen waste. (photo: Allianz SE)

The island of Taiwan faced a waste crisis in the 1980s because of lack of space to expand its landfill capacity. When the government turned to large-scale incineration, the community's fierce opposition n ot only stopped the construction of dozens of burners, but also drove the government to adopt goals and programs for waste prevention and recycling. These programs and policies were so effective that the volume of waste decreased significantly even while both population and gross domestic product increased. However, the government, by maintaining both pro-incinerator and waste prevention policies, has capped the potential of waste prevention strategies because large investments in incineration drain resources that could otherwise be used to improve and expand them.

TAIWAN

Population: 23 million

Area: 36,192 km^2

Population density: 642/km^2

Average annual rainfall: 2,500 mm

Average temperature range: 5°C to 35°C

Altitude: 0 - 3,952 meters above sea level

Waste diversion rate: 48.82%

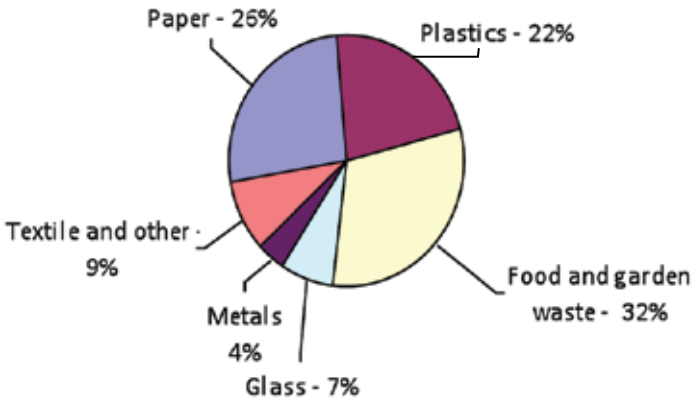
Waste generation: 0.942 kg/capita/day

Spending on waste management per capita: US $25.40 per year

In the 1980s, the combination of high population density, rapid industrial growth, landfills reaching full capacity, and lack of space for new dumping grounds led the Taiwan Environmental Protection Agency (TEPA) to adopt incineration as the priority for waste treatment, followed by landfilling. This shift was reaffirmed in 1990 with a plan to build 21 large-scale waste-to-energy incinerators, and again in 1996 when investors were solicited to build another 15 municipal solid waste incinerators to meet the national goal of at least one incinerator per county.

Dozens of anti-incineration meetings were held and communities organized widely against these plans. This grassroots movement was consolidated in 2002 with the creation of the Taiwan Anti-Incinerators Alliance (TAIA). As a result, by 2002, only 19 of the 36 planned incinerators had been built. The total capacity of those 19 incinerators was 21,000 tons per day, while nationwide municipal solid waste production was less than 20,000 tons per day.[1] Despite strong community resistance, TEPA was still holding to its plan to expand incineration capacity immensely. In fact, a third of TEPA´s budget for 2003—NT $3.7 billion (US $127 million)[2]—was allocated to waste incineration, while only NT $100 million (US $3.4 million) was intended for composting. A total of 122 community organizations signed a letter to the government warning of overcapacity of existing incinerators, as well as the environmental and health problems of incinerator emissions, and urged the government to put resources instead into safer and sustainable alternatives like waste prevention, recycling, and composting.

Figure 1. Municipal Solid Waste Characterization in Taiwan



Source: Li-Teh Lu, et al, 2006

Waste Prevention Targets

As a result of community pressure, in 2003, TEPA adopted a zero waste policy. Initially, the definition of zero waste included incineration, but after criticism from community organizations, the wording adopted in December 2003 defined zero waste as "effectively recycling and utilizing resources through green production, green consumption, source reduction, recovery, reuse, and recycling."[3] In addition, the policy established waste diversion targets of 25 percent by 2007, 40 percent by 2011, and 75 percent by 2020.[4] Unlike most diversion figures, these referenced a static baseline of 8.33 million tons of waste generated in 2001. Incineration was still part of the overall waste treatment plan for the nation, albeit with a lower priority than the measures included in the zero waste definition.

Minimizing Packaging and Disposables

TEPA´s approach to waste prevention put a strong emphasis on Extended Producer Responsibility (EPR)–making producers responsible for changes in design and production to reduce the waste generated by their products and packaging. Producers also manage their own items after they are discarded, taking back materials for reuse or disposal. This approach combines mandatory reduction goals, voluntary agreements, and incentives for businesses and industries.

Restricting the weight of boxes. In 2006, the government adopted restrictions relating to packaging for computer software CDs and gift boxes for pastry, cosmetics, alcoholic beverages and food. In 2009, TEPA signed a packaging reduction agreement with five major portable computer manufacturers that eliminated about 3,700 tons of computer packaging waste in just one year.

Banning disposable tableware at schools and government agencies. In 2006, TEPA requested government agencies and schools to stop using disposable tableware, and in 2007 the requirement was extended to paper cups.

Reducing plastic bags and plastic packaging. In 2007, TEPA required supermarkets to prepare plans to reduce plastic packaging. The businesses had to meet waste reduction targets of 15 percent and 25 percent in the first and second years, and 35 percent in 2011. Stores began to use thinner packaging and to sell goods unpackaged (30 percent of the products were sold unpackaged by the second year of implementation). According to TEPA, the average reduction rate in the first year was 21 percent, and by 2009 had reached 33 percent. According to TEPA, the amount of plastic from non-renewable resources used for packaging was reduced by 1,400 tons between July 2007 and December 2009. Operators who fail to reach the specified targets, or do not submit reduction plans or reduction results to the EPA, are fined NT $30,000 - 150,000 (US $1,000 - 5,000).[5]

Volunteers taking apart audiotapes sell the separated materials (plastics, metals) to recyclers, and the income is donated. (photo: Taiwan Watch Institute)

Encouraging a reduction in disposable chopsticks. In 2008, the government asked stores and cafeterias to provide reusable chopsticks and not automatically give out disposable chopsticks with take-out food. This policy is estimated to cut the use of 44 million pairs of chopsticks and reduce 350 tons of waste per year.[6]

Reducing disposable cups. In 2011, fast food, beverage, and convenience store chains were required by TEPA to provide discounts or extra portions to customers who brought their own cups. Stores that do not implement this measure are required to give customers NT $1 (US $0.03) for every two cups they return as an incentive to get shops to recycle their own cups.[7]

Maximizing Recycling

Resource Recycling Management Fund. Taiwanese legislation requires manufacturers and importers of mandatory recycling items like packaging and containers, tires, some electric and electronic goods, automobiles, batteries, and fluorescent lamps to report them, label them, and pay a fee to the Resource Recycling Management Fund, based on the material, volume, weight, and level of recycling. The fund is used to cover collection and recycling costs and provide subsidies to companies and governments to develop reuse and recycling systems. Recycling facilities are audited to confirm the actual amount of materials recycled and assure that operations meet the regulations. **This recycling system is called the four-in-one system, highlighting the**

Pay as You Throw Systems in Taipei and Xinbei

In two Taiwanese cities, Pay As You Throw (PAYT) systems have proved to be remarkably effective in rapidly boosting source separation of waste.

In 2000, the city of Taipei changed its waste collection payment system from one based on the amount of water used per household to PAYT: residents were required to purchase certified bags—available in shops throughout the city—to dispose of their residual waste. This served as an incentive for people to both reduce waste and separate at source. It is estimated that by 2003, the introduction of this system had reduced waste production by 28.3% compared to 1999 and had increased the recycling rate from 2.3% to 23%.

Xinbei, the largest city in Taiwan, started gradually introducing a PAYT system in 2008. By January 2011, the entire city of 3.9 million people was covered by PAYT. The results here were even more impressive than in Taipei: by 2011, residual waste had dropped 47.3% compared to 2008 (2,497 tons per day in 2008 and 1,316 tons per day in 2011).

Sources: Li-Teh Lu, et al, 2006, and Taiwan Watch Institute

cooperation of residents, local governments, recycling businesses, and the Recycling Fund Management Board.[8]

Mandatory beverage container take-back. Most businesses which sell beverages are required to install receptacles to drop off empty containers; these include hypermarkets, supermarkets, convenience stores, cosmetics shops, gas stations, fast food restaurants, and shops with beverage vending machines.[9] There are a total of about 14,000 such drop-off sites. Violators are subject to a fine ranging from a minimum of NT $60,000 (about US $2,000) to a maximum of NT $300,000 (US $10,200).[10]

Mandatory e-waste take-back.[11] As part of the four-in-one system, Taiwan announced mandatory recycling of e-waste in 1997 and coordinated residents, recycling businesses, local governments, and the Recycling Fund Management Board to monitor the recycling process.[12] **In 2010, the government passed legislation that requires retailers selling electronics and electric products to take back and recycle these products.**[13] According to the policy, the retailers may not charge consumers for this service or refuse to recycle. Consumers are asked to fill out forms to ensure vendors uphold transparency of recycling and treatment processes. Vendors that do not comply with the regulation are subject to fines of NT $60,000 - $300,000 (US $2,000 - $10,000).

Separation at Source

In 2005, Taiwan adopted a two-phase program under the Waste Disposal Act, which required people to separate waste into recyclables, food

Waste collection trucks with barrels for food waste collection (left) and large bags for recyclables (right). (photo: Taiwan Watch Institute)

waste, and residual waste.[14] In the first phase, the program was implemented in seven cities and ten counties. The second phase, extending source separation to the whole nation, started in 2006. By that time, Taipei was also operating a Pay As You Throw system that was later implemented in Xinbei as well (see box).

Taiwan's Waste Disposal Act requires the public to take their recyclable waste directly to the collection trucks. The trucks—collecting recyclables, food waste, and residual waste—are managed by collection crews hired by the government. They travel together, so people can take out all the materials at the same time.

The waste-collection crews are required to sort the resources after they are collected.[15] Every municipality has sites where materials are sorted and sold for recycling; sometimes they are sold mixed to recyclers who separate it themselves.

Food Waste Recovery

Recovery of source-separated food waste is covered by the Food Waste Recovery and Reuse Plan. By 2009, 319 townships had food waste recycling systems. The total volume of food waste collected per day rose from 80 tons in 2001 to 1,977 tons in 2009. Approximately 75 percent of the recovered food waste is sold to pig farms for about NT $400 (US $13.70) per ton. Most of the rest of the food waste is composted. To encourage food scrap recovery, the national government provides subsidies to local governments for education, promotion, and composting facilities.

Breaking the Correlation Between GDP and Waste Generation

Economic growth and waste reduction often seem contradictory goals: more wealth almost always creates more waste. Taiwan is providing evidence

Composting activities by the trash collection team of a township (Shigang) in central Taiwan. (photo: Taiwan Watch Institute)

that aggressive waste prevention programs can break this correlation. **Waste generation in Taiwan dropped from 8.7 to 7.95 million tons between 2000 and 2010, despite a 47 percent increase in GDP in the same period.**[16] [17] At the same time, the population also grew, so in 2010 per capita waste generation was 12.7 percent lower than in 2000. A combination of several factors contributed to this achievement. The landfill crisis in the 1980s and 1990s resulted in higher awareness and motivation on the part of individuals and community groups to work towards waste prevention and recycling. Furthermore, a widening gap between rich and poor concentrated much of the wealth gain in a small subsection of the population. Those who saw stable, or even declining, incomes would not be expected to generate increased waste. However, this alone does not explain the reduction in waste generation during that period. While more research is needed to analyze these and other factors, such a remarkable drop in waste generation must be attributed in large part to successful waste prevention policies.

As shown in Table 2, the waste diversion rate in 2010 was 48.7 percent. That figure applies to materials that were recycled or recovered through compost, animal feed, etc., instead of being landfilled or incinerated. The residuals (i.e., waste going to landfills or incinerators)

Table 1. Trend in Waste Generation, Population, and GDP in Taiwan

	Population	GDP (US $ millions)	Waste Generation (tons)	Waste Generation (kg per capita)
2000	22,100,000	293*	8,700,000	394
2010	23,100,000	430	7,950,000	344
Comparison	+ 4.52%	+ 46.7%	- 8.6%	-12.7%

*Data from 2001.

Sources: http://sowf.moi.gov.tw/stat/month/m1-09.xls, and http://eng.stat.gov.tw/public/data/dgbas03/bs4/ninews_e/10002/enewtotal10002.pdf.

Table 2. MSW Production and Treatment in Taiwan

2010	Tons per year	%
Garden and bulky waste recycled	80,217	1%
Food recycled	769,164	9.6%
Garbage recycled	3,035,617	38.1%
Subtotal Recycled	3,884,998	48.7%
Landfilled/buried	181,771	2.28%
Incinerated	3,888,641	48.8%
Other	2,191	0.02%
Subtotal Disposed	4,072,603	51.1%
Total Waste Generated	7,957,601	100%

Source: Based on data published by TEPA, http://www.epa.gov.tw/en/statistics/c4010.pdf.

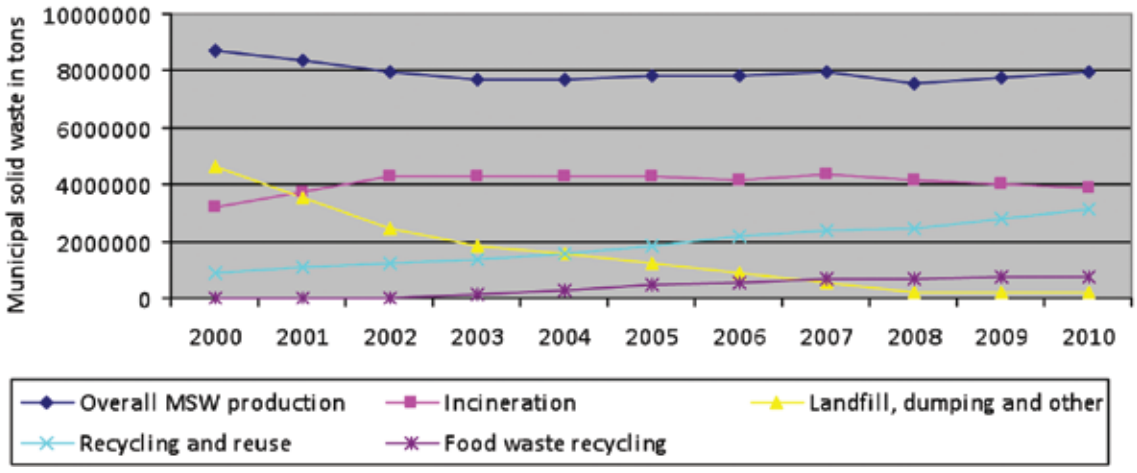
dropped from 1.14 kg per capita per day in 1997 to 0.48 kg per capita per day in 2010.[18]

Waste Incineration vs. Waste Prevention

While the government publicizes its waste prevention and recycling policies, incineration still plays a major role in Taiwan's waste management system, as reflected in Table 2 above. Thanks to the community's passionate resistance to waste incineration, Taiwan has not fully implemented its original plan to build many new burners, and the amount of waste incinerated in the country has remained fairly constant since 2002. Still, the costs of incineration are so high, and require such a large percentage of the budget, that the potential of waste prevention and materials recovery efforts are drastically curtailed.

Currently there are 24 incinerators operating in Taiwan, and they receive 60 percent of the nation's municipal solid waste and 40 percent of its industrial waste. Nonetheless, since 2004 the incinerators have been facing a shortage of materials to burn as well as problems due to community complaints about the emissions. **The three incinerators in Taipei had to cut their operations by half, at least partly because there were not enough materials to burn.**[19] Furthermore, the government promotion of ash "recycling" in construction and pavement work

Figure 2. Solid Waste Production and Treatment in Taiwan (2000 - 2010)



Source: Based on data published by TEPA, http://www.epa.gov.tw/en/statistics/c4010.pdf.

represents a serious environmental liability in Taiwan, given that many toxics remain in those ashes. Since many companies are not willing to use the ash in their own pavement, and there is not enough storage space, the ash is often spread in places like farms, posing a huge environmental threat.

An analysis of the waste being burned in municipal waste incinerators in Taichung, Taipei, and Tainan showed that 48.6 percent of it is organic (i.e., kitchen waste and organic yard waste), while non-organic recyclable resources account for 9.3 percent. Thus, **57.9 percent of what is being burned is recyclable or compostable.** This number is probably much higher. For instance, 30 percent of what the government considers garbage—unrecyclable paper products such as bath tissue, and other soiled paper—is compostable.[20]

Huge investments required for the construction and operation of incinerators drain funds for years that could otherwise be used to boost resource recovery. Typically, a contractor pays for the construction of the incinerator, and the government is then committed to making payments to the contractor for 20 years, as shown in Table 3 below.

Table 3: Subsidies Given by TEPA to Local Governments (2011)

	Program	NT $ (thousands)	USD $
Zero Waste	Zero waste projects	309,925	10,610,000
	Collection, separation, and reuse/recycling of waste from building decoration and overhauling	24,015	822,000
	Food waste recycling	158,600	5,429,000
	Bulky waste recycling	48,990	1,677,000
Total for Zero Waste		**541,530**	**18,538,000**
Waste Incineration	Incineration ash "recycling"	353,000	12,084,000
	Amortization of incinerator construction costs	1,002,214	34,310,000
Total for Incineration		**1,355,214**	**46,394,000**

Source: TEPA.

Table 4: TEPA Budget for General Waste Management (2011)

Source	Program	NT $ (thousands)	USD $
Subsidies provided for local governments to implement projects or policies of general waste management	Education and promotion	30,000	1,027,000
	Vehicles for waste collection	328,500	11,246,000
	Design the facilities for manure treatment	1,000	34,000
	Collection, separation, and reuse/recycling of waste from building decoration and overhauling	24,015	822,000
	Zero waste projects	309,925	10,610,000
	Food waste recycling	158,600	5,429,000
	Bulk waste recycling	48,990	1,677,000
	Incineration ash "recycling"	353,000	12,084,000
	Amortization of incinerator construction	1,002,214	34,310,000
	Disposal of waste created by emergencies (typhoons, etc.)	96,000	3,286,000
Sub-total Subsidies		235,2244	80,525,000
Developing and implementing national government policies	General policy making on zero waste, source prevention, and recycling programs	17,300	592,000
	Implementation of policies on waste separation and recycling and EPR	6,742	230,800
	Implementation of policies on disposable waste reduction, mercury product (e.g., battery) restriction, package reduction, and green package design	14,800	506,000
	Policy making on waste disposal	5,500	188,000
	Monitoring of incineration ash "recycling"	3,000	102,700
Sub-total National Policies		47,342	1,618,700
EPR (resource recycling fund operated by TEPA)	Subsidies for recycling, collection and disposal companies; subsidies and incentives for recycling systems and reuse; expenses for disposal services paid by the enforcement authority on behalf of others; auditing and certification, other expenses.	1,392,726	47,679,000
Total		**3,792,312**	**129,822,700**

Note: Figures in US $ are rounded to facilitate reading.

Source: TEPA.

Waste prevention and recycling policies in Taiwan seem to be yielding good results, and there is immense potential for further advances. Recovery of organic waste can certainly improve, as the investments and programs related to this are very limited, and food and garden waste represent the largest municipal solid waste stream. Likewise, there is great potential to learn from the Pay As You Throw system, which has succeeded in reducing waste and increasing separation at source in Taipei and Xinbei. The people of Taiwan have expressed deep opposition to the practice of burning waste and a willingness to engage in waste prevention and recycling practices. Unfortunately, the very large investments in waste incineration and "recycling" of incinerator ash take away money needed to further increase prevention and recovery.

Sources:

Taiwan Watch Institute.

Taiwan EPA.
http://www.epa.gov.tw.

Environmental Policy Monthly newsletter
http://www.epa.gov.tw/en/FileDownloadPage_EN.aspx?list=420&path=420.

Li-Teh Lu, et al: "MSW management for waste minimization in Taiwan: The last two decades" (Waste management 26:661-667, 2006).
http://ntur.lib.ntu.edu.tw/bitstream/246246/96884/1/14.pdf.

MSW characterization
http://www.epa.gov.tw/en/statistics/c4020.pdf.

Data on waste generation, recycling, disposal, incineration 2000-2011.
http://www.epa.gov.tw/en/statistics/c4010.pdf.

Zero Waste and Resource Recycling Promotion.
http://www.epa.gov.tw/en/epashow.aspx?list=112&path=12305&guid=54ed0a74-3dc5-42c5-9250-0fbf51f92dc3&lang=en-us.

The current Status for kitchen waste recycling and reuse.
http://www.epa.gov.tw/en/epashow.aspx?list=125&path=9105&guid=2d105564-911d-4536-ae70-798eb75b345c&lang=en-us.

Household refuse in decline
Article, Taiwan EPA.
http://www.epa.gov.tw/FileLink/FileHandler.ashx?file=13046.

Encouraging Private Composting of Food Waste
http://www.epa.gov.tw/FileLink/FileHandler.ashx?file=12227.

The operation of municipal solid waste incinerator plants 2001-2010
http://www.epa.gov.tw/en/statistics/c4060.pdf
(Includes info on energy produced and sold, and tons of ashes created).

Feature Column: Regulations and Policies for Resource Recovery.
http://www.epa.gov.tw/FileLink/FileHandler.ashx?file=13314.

New Regulation Puts Vendors in Charge of Recycling.
http://www.epa.gov.tw/FileLink/FileHandler.ashx?file=14703.

Special Deals for Customers Who Bring Their Own Cups.
http://www.epa.gov.tw/FileLink/FileHandler.ashx?file=14917.

Y.Y. Lai: status and policy of msw reduction and recycling in Taiwan Taiwan Environmental Protection Agency. Country report presented at the International Conference on Solid Waste 2011: Moving Towards Sustainable Resource Management, ISWA.
http://www.iswa.org/uploads/tx_iswaknowledgebase/04_Countries_Perspectives.pdf.

Kojima, Michikazu: Extended Producer Responsibility and the Informal Sector. Institute of Developing Economies, November 2010.
http://www.swapp.org/attachments/article/280/1c%20KOJIMA_EPRandInformal_FINAL.pdf.

Endnotes:

1 Taiwan Watch Institute.

2 Exchange rate: US$ 1 = NT $ 29.21.

3 TEPA: Review and Outlook of Trash Treatment Program, December 2003.

4 Source minimization and resource recycling, TEPA. www.epa.gov.tw.

5 TEPA, Environmental Policy Monthly Newsletter. September 2010.

6 TEPA, Environmental Policy Monthly Newsletter. January 2010.

7 Special Deals for Customers Who Bring Their Own Cups, TEPA, 2011.

8 Lu et al 2006, Kokima, 2010.

9 Until 2002, there was a refund when taking bottles back to retailers. This system was discontinued by TEPA after finding an imbalance in the recycling fund. Misguided reporting by the industry of the number of bottles placed on the market did not correspond to the number being returned and led to reported recycling levels that surpassed 100%. Since TEPA was paying the refunds and recycling for the bottles actually recycled and the industry was paying for the amount of bottles they declared to put in the market, the fund went out of balance.

10 TEPA, Environmental Policy Monthly Newsletter. February, 2011.

11 TEPA, Environmental Policy Monthly Newsletter. March, 2011.

12 http://recycle.epa.gov.tw/Recycle/index2.aspx (in Mandarin).

13 Scope, Facilities, Specifications and Other Criteria for Electric and Electronic Product Vendors Required to Install Recycling Facilities.

14 Called resources, kitchen waste and garbage in Taiwan.

15 Li-Teh Lu, et al, 2006.

16 http://sowf.moi.gov.tw/stat/month/m1-09.xls.

17 http://eng.stat.gov.tw/public/data/dgbas03/bs4/ninews_e/10002/enewtotal10002.pdf.

18 Y.Y. Lai, 2011.

19 Taiwan Watch Institute.

20 TEPA, Environmental Policy Monthly Newsletter. May 2010.

Global Alliance for Incinerator Alternatives
Global Anti-Incinerator Alliance

www.no-burn.org
June 2012

This case study was originally published as part of On the Road to Zero Waste: Successes and Lessons from around the World (GAIA, 2012). On the Road profiles nine diverse communities, each providing a real-world example of authentic progress toward the goal of zero waste. None has yet achieved this goal, and a few still employ practices that are incompatible with zero waste, such as incineration. Nonetheless, each community has achieved considerable success with one or more elements of zero waste and has something to teach us. For more case studies, visit: www.no-burn.org/ZWcasestudies.